AMERICAN ACADEMY OF PEDIATRICS

Policy of the American Academy of Pediatrics

Pediatric Clinical Practice Guidelines & Policies

A Compendium of Evidence-based Research for Pediatric Practice

22nd Edition

eBook access included!

American Academy of Pediatrics
DEDICATED TO THE HEALTH OF ALL CHILDREN®

Pediatric Clinical Practice Guidelines & Policies

A Compendium of Evidence-based Research for Pediatric Practice

22nd Edition

American Academy of Pediatrics
345 Park Blvd
Itasca, IL 60143
www.aap.org

AMERICAN ACADEMY OF PEDIATRICS
PUBLISHING STAFF

Mary Lou White
Chief Product and Services Officer/SVP, Membership, Marketing, and Publishing

Mark Grimes
Vice President, Publishing

Jennifer McDonald
Senior Editor, Digital Publishing

Leesa Levin-Doroba
Production Manager, Practice Management

Peg Mulcahy
Manager, Art Direction and Production

Linda Smessaert, MSIMC
Director, Marketing

Mary Louise Carr
Marketing Manager, Clinical Publications

Printed in the United States of America

9-5/0621
MA1058
ISBN: 978-1-61002-607-9
eBook: 978-1-61002-608-6
ISSN: 1942-2024

INTRODUCTION TO *PEDIATRIC CLINICAL PRACTICE GUIDELINES & POLICIES: A COMPENDIUM OF EVIDENCE-BASED RESEARCH FOR PEDIATRIC PRACTICE*

Clinical practice guidelines have long provided physicians with evidence-based decision-making tools for managing common pediatric conditions. Policy statements issued and endorsed by the American Academy of Pediatrics (AAP) are developed to provide physicians with a quick reference guide to the AAP position on child health care issues. We have combined these 2 authoritative resources into 1 comprehensive manual/eBook resource to provide easy access to important clinical and policy information.

This manual contains

- Clinical practice guidelines from the AAP, plus related recommendation summaries, *ICD-10-CM* coding information, and AAP patient education handouts
- Clinical practice guidelines endorsed by the AAP, including abstracts where applicable
- Full text of all 2021 AAP policy statements, clinical reports, and technical reports
- Policy statements, clinical reports, and technical reports issued or endorsed through December 2021, including abstracts where applicable

The eBook, which is available via the code on the inside cover of this manual, builds on content of the manual and points to the full text of all AAP

- Clinical practice guidelines
- Policy statements
- Clinical reports
- Technical reports
- Endorsed clinical practice guidelines and policies

For easy reference within this publication, dates when AAP clinical practice guidelines, policy statements, clinical reports, and technical reports first appeared in the AAP journal *Pediatrics* are provided. In 2009, the online version of *Pediatrics* at https://publications.aap.org/pediatrics became the official journal of record; therefore, date of online publication is given for policies from 2010 to present.

Additional information about AAP policy can be found in a variety of professional publications such as

Red Book®, 32nd Edition, and *Red Book® Online* (https://publications.aap.org/redbook)

Pediatric Nutrition, 8th Edition

Medications in Pediatrics: A Compendium of AAP Clinical Practice Guidelines and Policies

Injury and Violence Prevention: A Compendium of AAP Clinical Practice Guidelines and Policies

Adolescent Health: A Compendium of AAP Clinical Practice Guidelines and Policies

Pediatric Mental Health: A Compendium of AAP Clinical Practice Guidelines and Policies

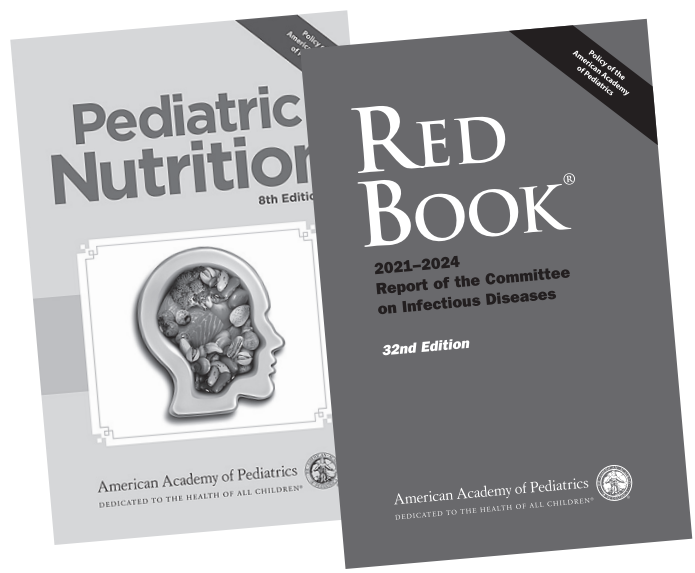
Neonatal Care: A Compendium of AAP Clinical Practice Guidelines and Policies

Guidelines for Air and Ground Transport of Neonatal and Pediatric Patients, 4th Edition

Guidelines for Perinatal Care, 8th Edition

Pediatric Environmental Health, 4th Edition

To order these and other pediatric resources, please call 866/843-2271 or visit http://shop.aap.org/books.



All policy statements, clinical reports, and technical reports from the American Academy of Pediatrics automatically expire 5 years after publication unless reaffirmed, revised, or retired at or before that time. Please check the American Academy of Pediatrics website at www.aap.org for up-to-date reaffirmations, revisions, and retirements.

AMERICAN ACADEMY OF PEDIATRICS

The American Academy of Pediatrics (AAP) and its member pediatricians dedicate their efforts and resources to the health, safety, and well-being of infants, children, adolescents, and young adults. The AAP has approximately 67,000 members in the United States, Canada, and Latin America. Members include pediatricians, pediatric medical subspecialists, and pediatric surgical specialists.

Core Values. ***We believe***

- In the inherent worth of all children; they are our most enduring and vulnerable legacy.
- Children deserve optimal health and the highest quality health care.
- Pediatricians, pediatric medical subspecialists, and pediatric surgical specialists are the best qualified to provide child health care.
- Multidisciplinary teams including patients and families are integral to delivering the highest quality health care.

The AAP is the organization to advance child health and well-being and the profession of pediatrics.

Vision. Children have optimal health and well-being and are valued by society. American Academy of Pediatrics members practice the highest quality health care and experience professional satisfaction and personal well-being.

Mission. The mission of the AAP is to attain optimal physical, mental, and social health and well-being for all infants, children, adolescents, and young adults. To accomplish this mission, the AAP shall support the professional needs of its members.

Table of Contents

SECTION 4

CURRENT POLICIES FROM THE AMERICAN ACADEMY OF PEDIATRICS

See Appendix 1.

See Appendix 1.

SECTION 5

ENDORSED POLICIES

SECTION 1

Clinical Practice Guidelines

From the American Academy of Pediatrics

- *Clinical Practice Guidelines*
  EVIDENCE-BASED DECISION-MAKING TOOLS FOR MANAGING COMMON PEDIATRIC CONDITIONS

- *Quick Reference Tools*
  TOOLS FOR IMPLEMENTING AMERICAN ACADEMY OF PEDIATRICS GUIDELINES IN YOUR PRACTICE AND AT THE POINT OF CARE

FOREWORD

To promote the practice of evidence-based medicine and to improve the health outcomes of children, the American Academy of Pediatrics (AAP) provides physicians with evidence-based guidelines for managing common pediatric conditions. The AAP has established an organizational process and methodology for the development, implementation, and improvement of these clinical practice guidelines.

The evidence-based approach to developing clinical practice guidelines begins by systematically reviewing and synthesizing the literature to provide the scientific basis for guideline recommendations. Clinical practice guideline teams with stakeholder representation systematically develop recommendations by carefully considering the evidence, risk, benefits, patient and caregiver preferences, and effect on equity, diversity, and inclusion. Each clinical practice guideline undergoes a thorough peer-review process before publication. The AAP supports efforts to implement the recommendations into practice and to evaluate whether they are leading to improved outcomes. Every 5 years, each clinical practice guideline and the scientific literature are ideally reevaluated by the subcommittee to ensure that the recommendations are based on the most up-to-date science.

American Academy of Pediatrics clinical practice guidelines are designed to provide physicians with an analytic framework for evaluating and treating common pediatric conditions and are not intended as an exclusive course of treatment or standard of care. The AAP recognizes circumstances in which there is a lack of definitive data and relies on expert consensus in cases in which data do not exist. American Academy of Pediatrics clinical practice guidelines allow for flexibility and adaptability at the local and patient levels to address unique circumstances and should not replace sound clinical judgment.

If you have any questions about current or future clinical practice guidelines, please contact Kymika Okechukwu, senior manager of evidence-based medicine initiatives at the AAP, at 630/626-6317 or via email at kokechukwu@aap.org.

To order copies of patient education resources that accompany each guideline, please call the AAP at 866/843-2271 or visit http://shop.aap.org/books.

Joel Tieder, MD, MPH, FAAP
Chairperson, Council on Quality Improvement and Patient Safety

Clinical Practice Guideline for the Diagnosis, Evaluation, and Treatment of Attention-Deficit/ Hyperactivity Disorder in Children and Adolescents

- *Clinical Practice Guideline*
  - *PPI: AAP Partnership for Policy Implementation*
    See Appendix 1 for more information.

CLINICAL PRACTICE GUIDELINE

American Academy of Pediatrics
DEDICATED TO THE HEALTH OF ALL CHILDREN™

Clinical Practice Guideline for the Diagnosis, Evaluation, and Treatment of Attention-Deficit/Hyperactivity Disorder in Children and Adolescents

Mark L. Wolraich, MD, FAAP,[a] Joseph F. Hagan, Jr, MD, FAAP,[b,c] Carla Allan, PhD,[d,e] Eugenia Chan, MD, MPH, FAAP,[f,g] Dale Davison, MSpEd, PCC,[h,i] Marian Earls, MD, MTS, FAAP,[j,k] Steven W. Evans, PhD,[l,m] Susan K. Flinn, MA,[n] Tanya Froehlich, MD, MS, FAAP,[o,p] Jennifer Frost, MD, FAAFP,[q,r] Joseph R. Holbrook, PhD, MPH,[s] Christoph Ulrich Lehmann, MD, FAAP,[t] Herschel Robert Lessin, MD, FAAP,[u] Kymika Okechukwu, MPA,[v] Karen L. Pierce, MD, DFAACAP,[w,x] Jonathan D. Winner, MD, FAAP,[y] William Zurhellen, MD, FAAP,[z] SUBCOMMITTEE ON CHILDREN AND ADOLESCENTS WITH ATTENTION-DEFICIT/HYPERACTIVE DISORDER

Attention-deficit/hyperactivity disorder (ADHD) is 1 of the most common neurobehavioral disorders of childhood and can profoundly affect children's academic achievement, well-being, and social interactions. The American Academy of Pediatrics first published clinical recommendations for evaluation and diagnosis of pediatric ADHD in 2000; recommendations for treatment followed in 2001. The guidelines were revised in 2011 and published with an accompanying process of care algorithm (PoCA) providing discrete and manageable steps by which clinicians could fulfill the clinical guideline's recommendations. Since the release of the 2011 guideline, the *Diagnostic and Statistical Manual of Mental Disorders* has been revised to the fifth edition, and new ADHD-related research has been published. These publications do not support dramatic changes to the previous recommendations. Therefore, only incremental updates have been made in this guideline revision, including the addition of a key action statement related to diagnosis and treatment of comorbid conditions in children and adolescents with ADHD. The accompanying process of care algorithm has also been updated to assist in implementing the guideline recommendations. Throughout the process of revising the guideline and algorithm, numerous systemic barriers were identified that restrict and/or hamper pediatric clinicians' ability to adopt their recommendations. Therefore, the subcommittee created a companion article (available in the Supplemental Information) on systemic barriers to the care of children and adolescents with ADHD, which identifies the major systemic-level barriers and presents recommendations to address those barriers; in this article, we support the recommendations of the clinical practice guideline and accompanying process of care algorithm.

abstract

[a]*Section of Developmental and Behavioral Pediatrics, University of Oklahoma, Oklahoma City, Oklahoma;* [b]*Department of Pediatrics, The Robert Larner, MD, College of Medicine, The University of Vermont, Burlington, Vermont;* [c]*Hagan, Rinehart, and Connolly Pediatricians, PLLC, Burlington, Vermont;* [d]*Division of Developmental and Behavioral Health, Department of Pediatrics, Children's Mercy Kansas City, Kansas City, Missouri;* [e]*School of Medicine, University of Missouri-Kansas City, Kansas City, Missouri;* [f]*Division of Developmental Medicine, Boston Children's Hospital, Boston, Massachusetts;* [g]*Harvard Medical School, Harvard University, Boston, Massachusetts;* [h]*Children and Adults with Attention-Deficit/Hyperactivity Disorder, Lanham, Maryland;* [i]*Dale Davison, LLC, Skokie, Illinois;* [j]*Community Care of North Carolina, Raleigh, North Carolina;* [k]*School of Medicine, University of North Carolina, Chapel Hill, North Carolina;* [l]*Department of Psychology, Ohio University, Athens, Ohio;* [m]*Center for Intervention Research in Schools, Ohio University, Athens, Ohio;* [n]*American Academy of Pediatrics, Alexandria, Virginia;* [o]*Department of Pediatrics, University of Cincinnati, Cincinnati, Ohio;* [p]*Cincinnati Children's Hospital Medical Center, Cincinnati, Ohio;* [q]*Swope Health Services, Kansas City, Kansas;* [r]*American Academy of Family Physicians, Leawood, Kansas;* [s]*National Center on Birth Defects and Developmental Disabilities, Centers for Disease Control and Prevention, Atlanta, Georgia;* [t]*Departments of Biomedical Informatics and Pediatrics, Vanderbilt University, Nashville, Tennessee;* [u]*The Children's Medical Group, Poughkeepsie, New York;*

To cite: Wolraich ML, Hagan JF, Allan C, et al. AAP SUBCOMMITTEE ON CHILDREN AND ADOLESCENTS WITH ATTENTION-DEFICIT/HYPERACTIVE DISORDER. Clinical Practice Guideline for the Diagnosis, Evaluation, and Treatment of Attention-Deficit/Hyperactivity Disorder in Children and Adolescents. *Pediatrics.* 2019;144(4):e20192528

INTRODUCTION

This article updates and replaces the 2011 clinical practice guideline revision published by the American Academy of Pediatrics (AAP), "Clinical Practice Guideline: Diagnosis and Evaluation of the Child with Attention-Deficit/Hyperactivity Disorder."[1] This guideline, like the previous document, addresses the evaluation, diagnosis, and treatment of attention-deficit/hyperactivity disorder (ADHD) in children from age 4 years to their 18th birthday, with special guidance provided for ADHD care for preschool-aged children and adolescents. (Note that for the purposes of this document, "preschool-aged" refers to children from age 4 years to the sixth birthday.) Pediatricians and other primary care clinicians (PCCs) may continue to provide care after 18 years of age, but care beyond this age was not studied for this guideline.

Since 2011, much research has occurred, and the *Diagnostic and Statistical Manual of Mental Disorders, Fifth Edition (DSM-5)*, has been released. The new research and *DSM-5* do not, however, support dramatic changes to the previous recommendations. Hence, this new guideline includes only incremental updates to the previous guideline. One such update is the addition of a key action statement (KAS) about the diagnosis and treatment of coexisting or comorbid conditions in children and adolescents with ADHD. The subcommittee uses the term "comorbid," to be consistent with the *DSM-5*.

Since 2011, the release of new research reflects an increased understanding and recognition of ADHD's prevalence and epidemiology; the challenges it raises for children and families; the need for a comprehensive clinical resource for the evaluation, diagnosis, and treatment of pediatric ADHD; and the barriers that impede the implementation of such a resource. In response, this guideline is supported by 2 accompanying documents, available in the Supplemental Information: (1) a process of care algorithm (PoCA) for the diagnosis and treatment of children and adolescents with ADHD and (2) an article on systemic barriers to the care of children and adolescents with ADHD. These supplemental documents are designed to aid PCCs in implementing the formal recommendations for the evaluation, diagnosis, and treatment of children and adolescents with ADHD. Although this document is specific to children and adolescents in the United States in some of its recommendations, international stakeholders can modify specific content (ie, educational laws about accommodations, etc) as needed. (Prevention is addressed in the Mental Health Task Force recommendations.[2])

PoCA for the Diagnosis and Treatment of Children and Adolescents With ADHD

In this revised guideline and accompanying PoCA, we recognize that evaluation, diagnosis, and treatment are a continuous process. The PoCA provides recommendations for implementing the guideline steps, although there is less evidence for the PoCA than for the guidelines. The section on evaluating and treating comorbidities has also been expanded in the PoCA document.

Systems Barriers to the Care of Children and Adolescents With ADHD

There are many system-level barriers that hamper the adoption of the best-practice recommendations contained in the clinical practice guideline and the PoCA. The procedures recommended in this guideline necessitate spending more time with patients and their families, developing a care management system of contacts with school and other community stakeholders, and providing continuous, coordinated care to the patient and his or her family. There is some evidence that African American and Latino children are less likely to have ADHD diagnosed and are less likely to be treated for ADHD. Special attention should be given to these populations when assessing comorbidities as they relate to ADHD and when treating for ADHD symptoms.[3] Given the nationwide problem of limited access to mental health clinicians,[4] pediatricians and other PCCs are increasingly called on to provide services to patients with ADHD and to their families. In addition, the AAP holds that primary care pediatricians should be prepared to diagnose and manage mild-to-moderate ADHD, anxiety, depression, and problematic substance use, as well as co-manage patients who have more severe conditions with mental health professionals. Unfortunately, third-party payers seldom pay appropriately for these time-consuming services.[5,6]

To assist pediatricians and other PCCs in overcoming such obstacles, the companion article on systemic barriers to the care of children and adolescents with ADHD reviews the barriers and makes recommendations to address them to enhance care for children and adolescents with ADHD.

ADHD EPIDEMIOLOGY AND SCOPE

Prevalence estimates of ADHD vary on the basis of differences in research methodologies, the various age groups being described, and changes in diagnostic criteria over time.[7] Authors of a recent meta-analysis calculated a pooled worldwide ADHD prevalence of 7.2% among children[8]; estimates from some community-based samples are somewhat higher, at 8.7% to 15.5%.[9,10] National survey data from 2016 indicate that 9.4% of children in the United States 2 to 17 years of age have ever had an ADHD diagnosis, including 2.4% of children 2 to 5 years of age.[11] In that

national survey, 8.4% of children 2 to 17 years of age currently had ADHD, representing 5.4 million children.[11] Among children and adolescents with current ADHD, almost two-thirds were taking medication, and approximately half had received behavioral treatment of ADHD in the past year. Nearly one quarter had received neither type of treatment of ADHD.[11]

Symptoms of ADHD occur in childhood, and most children with ADHD will continue to have symptoms and impairment through adolescence and into adulthood. According to a 2014 national survey, the median age of diagnosis was 7 years; approximately one-third of children were diagnosed before 6 years of age.[12] More than half of these children were first diagnosed by a PCC, often a pediatrician.[12] As individuals with ADHD enter adolescence, their overt hyperactive and impulsive symptoms tend to decline, whereas their inattentive symptoms tend to persist.[13,14] Learning and language problems are common comorbid conditions with ADHD.[15]

Boys are more than twice as likely as girls to receive a diagnosis of ADHD,[9,11,16] possibly because hyperactive behaviors, which are easily observable and potentially disruptive, are seen more frequently in boys. The majority of both boys and girls with ADHD also meet diagnostic criteria for another mental disorder.[17,18] Boys are more likely to exhibit externalizing conditions like oppositional defiant disorder or conduct disorder.[17,19,20] Recent research has established that girls with ADHD are more likely than boys to have a comorbid internalizing condition like anxiety or depression.[21]

Although there is a greater risk of receiving a diagnosis of ADHD for children who are the youngest in their class (who are therefore less developmentally capable of compensating for their weaknesses), for most children, retention is not beneficial.[22]

METHODOLOGY

As with the original 2000 clinical practice guideline and the 2011 revision, the AAP collaborated with several organizations to form a subcommittee on ADHD (the subcommittee) under the oversight of the AAP Council on Quality Improvement and Patient Safety.

The subcommittee's membership included representation of a wide range of primary care and subspecialty groups, including primary care pediatricians, developmental-behavioral pediatricians, an epidemiologist from the Centers for Disease Control and Prevention; and representatives from the American Academy of Child and Adolescent Psychiatry, the Society for Pediatric Psychology, the National Association of School Psychologists, the Society for Developmental and Behavioral Pediatrics (SDBP), the American Academy of Family Physicians, and Children and Adults with Attention-Deficit/Hyperactivity Disorder (CHADD) to provide feedback on the patient/parent perspective.

This subcommittee met over a 3.5-year period from 2015 to 2018 to review practice changes and newly identified issues that have arisen since the publication of the 2011 guidelines. The subcommittee members' potential conflicts were identified and taken into consideration in the group's deliberations. No conflicts prevented subcommittee member participation on the guidelines.

Research Questions

The subcommittee developed a series of research questions to direct an evidence-based review sponsored by 1 of the Evidence-based Practice Centers of the US Agency for Healthcare Research and Quality (AHRQ).[23] These questions assessed 4 diagnostic areas and 3 treatment areas on the basis of research published in 2011 through 2016.

The AHRQ's framework was guided by key clinical questions addressing diagnosis as well as treatment interventions for children and adolescents 4 to 18 years of age.

The first clinical questions pertaining to ADHD diagnosis were as follows:

1. What is the comparative diagnostic accuracy of approaches that can be used in the primary care practice setting or by specialists to diagnose ADHD among children younger than 7 years of age?
2. What is the comparative diagnostic accuracy of EEG, imaging, or executive function approaches that can be used in the primary care practice setting or by specialists to diagnose ADHD among individuals aged 7 to their 18th birthday?
3. What are the adverse effects associated with being labeled correctly or incorrectly as having ADHD?
4. Are there more formal neuropsychological, imaging, or genetic tests that improve the diagnostic process?

The treatment questions were as follows:

1. What are the comparative safety and effectiveness of pharmacologic and/or nonpharmacologic treatments of ADHD in improving outcomes associated with ADHD?
2. What is the risk of diversion of pharmacologic treatment?
3. What are the comparative safety and effectiveness of different monitoring strategies to evaluate the effectiveness of treatment or changes in ADHD status (eg, worsening or resolving symptoms)?

In addition to this review of the research questions, the subcommittee considered information from a review of evidence-based psychosocial treatments for children and adolescents with ADHD[24] (which, in some cases, affected the evidence grade) as well as updated information on prevalence from the Centers for Disease Control and Prevention.

Evidence Review

This article followed the latest version of the evidence base update format used to develop the previous 3 clinical practice guidelines.[24–26] Under this format, studies were only included in the review when they met a variety of criteria designed to ensure the research was based on a strong methodology that yielded confidence in its conclusions.

The level of efficacy for each treatment was defined on the basis of child-focused outcomes related to both symptoms and impairment. Hence, improvements in behaviors on the part of parents or teachers, such as the use of communication or praise, were not considered in the review. Although these outcomes are important, they address how treatment reaches the child or adolescent with ADHD and are, therefore, secondary to changes in the child's behavior. Focusing on improvements in the child or adolescent's symptoms and impairment emphasizes the disorder's characteristics and manifestations that affect children and their families.

The treatment-related evidence relied on a recent review of literature from 2011 through 2016 by the AHRQ of citations from Medline, Embase, PsycINFO, and the Cochrane Database of Systematic Reviews.

The original methodology and report, including the evidence search and review, are available in their entirety and as an executive summary at https://effectivehealthcare.ahrq.gov/sites/default/files/pdf/cer-203-adhd-final_0.pdf.

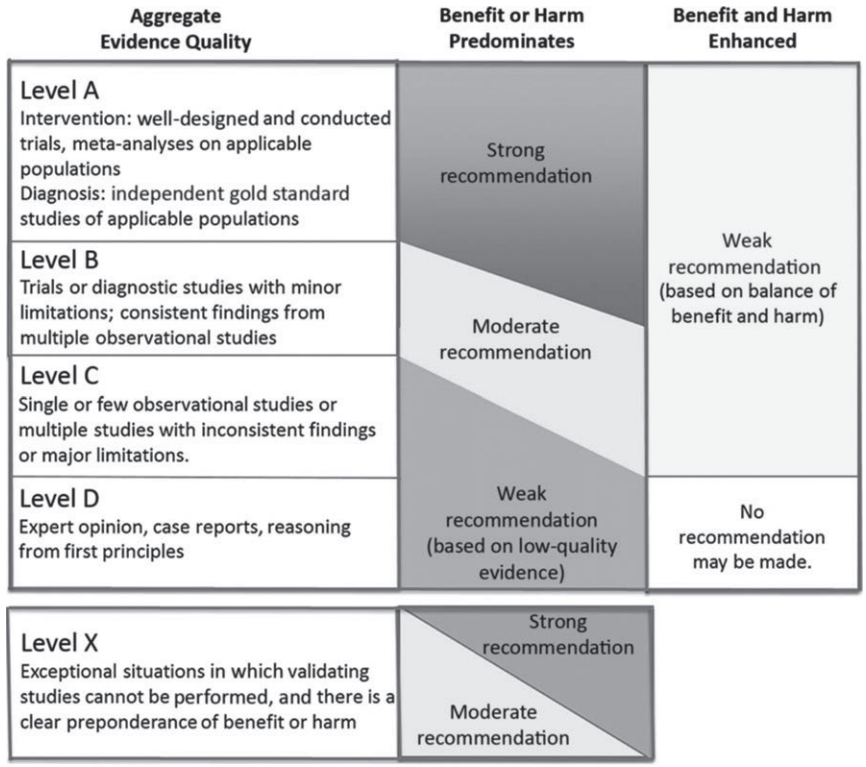


FIGURE 1
AAP rating of evidence and recommendations.

The evidence is discussed in more detail in published reports and articles.[25]

Guideline Recommendations and Key Action Statements

The AAP policy statement, "Classifying Recommendations for Clinical Practice Guidelines," was followed in designating aggregate evidence quality levels for the available evidence (see Fig 1).[27] The AAP policy statement is consistent with the grading recommendations advanced by the University of Oxford Centre for Evidence Based Medicine.

The subcommittee reached consensus on the evidence, which was then used to develop the clinical practice guideline's KASs.

When the scientific evidence was at least "good" in quality and demonstrated a preponderance of benefits over harms, the KAS provides a "strong recommendation" or "recommendation."[27] Clinicians should follow a "strong recommendation" unless a clear and compelling rationale for an alternative approach is present; clinicians are prudent to follow a "recommendation" but are advised to remain alert to new information and be sensitive to patient preferences[27] (see Fig 1).

When the scientific evidence comprised lower-quality or limited data and expert consensus or high-quality evidence with a balance between benefits and harms, the KAS provides an "option" level of recommendation. Options are clinical interventions that a reasonable health care provider might or might not wish to implement in the practice.[27] Where the evidence was lacking, a combination of evidence and expert consensus

would be used, although this did not occur in these guidelines, and all KASs achieved a "strong recommendation" level except for KAS 7, on comorbidities, which received a recommendation level (see Fig 1).

As shown in Fig 1, integrating evidence quality appraisal with an assessment of the anticipated balance between benefits and harms leads to a designation of a strong recommendation, recommendation, option, or no recommendation.

Once the evidence level was determined, an evidence grade was assigned. AAP policy stipulates that the evidence supporting each KAS be prospectively identified, appraised, and summarized, and an explicit link between quality levels and the grade of recommendation must be defined. Possible grades of recommendations range from "A" to "D," with "A" being the highest:

- grade A: consistent level A studies;
- grade B: consistent level B or extrapolations from level A studies;
- grade C: level C studies or extrapolations from level B or level C studies;
- grade D: level D evidence or troublingly inconsistent or inconclusive studies of any level; and
- level X: not an explicit level of evidence as outlined by the Centre for Evidence-Based Medicine. This level is reserved for interventions that are unethical or impossible to test in a controlled or scientific fashion and for which the preponderance of benefit or harm is overwhelming, precluding rigorous investigation.

Guided by the evidence quality and grade, the subcommittee developed 7 KASs for the evaluation, diagnosis, and treatment of ADHD in children and adolescents (see Table 1).

These KASs provide for consistent and high-quality care for children and adolescents who may have symptoms suggesting attention disorders or problems as well as for their families. In developing the 7 KASs, the subcommittee considered the requirements for establishing the diagnosis; the prevalence of ADHD; the effect of untreated ADHD; the efficacy and adverse effects of treatment; various long-term outcomes; the importance of coordination between pediatric and mental health service providers; the value of the medical home; and the common occurrence of comorbid conditions, the importance of addressing them, and the effects of not treating them.

The subcommittee members with the most epidemiological experience assessed the strength of each recommendation and the quality of evidence supporting each draft KAS.

Peer Review

The guidelines and PoCA underwent extensive peer review by more than 30 internal stakeholders (eg, AAP committees, sections, councils, and task forces) and external stakeholder groups identified by the subcommittee. The resulting comments were compiled and reviewed by the chair and vice chair; relevant changes were incorporated into the draft, which was then reviewed by the full subcommittee.

KASS FOR THE EVALUATION, DIAGNOSIS, TREATMENT, AND MONITORING OF CHILDREN AND ADOLESCENTS WITH ADHD

KAS 1

The pediatrician or other PCC should initiate an evaluation for ADHD for any child or adolescent age 4 years to the 18th birthday who presents with academic or behavioral problems and symptoms of inattention, hyperactivity, or impulsivity (Table 2). (Grade B: strong recommendation.)

The basis for this recommendation is essentially unchanged from the previous guideline. As noted, ADHD is the most common neurobehavioral disorder of childhood, occurring in approximately 7% to 8% of children and youth.[8,18,28,29] Hence, the number of children with this condition is far greater than can be managed by the mental health system.[4] There is evidence that appropriate diagnosis can be accomplished in the primary care setting for children and adolescents.[30,31] Note that there is insufficient evidence to recommend diagnosis or treatment for children younger than 4 years (other than parent training in behavior management [PTBM], which does not require a diagnosis to be applied); in instances in which ADHD-like symptoms in children younger than 4 years bring substantial impairment, PCCs can consider making a referral for PTBM.

KAS 2

To make a diagnosis of ADHD, the PCC should determine that *DSM-5* criteria have been met, including documentation of symptoms and impairment in more than 1 major setting (ie, social, academic, or occupational), with information obtained primarily from reports from parents or guardians, teachers, other school personnel, and mental health clinicians who are involved in the child or adolescent's care. The PCC should also rule out any alternative cause (Table 3). (Grade B: strong recommendation.)

The American Psychiatric Association developed the *DSM-5* using expert consensus and an expanding research foundation.[32] The *DSM-5* system is used by professionals in psychiatry, psychology, health care systems, and primary care; it is also well established with third-party payers.

TABLE 1 Summary of KASs for Diagnosing, Evaluating, and Treating ADHD in Children and Adolescents

KASs	Evidence Quality, Strength of Recommendation
KAS 1: The pediatrician or other PCC should initiate an evaluation for ADHD for any child or adolescent age 4 years to the 18th birthday who presents with academic or behavioral problems and symptoms of inattention, hyperactivity, or impulsivity.	Grade B, strong recommendation
KAS 2: To make a diagnosis of ADHD, the PCC should determine that *DSM-5* criteria have been met, including documentation of symptoms and impairment in more than 1 major setting (ie, social, academic, or occupational), with information obtained primarily from reports from parents or guardians, teachers, other school personnel, and mental health clinicians who are involved in the child or adolescent's care. The PCC should also rule out any alternative cause.	Grade B, strong recommendation
KAS 3: In the evaluation of a child or adolescent for ADHD, the PCC should include a process to at least screen for comorbid conditions, including emotional or behavioral conditions (eg, anxiety, depression, oppositional defiant disorder, conduct disorders, substance use), developmental conditions (eg, learning and language disorders, autism spectrum disorders), and physical conditions (eg, tics, sleep apnea).	Grade B, strong recommendation
KAS 4: ADHD is a chronic condition; therefore, the PCC should manage children and adolescents with ADHD in the same manner that they would children and youth with special health care needs, following the principles of the chronic care model and the medical home.	Grade B, strong recommendation
KAS 5a: For preschool-aged children (age 4 years to the sixth birthday) with ADHD, the PCC should prescribe evidence-based PTBM and/or behavioral classroom interventions as the first line of treatment, if available.	Grade A, strong recommendation for PTBM
Methylphenidate may be considered if these behavioral interventions do not provide significant improvement and there is moderate-to-severe continued disturbance in the 4- through 5-year-old child's functioning. In areas in which evidence-based behavioral treatments are not available, the clinician needs to weigh the risks of starting medication before the age of 6 years against the harm of delaying treatment.	Grade B, strong recommendation for methylphenidate
KAS 5b. For elementary and middle school-aged children (age 6 years to the 12th birthday) with ADHD, the PCC should prescribe FDA-approved medications for ADHD, along with PTBM and/or behavioral classroom intervention (preferably both PTBM and behavioral classroom interventions). Educational interventions and individualized instructional supports, including school environment, class placement, instructional placement, and behavioral supports, are a necessary part of any treatment plan and often include an IEP or a rehabilitation plan (504 plan).	Grade A, strong recommendation for medications Grade A, strong recommendation for training and behavioral treatments for ADHD with family and school
KAS 5c. For adolescents (age 12 years to the 18th birthday) with ADHD, the PCC should prescribe FDA-approved medications for ADHD with the adolescent's assent. The PCC is encouraged to prescribe evidence-based training interventions and/or behavioral interventions as treatment of ADHD, if available. Educational interventions and individualized instructional supports, including school environment, class placement, instructional placement, and behavioral supports, are a necessary part of any treatment plan and often include an IEP or a rehabilitation plan (504 plan).	Grade A, strong recommendation for medications Grade A, strong recommendation for training and behavioral treatments for ADHD with the family and school
KAS 6. The PCC should titrate doses of medication for ADHD to achieve maximum benefit with tolerable side effects.	Grade B, strong recommendation
KAS 7. The PCC, if trained or experienced in diagnosing comorbid conditions, may initiate treatment of such conditions or make a referral to an appropriate subspecialist for treatment. After detecting possible comorbid conditions, if the PCC is not trained or experienced in making the diagnosis or initiating treatment, the patient should be referred to an appropriate subspecialist to make the diagnosis and initiate treatment.	Grade C, recommendation

The *DSM-5* criteria define 4 dimensions of ADHD:

1. attention-deficit/hyperactivity disorder primarily of the inattentive presentation (ADHD/I) (314.00 [F90.0]);
2. attention-deficit/hyperactivity disorder primarily of the hyperactive-impulsive presentation (ADHD/HI) (314.01 [F90.1]);
3. attention-deficit/hyperactivity disorder combined presentation (ADHD/C) (314.01 [F90.2]); and
4. ADHD other specified and unspecified ADHD (314.01 [F90.8]).

As with the previous guideline recommendations, the *DSM-5* classification criteria are based on the best available evidence for ADHD diagnosis and are the standard most frequently used by clinicians and researchers to render the diagnosis and document its appropriateness for a given child. The use of neuropsychological testing has not been found to improve diagnostic accuracy in most cases, although it may have benefit in clarifying the child or adolescent's learning strengths and weaknesses. (See the

TABLE 2 KAS 1: The pediatrician or other PCC should initiate an evaluation for ADHD for any child or adolescent age 4 years to the 18th birthday who presents with academic or behavioral problems and symptoms of inattention, hyperactivity, or impulsivity. (Grade B: strong recommendation.)

Aggregate evidence quality	Grade B
Benefits	ADHD goes undiagnosed in a considerable number of children and adolescents. Primary care clinicians' more-rigorous identification of children with these problems is likely to decrease the rate of undiagnosed and untreated ADHD in children and adolescents.
Risks, harm, cost	Children and adolescents in whom ADHD is inappropriately diagnosed may be labeled inappropriately, or another condition may be missed, and they may receive treatments that will not benefit them.
Benefit-harm assessment	The high prevalence of ADHD and limited mental health resources require primary care pediatricians and other PCCs to play a significant role in the care of patients with ADHD and assist them to receive appropriate diagnosis and treatment. Treatments available have good evidence of efficacy, and a lack of treatment has the risk of impaired outcomes.
Intentional vagueness	There are limits between what a PCC can address and what should be referred to a subspecialist because of varying degrees of skills and comfort levels present among the former.
Role of patient preferences	Success with treatment is dependent on patient and family preference, which need to be taken into account.
Exclusions	None.
Strength	Strong recommendation.
Key references	Wolraich et al[31]; Visser et al[28]; Thomas et al[8]; Egger et al[30]

PoCA for more information on implementing this KAS.)

Special Circumstances: Preschool-Aged Children (Age 4 Years to the Sixth Birthday)

There is evidence that the diagnostic criteria for ADHD can be applied to preschool-aged children.[33–39] A review of the literature, including the multisite study of the efficacy of methylphenidate in preschool-aged children, found that the *DSM-5* criteria could appropriately identify children with ADHD.[25]

To make a diagnosis of ADHD in preschool-aged children, clinicians should conduct a clinical interview with parents, examine and observe the child, and obtain information from parents and teachers through *DSM*-based ADHD rating scales.[40] Normative data are available for the *DSM-5*–based rating scales for ages 5 years to the 18th birthday.[41] There are, however, minimal changes in the specific behaviors from the *DSM-IV*, on which all the other *DSM*-based ADHD rating scales obtained normative data. Both the ADHD Rating Scale-IV and the Conners Rating Scale have preschool-age normative data based on the *DSM-IV*. The specific behaviors in the *DSM-5* criteria for ADHD are the same for all children younger than 18 years (ie, preschool-aged children, elementary and middle school–aged children, and adolescents) and are only minimally different from the *DSM-IV*. Hence, if clinicians do not have the ADHD Rating Scale-5 or the ADHD Rating Scale-IV Preschool Version,[42] any other *DSM*-based scale can be used to provide a systematic method for collecting information from parents and teachers, even in the absence of normative data.

Pediatricians and other PCCs should be aware that determining the presence of key symptoms in this age group has its challenges, such as

TABLE 3 KAS 2: To make a diagnosis of ADHD, the PCC should determine that *DSM-5* criteria have been met, including documentation of symptoms and impairment in more than 1 major setting (ie, social, academic, or occupational), with information obtained primarily from reports from parents or guardians, teachers, other school personnel, and mental health clinicians who are involved in the child or adolescent's care. The PCC should also rule out any alternative cause. (Grade B: strong recommendation.)

Aggregate evidence quality	Grade B
Benefits	Use of the *DSM-5* criteria has led to more uniform categorization of the condition across professional disciplines. The criteria are essentially unchanged from the *Diagnostic and Statistical Manual of Mental Disorders, Fourth Edition (DSM-IV)*, for children up to their 18th birthday, except that *DSM-IV* required onset prior to age 7 for a diagnosis, while *DSM-5* requires onset prior to age 12.
Risks, harm, cost	The *DSM-5* does not specifically state that symptoms must be beyond expected levels for developmental (rather than chronologic) age to qualify for an ADHD diagnosis, which may lead to some misdiagnoses in children with developmental disorders.
Benefit-harm assessment	The benefits far outweigh the harm.
Intentional vagueness	None.
Role of patient preferences	Although there is some stigma associated with mental disorder diagnoses, resulting in some families preferring other diagnoses, the need for better clarity in diagnoses outweighs this preference.
Exclusions	None.
Strength	Strong recommendation.
Key references	Evans et al[25]; McGoey et al[42]; Young[43]; Sibley et al[46]

observing symptoms across multiple settings as required by the *DSM-5*, particularly among children who do not attend a preschool or child care program. Here, too, focused checklists can be used to aid in the diagnostic evaluation.

PTBM is the recommended primary intervention for preschool-aged children with ADHD as well as children with ADHD-like behaviors whose diagnosis is not yet verified. This type of training helps parents learn age-appropriate developmental expectations, behaviors that strengthen the parent-child relationship, and specific management skills for problem behaviors. Clinicians do not need to have made an ADHD diagnosis before recommending PTBM because PTBM has documented effectiveness with a wide variety of problem behaviors, regardless of etiology. In addition, the intervention's results may inform the subsequent diagnostic evaluation. Clinicians are encouraged to recommend that parents complete PTBM, if available, before assigning an ADHD diagnosis.

After behavioral parent training is implemented, the clinician can obtain information from parents and teachers through *DSM-5*–based ADHD rating scales. The clinician may obtain reports about the parents' ability to manage their children and about the child's core symptoms and impairments. Referral to an early intervention program or enrolling in a PTBM program can help provide information about the child's behavior in other settings or with other observers. The evaluators for these programs and/or early childhood special education teachers may be useful observers, as well.

Special Circumstances: Adolescents (Age 12 Years to the 18th Birthday)

Obtaining teacher reports for adolescents is often more challenging than for younger children because many adolescents have multiple teachers. Likewise, an adolescent's parents may have less opportunity to observe their child's behaviors than they did when the child was younger. Furthermore, some problems experienced by children with ADHD are less obvious in adolescents than in younger children because adolescents are less likely to exhibit overt hyperactive behavior. Of note, adolescents' reports of their own behaviors often differ from other observers because they tend to minimize their own problematic behaviors.[43–45]

Despite these difficulties, clinicians need to try to obtain information from at least 2 teachers or other sources, such as coaches, school guidance counselors, or leaders of community activities in which the adolescent participates.[46] For the evaluation to be successful, it is essential that adolescents agree with and participate in the evaluation. Variability in ratings is to be expected because adolescents' behavior often varies between different classrooms and with different teachers. Identifying reasons for any variability can provide valuable clinical insight into the adolescent's problems.

Note that, unless they previously received a diagnosis, to meet *DSM-5* criteria for ADHD, adolescents must have some reported or documented manifestations of inattention or hyperactivity/impulsivity before age 12. Therefore, clinicians must establish that an adolescent had manifestations of ADHD before age 12 and strongly consider whether a mimicking or comorbid condition, such as substance use, depression, and/or anxiety, is present.[46]

In addition, the risks of mood and anxiety disorders and risky sexual behaviors increase during adolescence, as do the risks of intentional self-harm and suicidal behaviors.[31] Clinicians should also be aware that adolescents are at greater risk for substance use than are younger children.[44,45,47] Certain substances, such as marijuana, can have effects that mimic ADHD; adolescent patients may also attempt to obtain stimulant medication to enhance performance (ie, academic, athletic, etc) by feigning symptoms.[48]

Trauma experiences, posttraumatic stress disorder, and toxic stress are additional comorbidities and risk factors of concern.

Special Circumstances: Inattention or Hyperactivity/Impulsivity (Problem Level)

Teachers, parents, and child health professionals typically encounter children who demonstrate behaviors relating to activity level, impulsivity, and inattention but who do not fully meet *DSM-5* criteria. When assessing these children, diagnostic criteria should be closely reviewed, which may require obtaining more information from other settings and sources. Also consider that these symptoms may suggest other problems that mimic ADHD.

Behavioral interventions, such as PTBM, are often beneficial for children with hyperactive/impulsive behaviors who do not meet full diagnostic criteria for ADHD. As noted previously, these programs do not require a specific diagnosis to be beneficial to the family. The previous guideline discussed the diagnosis of problem-level concerns on the basis of the *Diagnostic and Statistical Manual for Primary Care (DSM-PC), Child and Adolescent Version*,[49] and made suggestions for treatment and care. The *DSM-PC* was published in 1995, however, and it has not been revised to be compatible with the *DSM-5*. Therefore, the *DSM-PC* cannot be used as a definitive source for diagnostic codes related to ADHD and comorbid conditions, although it can be used conceptually as a resource for

enriching the understanding of problem-level manifestations.

KAS 3

In the evaluation of a child or adolescent for ADHD, the PCC should include a process to at least screen for comorbid conditions, including emotional or behavioral conditions (eg, anxiety, depression, oppositional defiant disorder, conduct disorders, substance use), developmental conditions (eg, learning and language disorders, autism spectrum disorders), and physical conditions (eg, tics, sleep apnea) (Table 4). (Grade B: strong recommendation.)

The majority of both boys and girls with ADHD also meet diagnostic criteria for another mental disorder.[17,18] A variety of other behavioral, developmental, and physical conditions can be comorbid in children and adolescents who are evaluated for ADHD, including emotional or behavioral conditions or a history of these problems. These include but are not limited to learning disabilities, language disorder, disruptive behavior, anxiety, mood disorders, tic disorders, seizures, autism spectrum disorder, developmental coordination disorder, and sleep disorders.[50–66] In some cases, the presence of a comorbid condition will alter the treatment of ADHD.

The SDBP is developing a clinical practice guideline to support clinicians in the diagnosis of treatment of "complex ADHD," which includes ADHD with comorbid developmental and/or mental health conditions.[67]

Special Circumstances: Adolescents (Age 12 Years to the 18th Birthday)

At a minimum, clinicians should assess adolescent patients with newly diagnosed ADHD for symptoms and signs of substance use, anxiety, depression, and learning disabilities. As noted, all 4 are common comorbid conditions that affect the treatment approach. These comorbidities make it important for the clinician to consider sequencing psychosocial and medication treatments to maximize the impact on areas of greatest risk and impairment while monitoring for possible risks such as stimulant abuse or suicidal ideation.

KAS 4

ADHD is a chronic condition; therefore, the PCC should manage children and adolescents with ADHD in the same manner that they would children and youth with special health care needs, following the principles of the chronic care model and the medical home (Table 5). (Grade B: strong recommendation.)

As in the 2 previous guidelines, this recommendation is based on the evidence that for many individuals, ADHD causes symptoms and dysfunction over long periods of time, even into adulthood. Available treatments address symptoms and function but are usually not curative. Although the chronic illness model has not been specifically studied in children and adolescents with ADHD, it has been effective for other chronic conditions, such as asthma.[68] In addition, the medical home model has been accepted as the preferred standard of care for children with chronic conditions.[69]

The medical home and chronic illness approach may be particularly beneficial for parents who also have ADHD themselves. These parents can benefit from extra support to help them follow a consistent schedule for medication and behavioral programs.

Authors of longitudinal studies have found that ADHD treatments are frequently not maintained over time[13] and impairments persist into adulthood.[70] It is indicated in prospective studies that patients with ADHD, whether treated or not, are at increased risk for early death, suicide, and increased psychiatric

TABLE 4 KAS 3: In the evaluation of a child or adolescent for ADHD, the PCC should include a process to at least screen for comorbid conditions, including emotional or behavioral conditions (eg, anxiety, depression, oppositional defiant disorder, conduct disorders, substance use), developmental conditions (eg, learning and language disorders, autism spectrum disorders), and physical conditions (eg, tics, sleep apnea). (Grade B: strong recommendation.)

Aggregate evidence quality	Grade B
Benefits	Identifying comorbid conditions is important in developing the most appropriate treatment plan for the child or adolescent with ADHD.
Risks, harm, cost	The major risk is misdiagnosing the comorbid condition(s) and providing inappropriate care.
Benefit-harm assessment	There is a preponderance of benefits over harm.
Intentional vagueness	None.
Role of patient preferences	None.
Exclusions	None.
Strength	Strong recommendation.
Key references	Cuffe et al[51]; Pastor and Reuben[52]; Bieiderman et al[53]; Bieiderman et al[54]; Bieiderman et al[72]; Crabtree et al[57]; LeBourgeois et al[58]; Chan[115]; Newcorn et al[60]; Sung et al[61]; Larson et al[66]; Mahajan et al[65]; Antshel et al[64]; Rothenberger and Roessner[63]; Froehlich et al[62]

TABLE 5 KAS 4: ADHD is a chronic condition; therefore, the PCC should manage children and adolescents with ADHD in the same manner that they would children and youth with special health care needs, following the principles of the chronic care model and the medical home. (Grade B: strong recommendation.)

Aggregate evidence quality	Grade B
Benefits	The recommendation describes the coordinated services that are most appropriate to manage the condition.
Risks, harm, cost	Providing these services may be more costly.
Benefit-harm assessment	There is a preponderance of benefits over harm.
Intentional vagueness	None.
Role of patient preferences	Family preference in how these services are provided is an important consideration, because it can increase adherence.
Exclusions	None
Strength	Strong recommendation.
Key references	Brito et al[69]; Biederman et al[72]; Scheffler et al[74]; Barbaresi et al[75]; Chang et al[71]; Chang et al[78]; Lichtenstein et al[77]; Harstad and Levy[80]

comorbidity, particularly substance use disorders.[71,72] They also have lower educational achievement than those without ADHD[73,74] and increased rates of incarceration.[75–77] Treatment discontinuation also places individuals with ADHD at higher risk for catastrophic outcomes, such as motor vehicle crashes[78,79]; criminality, including drug-related crimes[77] and violent reoffending[76]; depression[71]; interpersonal issues[80]; and other injuries.[81,82]

To continue providing the best care, it is important for a treating pediatrician or other PCC to engage in bidirectional communication with teachers and other school personnel as well as mental health clinicians involved in the child or adolescent's care. This communication can be difficult to achieve and is discussed in both the PoCA and the section on systemic barriers to the care of children and adolescents with ADHD in the Supplemental Information, as is the medical home model.[69]

Special Circumstances: Inattention or Hyperactivity/Impulsivity (Problem Level)

Children with inattention or hyperactivity/impulsivity at the problem level, as well as their families, may also benefit from the chronic illness and medical home principles.

Recommendations for the Treatment of Children and Adolescents With ADHD: KAS 5a, 5b, and 5c

Recommendations vary depending on the patient's age and are presented for the following age ranges:

a. preschool-aged children: age 4 years to the sixth birthday;
b. elementary and middle school–aged children: age 6 years to the 12th birthday; and
c. adolescents: age 12 years to the 18th birthday.

The KASs are presented, followed by information on medication, psychosocial treatments, and special circumstances.

KAS 5a

For preschool-aged children (age 4 years to the sixth birthday) with ADHD, the PCC should prescribe evidence-based behavioral PTBM and/or behavioral classroom interventions as the first line of treatment, if available (grade A: strong recommendation). Methylphenidate may be considered if these behavioral interventions do not provide significant improvement and there is moderate-to-severe continued disturbance in the 4- through 5-year-old child's functioning. In areas in which evidence-based behavioral treatments are not available, the clinician needs to weigh the risks of starting medication before the age of 6 years against the harm of delaying treatment (Table 6). (Grade B: strong recommendation.)

A number of special circumstances support the recommendation to initiate PTBM as the first treatment of preschool-aged children (age 4 years to the sixth birthday) with ADHD.[25,83] Although it was limited to children who had moderate-to-severe dysfunction, the largest multisite study of methylphenidate use in preschool-aged children revealed symptom improvements after PTBM alone.[83] The overall evidence for PTBM among preschoolers is strong.

PTBM programs for preschool-aged children are typically group programs and, although they are not always paid for by health insurance, they may be relatively low cost. One evidence-based PTBM, parent-child interaction therapy, is a dyadic therapy for parent and child. The PoCA contains criteria for the clinician's use to assess the quality of PTBM programs. If the child attends preschool, behavioral classroom interventions are also recommended. In addition, preschool programs (such as Head Start) and ADHD-focused organizations (such as CHADD[84]) can also provide behavioral supports. The issues related to referral, payment, and communication are discussed in the section on systemic barriers in the Supplemental Information.

TABLE 6 KAS 5a: For preschool-aged children (age 4 years to the sixth birthday) with ADHD, the PCC should prescribe evidence-based behavioral PTBM and/or behavioral classroom interventions as the first line of treatment, if available (grade A: strong recommendation). Methylphenidate may be considered if these behavioral interventions do not provide significant improvement and there is moderate-to-severe continued disturbance in the 4- through 5-year-old child's functioning. In areas in which evidence-based behavioral treatments are not available, the clinician needs to weigh the risks of starting medication before the age of 6 years against the harm of delaying treatment (grade B: strong recommendation).

Aggregate evidence quality	Grade A for PTBM; Grade B for methylphenidate
Benefits	Given the risks of untreated ADHD, the benefits outweigh the risks.
Risks, harm, cost	Both therapies increase the cost of care; PTBM requires a high level of family involvement, whereas methylphenidate has some potential adverse effects.
Benefit-harm assessment	Both PTBM and methylphenidate have relatively low risks; initiating treatment at an early age, before children experience repeated failure, has additional benefits. Thus, the benefits outweigh the risks.
Intentional vagueness	None.
Role of patient preferences	Family preference is essential in determining the treatment plan.
Exclusions	None.
Strength	Strong recommendation.
Key references	Greenhill et al[83]; Evans et al[25]

In areas in which evidence-based behavioral treatments are not available, the clinician needs to weigh the risks of starting methylphenidate before the age of 6 years against the harm of delaying diagnosis and treatment. Other stimulant or nonstimulant medications have not been adequately studied in children in this age group with ADHD.

KAS 5b

For elementary and middle school–aged children (age 6 years to the 12th birthday) with ADHD, the PCC should prescribe US Food and Drug Administration (FDA)–approved medications for ADHD, along with PTBM and/or behavioral classroom intervention (preferably both PTBM and behavioral classroom interventions). Educational interventions and individualized instructional supports, including school environment, class placement, instructional placement, and behavioral supports, are a necessary part of any treatment plan and often include an Individualized Education Program (IEP) or a rehabilitation plan (504 plan) (Table 7). (Grade A: strong recommendation for medications; grade A: strong recommendation for PTBM training and behavioral treatments for ADHD implemented with the family and school.)

The evidence is particularly strong for stimulant medications; it is sufficient, but not as strong, for atomoxetine, extended-release guanfacine, and extended-release clonidine, in that order (see the Treatment section, and see the PoCA for more information on implementation).

KAS 5c

For adolescents (age 12 years to the 18th birthday) with ADHD, the PCC should prescribe FDA-approved medications for ADHD with the adolescent's assent (grade A: strong recommendation). The PCC is encouraged to prescribe evidence-based training interventions and/or behavioral interventions as treatment of ADHD, if available. Educational interventions and individualized instructional supports, including school environment, class placement, instructional placement, and behavioral supports, are a necessary part of any treatment plan and often include an IEP or a rehabilitation plan (504 plan) (Table 8). (Grade A: strong recommendation.)

Transition to adult care is an important component of the chronic care model for ADHD. Planning for the transition to adult care is an ongoing process that may culminate after high school or, perhaps, after college. To foster a smooth transition, it is best to introduce components at the start of high school, at about 14 years of age, and specifically focus during the 2 years preceding high school completion.

Psychosocial Treatments

Some psychosocial treatments for children and adolescents with ADHD have been demonstrated to be effective for the treatment of ADHD, including behavioral therapy and training interventions.[24–26,85] The diversity of interventions and outcome measures makes it challenging to assess a meta-analysis of psychosocial treatment's effects alone or in association with medication treatment. As with medication treatment, the long-term positive effects of psychosocial treatments have yet to be determined. Nonetheless, ongoing adherence to psychosocial treatment is a key contributor to its beneficial effects, making implementation of a chronic care model for child health important to ensure sustained adherence.[86]

Behavioral therapy involves training adults to influence the contingencies in an environment to improve the behavior of a child or adolescent in that setting. It can help parents and school personnel learn how to effectively prevent and respond to adolescent behaviors such as

TABLE 7 KAS 5b: For elementary and middle school–aged children (age 6 years to the 12th birthday) with ADHD, the PCC should prescribe US Food and Drug Administration (FDA)–approved medications for ADHD, along with PTBM and/or behavioral classroom intervention (preferably both PTBM and behavioral classroom interventions). Educational interventions and individualized instructional supports, including school environment, class placement, instructional placement, and behavioral supports, are a necessary part of any treatment plan and often include an Individualized Education Program (IEP) or a rehabilitation plan (504 plan). (Grade A: strong recommendation for medications; grade A: strong recommendation for PTBM training and behavioral treatments for ADHD implemented with the family and school.)

Aggregate evidence quality	Grade A for Treatment with FDA-Approved Medications; Grade A for Training and Behavioral Treatments for ADHD With the Family and School.
Benefits	Both behavioral therapy and FDA-approved medications have been shown to reduce behaviors associated with ADHD and to improve function.
Risks, harm, cost	Both therapies increase the cost of care. Psychosocial therapy requires a high level of family and/or school involvement and may lead to increased family conflict, especially if treatment is not successfully completed. FDA-approved medications may have some adverse effects and discontinuation of medication is common among adolescents.
Benefit-harm assessment	Given the risks of untreated ADHD, the benefits outweigh the risks.
Intentional vagueness	None.
Role of patient preferences	Family preference, including patient preference, is essential in determining the treatment plan and enhancing adherence.
Exclusions	None.
Strength	Strong recommendation.
Key references	Evans et al[25]; Barbaresi et al[73]; Jain et al[103]; Brown and Bishop[104]; Kambeitz et al[105]; Bruxel et al[106]; Kieling et al[107]; Froehlich et al[108]; Joensen et al[109]

interrupting, aggression, not completing tasks, and not complying with requests. Behavioral parent and classroom training are well-established treatments with preadolescent children.[25,87,88] Most studies comparing behavior therapy to stimulants indicate that stimulants have a stronger immediate effect on the 18 core symptoms of ADHD. Parents, however, were more satisfied with the effect of behavioral therapy, which addresses symptoms and functions in addition to ADHD's core symptoms. The positive effects of behavioral therapies tend to persist, but the positive effects of medication cease when medication stops. Optimal care is likely to occur when both therapies are used, but the decision about therapies is heavily dependent on acceptability by, and feasibility for, the family.

Training interventions target skill development and involve repeated practice with performance feedback over time, rather than modifying behavioral contingencies in a specific setting. Less research has been conducted on training interventions compared to behavioral treatments; nonetheless, training interventions are well-established treatments to target disorganization of materials and time that are exhibited by most youth with ADHD; it is likely that they will benefit younger children, as well.[25,89] Some training interventions, including social skills training, have not been shown to be effective for children with ADHD.[25]

TABLE 8 KAS 5c: For adolescents (age 12 years to the 18th birthday) with ADHD, the PCC should prescribe FDA-approved medications for ADHD with the adolescent's assent (grade A: strong recommendation). The PCC is encouraged to prescribe evidence-based training interventions and/or behavioral interventions as treatment of ADHD, if available. Educational interventions and individualized instructional supports, including school environment, class placement, instructional placement, and behavioral supports, are a necessary part of any treatment plan and often include an IEP or a rehabilitation plan (504 plan). (Grade A: strong recommendation.)

Aggregate evidence quality	Grade A for Medications; Grade A for Training and Behavioral Therapy
Benefits	Training interventions, behavioral therapy, and FDA-approved medications have been demonstrated to reduce behaviors associated with ADHD and to improve function.
Risks, harm, cost	Both therapies increase the cost of care. Psychosocial therapy requires a high level of family and/or school involvement and may lead to unintended increased family conflict, especially if treatment is not successfully completed. FDA-approved medications may have some adverse effects, and discontinuation of medication is common among adolescents.
Benefit-harm assessment	Given the risks of untreated ADHD, the benefits outweigh the risks.
Intentional vagueness	None.
Role of patient preferences	Family preference, including patient preference, is likely to predict engagement and persistence with a treatment.
Exclusions	None.
Strength	Strong recommendation.
Key references	Evans et al[25]; Webster-Stratton et al[87]; Evans et al[95]; Fabiano et al[93]; Sibley and Graziano et al[94]; Langberg et al[96]; Schultz et al[97]; Brown and Bishop[104]; Kambeitz et al[105]; Bruxel et al[106]; Froehlich et al[108]; Joensen et al[109]

Some nonmedication treatments for ADHD-related problems have either too little evidence to recommend them or have been found to have little or no benefit. These include mindfulness, cognitive training, diet modification, EEG biofeedback, and supportive counseling. The suggestion that cannabidiol oil has any effect on ADHD is anecdotal and has not been subjected to rigorous study. Although it is FDA approved, the efficacy for external trigeminal nerve stimulation (eTNS) is documented by one 5-week randomized controlled trial with just 30 participants receiving eTNS.[90] To date, there is no long-term safety and efficacy evidence for eTNS. Overall, the current evidence supporting treatment of ADHD with eTNS is sparse and in no way approaches the robust strength of evidence documented for established medication and behavioral treatments for ADHD; therefore, it cannot be recommended as a treatment of ADHD without considerably more extensive study on its efficacy and safety.

Special Circumstances: Adolescents

Much less research has been published on psychosocial treatments with adolescents than with younger children. PTBM has been modified to include the parents and adolescents in sessions together to develop a behavioral contract and improve parent-adolescent communication and problem-solving (see above).[91] Some training programs also include motivational interviewing approaches. The evidence for this behavioral family approach is mixed and less strong than PTBM with pre-adolescent children.[92–94] Adolescents' responses to behavioral contingencies are more varied than those of younger children because they can often effectively obstruct behavioral contracts, increasing parent-adolescent conflict.

Training approaches that are focused on school functioning skills have consistently revealed benefits for adolescents.[95–97] The greatest benefits from training interventions occur when treatment is continued over an extended period of time, performance feedback is constructive and frequent, and the target behaviors are directly applicable to the adolescent's daily functioning.

Overall, behavioral family approaches may be helpful to some adolescents and their families, and school-based training interventions are well established.[25,94] Meaningful improvements in functioning have not been reported from cognitive behavioral approaches.

Medication for ADHD

Preschool-aged children may experience increased mood lability and dysphoria with stimulant medications.[83] None of the nonstimulants have FDA approval for use in preschool-aged children. For elementary school–aged students, the evidence is particularly strong for stimulant medications and is sufficient, but less strong, for atomoxetine, extended-release guanfacine, and extended-release clonidine (in that order). The effect size for stimulants is 1.0 and for nonstimulants is 0.7. An individual's response to methylphenidate verses amphetamine is idiosyncratic, with approximately 40% responding to both and about 40% responding to only 1. The subtype of ADHD does not appear to be a predictor of response to a specific agent. For most adolescents, stimulant medications are highly effective in reducing ADHD's core symptoms.[73]

Stimulant medications have an effect size of around 1.0 (effect size = [treatment M − control M)/control SD]) for the treatment of ADHD.[98] Among nonstimulant medications, 1 selective norepinephrine reuptake inhibitor, atomoxetine,[99,100] and 2 selective α-2 adrenergic agonists, extended-release guanfacine[101,102] and extended-release clonidine,[103] have also demonstrated efficacy in reducing core symptoms among school-aged children and adolescents, although their effect sizes, —around 0.7 for all 3, are less robust than that of stimulant medications. Norepinephrine reuptake inhibitors and α-2 adrenergic agonists are newer medications, so, in general, the evidence base supporting them is considerably less than that for stimulants, although it was adequate for FDA approval.

A free list of the currently available, FDA-approved medications for ADHD is available online at www.ADHDMedicationGuide.com. Each medication's characteristics are provided to help guide the clinician's prescription choice. With the expanded list of medications, it is less likely that PCCs need to consider the off-label use of other medications. The section on systemic barriers in the Supplemental Information provides suggestions for fostering more realistic and effective payment and communication systems.

Because of the large variability in patients' response to ADHD medication, there is great interest in pharmacogenetic tools that can help clinicians predict the best medication and dose for each child or adolescent. At this time, however, the available scientific literature does not provide sufficient evidence to support their clinical utility given that the genetic variants assayed by these tools have generally not been fully studied with respect to medication effects on ADHD-related symptoms and/or impairment, study findings are inconsistent, or effect sizes are not of sufficient size to ensure clinical utility.[104–109] For that reason, these pharmacogenetics tools are not recommended. In addition, these tests may cost thousands of dollars and are typically not covered by insurance. For a pharmacogenetics tool to be recommended for clinical use, studies would need to reveal (1) the genetic variants assayed have consistent, replicated associations with

medication response; (2) knowledge about a patient's genetic profile would change clinical decision-making, improve outcomes and/or reduce costs or burden; and (3) the acceptability of the test's operating characteristics has been demonstrated (eg, sensitivity, specificity, and reliability).

Side Effects

Stimulants' most common short-term adverse effects are appetite loss, abdominal pain, headaches, and sleep disturbance. The Multimodal Treatment of Attention Deficit Hyperactivity Disorder (MTA) study results identified stimulants as having a more persistent effect on decreasing growth velocity compared to most previous studies.[110] Diminished growth was in the range of 1 to 2 cm from predicted adult height. The results of the MTA study were particularly noted among children who were on higher and more consistently administered doses of stimulants.[110] The effects diminished by the third year of treatment, but no compensatory rebound growth was observed.[110] An uncommon significant adverse effect of stimulants is the occurrence of hallucinations and other psychotic symptoms.[111]

Stimulant medications, on average, increase patient heart rate (HR) and blood pressure (BP) to a mild and clinically insignificant degree (average increases: 1–2 beats per minute for HR and 1–4 mm Hg for systolic and diastolic BP).[112] However, because stimulants have been linked to more substantial increases in HR and BP in a subset of individuals (5%–15%), clinicians are encouraged to monitor these vital signs in patients receiving stimulant treatment.[112] Although concerns have been raised about sudden cardiac death among children and adolescents using stimulant and medications,[113] it is an extremely rare occurrence. In fact, stimulant medications have not been shown to increase the risk of sudden death beyond that observed in children who are not receiving stimulants.[114–118] Nevertheless, before initiating therapy with stimulant medications, it is important to obtain the child or adolescent's history of specific cardiac symptoms in addition to the family history of sudden death, cardiovascular symptoms, Wolff-Parkinson-White syndrome, hypertrophic cardiomyopathy, and long QT syndrome. If any of these risk factors are present, clinicians should obtain additional evaluation to ascertain and address potential safety concerns of stimulant medication use by the child or adolescent.[112,114]

Among nonstimulants, the risk of serious cardiovascular events is extremely low, as it is for stimulants. The 3 nonstimulant medications that are FDA approved to treat ADHD (ie, atomoxetine, guanfacine, and clonidine) may be associated with changes in cardiovascular parameters or other serious cardiovascular events. These events could include increased HR and BP for atomoxetine and decreased HR and BP for guanfacine and clonidine. Clinicians are recommended to not only obtain the personal and family cardiac history, as detailed above, but also to perform additional evaluation if risk factors are present before starting nonstimulant medications (ie, perform an electrocardiogram [ECG] and possibly refer to a pediatric cardiologist if the ECG is not normal).[112]

Additional adverse effects of atomoxetine include initial somnolence and gastrointestinal tract symptoms, particularly if the dosage is increased too rapidly, and decreased appetite.[119–122] Less commonly, an increase in suicidal thoughts has been found; this is noted by an FDA black box warning. Extremely rarely, hepatitis has been associated with atomoxetine. Atomoxetine has also been linked to growth delays compared to expected trajectories in the first 1 to 2 years of treatment, with a return to expected measurements after 2 to 3 years of treatment, on average. Decreases were observed among those who were taller or heavier than average before treatment.[123]

For extended-release guanfacine and extended-release clonidine, adverse effects include somnolence, dry mouth, dizziness, irritability, headache, bradycardia, hypotension, and abdominal pain.[30,124,125] Because rebound hypertension after abrupt guanfacine and clonidine discontinuation has been observed,[126] these medications should be tapered off rather than suddenly discontinued.

Adjunctive Therapy

Adjunctive therapies may be considered if stimulant therapy is not fully effective or limited by side effects. Only extended-release guanfacine and extended-release clonidine have evidence supporting their use as adjunctive therapy with stimulant medications sufficient to have achieved FDA approval.[127] Other medications have been used in combination on an off-label basis, with some limited evidence available to support the efficacy and safety of using atomoxetine in combination with stimulant medications to augment treatment of ADHD.[128]

Special Circumstances: Preschool-Aged Children (Age 4 Years to the Sixth Birthday)

If children do not experience adequate symptom improvement with PTBM, medication can be prescribed for those with moderate-to-severe ADHD. Many young children with ADHD may require medication to achieve maximum improvement; methylphenidate is the recommended first-line pharmacologic treatment of preschool children because of the lack of sufficient rigorous study in the preschool-aged population for nonstimulant ADHD medications and dextroamphetamine. Although amphetamine is the only medication

with FDA approval for use in children younger than 6 years, this authorization was issued at a time when approval criteria were less stringent than current requirements. Hence, the available evidence regarding dextroamphetamine's use in preschool-aged children with ADHD is not adequate to recommend it as an initial ADHD medication treatment at this time.[80]

No nonstimulant medication has received sufficient rigorous study in the preschool-aged population to be recommended for treatment of ADHD of children 4 through 5 years of age.

Although methylphenidate is the ADHD medication with the strongest evidence for safety and efficacy in preschool-aged children, it should be noted that the evidence has not yet met the level needed for FDA approval. Evidence for the use of methylphenidate consists of 1 multisite study of 165 children[83] and 10 other smaller, single-site studies ranging from 11 to 59 children, for a total of 269 children.[129] Seven of the 10 single-site studies revealed efficacy for methylphenidate in preschoolers. Therefore, although there is moderate evidence that methylphenidate is safe and effective in preschool-aged children, its use in this age group remains on an "off-label" basis.

With these caveats in mind, before initiating treatment with medication, the clinician should assess the severity of the child's ADHD. Given current data, only preschool-aged children with ADHD and moderate-to-severe dysfunction should be considered for medication. Severity criteria are symptoms that have persisted for at least 9 months; dysfunction that is manifested in both home and other settings, such as preschool or child care; and dysfunction that has not responded adequately to PTBM.[83]

The decision to consider initiating medication at this age depends, in part, on the clinician's assessment of the estimated developmental impairment, safety risks, and potential consequences if medications are not initiated. Other considerations affecting the treatment of preschool-aged children with stimulant medications include the lack of information and experience about their longer-term effects on growth and brain development, as well as the potential for other adverse effects in this population. It may be helpful to obtain consultation from a mental health specialist with specific experience with preschool-aged children, if possible.

Evidence suggests that the rate of metabolizing methylphenidate is slower in children 4 through 5 years of age, so they should be given a low dose to start; the dose can be increased in smaller increments. Maximum doses have not been adequately studied in preschool-aged children.[83]

Special Circumstances: Adolescents (Age 12 Years to the 18th Birthday)

As noted, before beginning medication treatment of adolescents with newly diagnosed ADHD, clinicians should assess the patient for symptoms of substance use. If active substance use is identified, the clinician should refer the patient to a subspecialist for consultative support and guidance.[2,130–134]

In addition, diversion of ADHD medication (ie, its use for something other than its intended medical purposes) is a special concern among adolescents.[135] Clinicians should monitor the adolescent's symptoms and prescription refill requests for signs of misuse or diversion of ADHD medication, including by parents, classmates, or other acquaintances of the adolescent. The majority of states now require prescriber participation in prescription drug monitoring programs, which can be helpful in identifying and preventing diversion activities. They may consider prescribing nonstimulant medications that minimize abuse potential, such as atomoxetine and extended-release guanfacine or extended-release clonidine.

Given the risks of driving for adolescents with ADHD, including crashes and motor vehicle violations, special concern should be taken to provide medication coverage for symptom control while driving.[79,136,137] Longer-acting or late-afternoon, short-acting medications may be helpful in this regard.[138]

Special Circumstances: Inattention or Hyperactivity/Impulsivity (Problem Level)

Medication is not appropriate for children whose symptoms do not meet *DSM-5* criteria for ADHD. Psychosocial treatments may be appropriate for these children and adolescents. As noted, psychosocial treatments do not require a specific diagnosis of ADHD, and many of the studies on the efficacy of PTBM included children who did not have a specific psychiatric or ADHD diagnosis.

Combination Treatments

Studies indicate that behavioral therapy has positive effects when it is combined with medication for pre-adolescent children.[139] (The combined effects of training interventions and medication have not been studied.)

In the MTA study, researchers found that although the combination of behavioral therapy and stimulant medication was not significantly more effective than treatment with medication alone for ADHD's core symptoms, after correcting for multiple tests in the primary analysis,[139] a secondary analysis of a combined measure of parent and teacher ratings of ADHD symptoms did find a significant advantage for the combination, with a small effect of $d = 0.28$.[140] The combined treatment also offered greater improvements on academic and conduct measures, compared to medication alone, when the ADHD was comorbid with anxiety and the child or adolescent lived in a lower socioeconomic environment.

In addition, parents and teachers of children who received combined therapy reported that they were significantly more satisfied with the treatment plan. Finally, the combination of medication management and behavioral therapy allowed for the use of lower stimulant dosages, possibly reducing the risk of adverse effects.[141]

School Programming and Supports

Encouraging strong family-school partnerships helps the ADHD management process.[142] Psychosocial treatments that include coordinating efforts at school and home may enhance the effects.

Children and adolescents with ADHD may be eligible for services as part of a 504 Rehabilitation Act Plan (504 plan) or special education IEP under the "other health impairment" designation in the Individuals with Disability Education Act (IDEA).[143] (ADHD qualifies as a disability under a 504 plan. It does not qualify under an IEP unless its severity impairs the child's ability to learn. See the PoCA for more details.) It is helpful for clinicians to be aware of the eligibility criteria in their states and school districts to advise families of their options. Eligibility decisions can vary considerably between school districts, and school professionals' independent determinations might not agree with the recommendations of outside clinicians.

There are essentially 2 categories of school-based services for students with ADHD. The first category includes interventions that are intended to help the student independently meet age-appropriate academic and behavioral expectations. Examples of these interventions include daily report cards, training interventions, point systems, and academic remediation of skills. If successful, the student's impairment will resolve, and the student will no longer need services.

The second category is intended to provide changes in the student's program so his or her ADHD-related problems no longer result in failure and cause distress to parents, teachers, and the student.[144] These services are referred to as "accommodations" and include extended time to complete tests and assignments, reduced homework demands, the ability to keep study materials in class, and provision of the teacher's notes to the student. These services are intended to allow the student to accomplish his work successfully and communicate that the student's impairment is acceptable. Accommodations make the student's impairment acceptable and are separate from interventions aimed at improving the students' skills or behaviors. In the absence of such interventions, long-term accommodations may lead to reduced expectations and can lead to the need for accommodations to be maintained throughout the student's education.

Encouraging strong family-school partnerships helps the ADHD management process, and addressing social determinants of health is essential to these partnerships.[145,146] Psychosocial treatments that include coordinating efforts at school and home may enhance the effects.

KAS 6

The PCC should titrate doses of medication for ADHD to achieve maximum benefit with tolerable side effects (Table 9). (Grade B: strong recommendation.)

The MTA study is the landmark study comparing effects of methylphenidate and behavioral treatments in children with ADHD. Investigators compared treatment effects in 4 groups of children who received optimal medication management, optimal behavioral management, combined medication and behavioral management, or community treatment. Children in the optimal medication management and combined medication and behavioral management groups underwent a systematic trial with 4 different doses of methylphenidate, with results suggesting that when this full range of doses is administered, more than 70% of children and adolescents with ADHD are methylphenidate responders.[140]

Authors of other reports suggest that more than 90% of patients will have a beneficial response to 1 of the psychostimulants if a range of medications from both the methylphenidate and amphetamine and/or dextroamphetamine classes

TABLE 9 KAS 6: The PCC should titrate doses of medication for ADHD to achieve maximum benefit with tolerable side effects. (Grade B: strong recommendation.)

Aggregate evidence quality	Grade B
Benefits	The optimal dose of medication is required to reduce core symptoms to, or close to, the levels of children without ADHD.
Risks, harm, cost	Higher levels of medication increase the chances of side effects.
Benefit-harm assessment	The importance of adequately treating ADHD outweighs the risk of adverse effects.
Intentional vagueness	None.
Role of patient preferences	The families' preferences and comfort need to be taken into consideration in developing a titration plan, as they are likely to predict engagement and persistence with a treatment.
Exclusions	None
Strength	Strong recommendation
Key references	Jensen et al[140]; Solanto[147]; Brinkman et al[149]

are tried.[147] Of note, children in the MTA study who received care in the community as usual, either from a clinician they chose or to whom their family had access, showed less beneficial results compared with children who received optimal medication management. The explanation offered by the study investigators was that the community treatment group received lower medication doses and less frequent monitoring than the optimal medication management group.

A child's response to stimulants is variable and unpredictable. For this reason, it is recommended to titrate from a low dose to one that achieves a maximum, optimal effect in controlling symptoms without adverse effects. Calculating the dose on the basis of milligrams per kilogram has not usually been helpful because variations in dose have not been found to be related to height or weight. In addition, because stimulant medication effects are seen rapidly, titration can be accomplished in a relatively short time period. Stimulant medications can be effectively titrated on a 7-day basis, but in urgent situations, they may be effectively titrated in as few as 3 days.[140]

Parent and child and adolescent education is an important component in the chronic illness model to ensure cooperation in efforts to achieve appropriate titration, remembering that the parents themselves may be significantly challenged by ADHD.[148,149] The PCC should alert parents and children that changing medication dose and occasionally changing a medication may be necessary for optimal medication management, may require a few months to achieve optimal success, and that medication efficacy should be monitored at regular intervals.

By the 3-year (ie, 36-month) follow-up to the MTA interventions, there were no differences among the 4 groups (ie, optimal medications management, optimal behavioral management, a combination of medication and behavioral management, and community treatment). This equivalence in poststudy outcomes may, however, have been attributable to convergence in ongoing treatments received for the 4 groups. After the initial 14-month intervention, the children no longer received the careful monthly monitoring provided by the study and went back to receiving care from their community providers; therefore, they all effectively received a level of ongoing care consistent with the "community treatment" study arm of the study. After leaving the MTA trial, medications and doses varied for the children who had been in the optimal medication management or combined medication and behavioral management groups, and a number stopped taking ADHD medication. On the other hand, some children who had been in the optimal behavioral management group started taking medication after leaving the trial. The results further emphasize the need to treat ADHD as a chronic illness and provide continuity of care and, where possible, provide a medical home.[140]

See the PoCA for more on implementation of this KAS.

KAS 7

The PCC, if trained or experienced in diagnosing comorbid conditions, may initiate treatment of such conditions or make a referral to an appropriate subspecialist for treatment. After detecting possible comorbid conditions, if the PCC is not trained or experienced in making the diagnosis or initiating treatment, the patient should be referred to an appropriate subspecialist to make the diagnosis and initiate treatment (Table 10). (Grade C: recommendation.)

The effect of comorbid conditions on ADHD treatment is variable. In some cases, treatment of the ADHD may resolve the comorbid condition. For example, treatment of ADHD may lead to improvement in coexisting aggression and/or oppositional defiant, depressive, or anxiety symptoms.[150,151]

Sometimes, however, the comorbid condition may require treatment in addition to the ADHD treatment. If the PCC is confident of his or her ability to diagnose and treat certain comorbid conditions, the PCC may do so. The PCC may benefit from additional consultative support and guidance from a mental health subspecialist or may need to refer a child with ADHD and comorbid conditions, such as severe mood or anxiety disorders, to subspecialists for assessment and management. The subspecialists could include child and adolescent psychiatrists, clinical child psychologists, developmental-behavioral pediatricians, neurodevelopmental disability physicians, child neurologists, or child- or school-based evaluation teams.

IMPLEMENTATION: PREPARING THE PRACTICE

It is generally the role of the primary care pediatrician to manage mild-to-moderate ADHD, anxiety, depression, and substance use. The AAP statement "The Future of Pediatrics: Mental Health Competencies for Pediatric Primary Care" describes the competencies needed in both pediatric primary and specialty care to address the social-emotional and mental health needs of children and families.[152] Broadly, these include incorporating mental health content and tools into health promotion, prevention, and primary care intervention, becoming knowledgeable about use of evidence-based treatments, and participating as a team member and comanaging with pediatric and mental health specialists.

The recommendations made in this guideline are intended to be integrated with the broader mental health algorithm developed as part of the AAP Mental Health Initiatives.[2,133,153] Pediatricians have unique opportunities

TABLE 10 KAS 7: The PCC, if trained or experienced in diagnosing comorbid conditions, may initiate treatment of such conditions or make a referral to an appropriate subspecialist for treatment. After detecting possible comorbid conditions, if the PCC is not trained or experienced in making the diagnosis or initiating treatment, the patient should be referred to an appropriate subspecialist to make the diagnosis and initiate treatment. (Grade C: recommendation.)

Aggregate evidence quality	Grade C
Benefits	Clinicians are most effective when they know the limits of their practice to diagnose comorbid conditions and are aware of resources in their community.
Risks, harm, cost	Under-identification or inappropriate identification of comorbidities can lead to inadequate or inappropriate treatments.
Benefit-harm assessment	The importance of adequately identifying and addressing comorbidities outweighs the risk of inappropriate referrals or treatments.
Intentional vagueness	None.
Role of patient preferences	The families' preferences and comfort need to be taken into consideration in identifying and treating or referring their patients with comorbidities, as they are likely to predict engagement and persistence with a treatment.
Exclusions	None.
Strength	Recommendation.
Key references	Pliszka et al[150]; Pringsheim et al[151]

to identify conditions, including ADHD, intervene early, and partner with both families and specialists for the benefit of children's health. A wealth of useful information is available at the AAP Mental Health Initiatives Web site (https://www.aap.org/en-us/advocacy-and-policy/aap-health-initiatives/Mental-Health/Pages/Tips-For-Pediatricians.aspx).

It is also important for PCCs to be aware of health disparities and social determinants that may impact patient outcomes and strive to provide culturally appropriate care to all children and adolescents in their practice.[145,146,154,155]

The accompanying PoCA provides supplemental information to support PCCs as they implement this guideline's recommendations. In particular, the PoCA describes steps for preparing the practice that provide useful recommendations to clinicians. For example, the PoCA includes information about using standardized rating scales to diagnose ADHD, assessing for comorbid conditions, documenting all aspects of the diagnostic and treatment procedures in the patient's records, monitoring the patient's treatment and outcomes, and providing families with written management plans.

The AAP acknowledges that some PCCs may not have the training, experience, or resources to diagnose and treat children and adolescents with ADHD, especially if severity or comorbid conditions make these patients complex to manage. In these situations, comanagement with specialty clinicians is recommended. The SDBP is developing a guideline to address such complex cases and aid pediatricians and other PCCs to manage these cases; the SDBP currently expects to publish this document in 2019.[67]

AREAS FOR FUTURE RESEARCH

There is a need to conduct research on topics pertinent to the diagnosis and treatment of ADHD, developmental variations, and problems in children and adolescents in primary care. These research opportunities include the following:

- assessment of ADHD and its common comorbidities: anxiety, depression, learning disabilities, and autism spectrum disorder;
- identification and/or development of reliable instruments suitable for use in primary care to assess the nature or degree of functional impairment in children and adolescents with ADHD and to monitor improvement over time;
- refinement of developmentally informed assessment procedures for evaluating ADHD in preschoolers;
- study of medications and other therapies used clinically but not FDA approved for ADHD;
- determination of the optimal schedule for monitoring children and adolescents with ADHD, including factors for adjusting that schedule according to age, symptom severity, and progress reports;
- evaluation of the effectiveness and adverse effects of medications used in combination, such as a stimulant with an α-adrenergic agent, selective serotonin reuptake inhibitor, or atomoxetine;
- evaluation of processes of care to assist PCCs to identify and treat comorbid conditions;
- evaluation of the effectiveness of various school-based interventions;
- comparisons of medication use and effectiveness in different ages, including both harms and benefits;
- development of methods to involve parents, children, and adolescents in their own care and improve adherence to both psychosocial and medication treatments;
- conducting research into psychosocial treatments, such as cognitive behavioral therapy and cognitive training, among others;

- development of standardized and documented tools to help primary care providers identify comorbid conditions;
- development of effective electronic and Web-based systems to help gather information to diagnose and monitor children and adolescents with ADHD;
- improvements to systems for communicating with schools, mental health professionals, and other community agencies to provide effective collaborative care;
- development of more objective measures of performance to more objectively monitor aspects of severity, disability, or impairment;
- assessment of long-term outcomes for children in whom ADHD was first diagnosed at preschool ages; and
- identification and implementation of ideas to address the barriers that hamper the implementation of these guidelines and the PoCA.

CONCLUSIONS

Evidence is clear with regard to the legitimacy of the diagnosis of ADHD and the appropriate diagnostic criteria and procedures required to establish a diagnosis, identify comorbid conditions, and effectively treat with both psychosocial and pharmacologic interventions. The steps required to sustain appropriate treatments and achieve successful long-term outcomes remain challenging, however.

As noted, this clinical practice guideline is supported by 2 accompanying documents available in the Supplemental Information: the PoCA and the article on systemic barriers to the car of children and adolescents with ADHD. Full implementation of the guideline's KASs, the PoCA, and the recommendations to address barriers to care may require changes in office procedures and the identification of community resources. Fully addressing systemic barriers requires identifying local, state, and national entities with which to partner to advance solutions and manifest change.[156]

SUBCOMMITTEE ON CHILDREN AND ADOLESCENTS WITH ADHD (OVERSIGHT BY THE COUNCIL ON QUALITY IMPROVEMENT AND PATIENT SAFETY)

Mark L. Wolraich, MD, FAAP, Chairperson, Section on Developmental Behavioral Pediatrics
Joseph F. Hagan Jr, MD, FAAP, Vice Chairperson, Section on Developmental Behavioral Pediatrics
Carla Allan, PhD, Society of Pediatric Psychology
Eugenia Chan, MD, MPH, FAAP, Implementation Scientist
Dale Davison, MSpEd, PCC, Parent Advocate, Children and Adolescents with Attention-Deficit/Hyperactivity Disorder
Marian Earls, MD, MTS, FAAP, Mental Health Leadership Work Group
Steven W. Evans, PhD, Clinical Psychologist
Tanya Froehlich, MD, FAAP, Section on Developmental Behavioral Pediatrics/Society for Developmental and Behavioral Pediatrics
Jennifer Frost, MD, FAAFP, American Academy of Family Physicians
Joseph R. Holbrook, PhD, MPH, Epidemiologist, Centers for Disease Control and Prevention
Herschel Robert Lessin, MD, FAAP, Section on Administration and Practice Management
Karen L. Pierce, MD, DFAACAP, American Academy of Child and Adolescent Psychiatry
Christoph Ulrich Lehmann, MD, FAAP, Partnership for Policy Implementation
Jonathan D. Winner, MD, FAAP, Committee on Practice and Ambulatory Medicine
William Zurhellen, MD, FAAP, Section on Administration and Practice Management

STAFF

Kymika Okechukwu, MPA, Senior Manager, Evidence-Based Medicine Initiatives
Jeremiah Salmon, MPH, Program Manager, Policy Dissemination and Implementation

CONSULTANT

Susan K. Flinn, MA, Medical Editor

ABBREVIATIONS

AAP: American Academy of Pediatrics
ADHD: attention-deficit/hyperactivity disorder
ADHD/C: attention-deficit/hyperactivity disorder combined presentation
ADHD/HI: attention-deficit/hyperactivity disorder primarily of the hyperactive-impulsive presentation
ADHD/I: attention-deficit/hyperactivity disorder primarily of the inattentive presentation
AHRQ: Agency for Healthcare Research and Quality
BP: blood pressure
CHADD: Children and Adults with Attention-Deficit/Hyperactivity Disorder
DSM-5: *Diagnostic and Statistical Manual of Mental Disorders, Fifth Edition*
DSM-IV: *Diagnostic and Statistical Manual of Mental Disorders Fourth Edition*
DSM-PC: *Diagnostic and Statistical Manual for Primary Care*
ECG: electrocardiogram
eTNS: external trigeminal nerve stimulation
FDA: US Food and Drug Administration
HR: heart rate
IDEA: Individuals with Disability Education Act
IEP: Individualized Education Program
KAS: key action statement
MTA: The Multimodal Treatment of Attention Deficit Hyperactivity Disorder
PCC: primary care clinician
PoCA: process of care algorithm
PTBM: parent training in behavior management
SDBP: Society for Developmental and Behavioral Pediatrics

[v]American Academy of Pediatrics, Itasca, Illinois; [w]American Academy of Child and Adolescent Psychiatry, Washington, District of Columbia; [x]Feinberg School of Medicine, Northwestern University, Chicago, Illinois; [y]Atlanta, Georgia; and [z]Holderness, New Hampshire

The guidance in this report does not indicate an exclusive course of treatment or serve as a standard of medical care. Variations, taking into account individual circumstances, may be appropriate.

All clinical practice guidelines from the American Academy of Pediatrics automatically expire 5 years after publication unless reaffirmed, revised, or retired at or before that time.

The findings and conclusions in this report are those of the authors and do not necessarily represent the official position of the Centers for Disease Control and Prevention. Dr Holbrook was not an author of the accompanying supplemental section on barriers to care.

DOI: https://doi.org/10.1542/peds.2019-2528

Address correspondence to Mark L. Wolraich, MD, FAAP. Email: mark-wolraich@ouhsc.edu

PEDIATRICS (ISSN Numbers: Print, 0031-4005; Online, 1098-4275).

FINANCIAL DISCLOSURE: The authors have indicated they have no financial relationships relevant to this article to disclose.

FUNDING: No external funding.

POTENTIAL CONFLICT OF INTEREST: All authors have filed conflict of interest statements with the American Academy of Pediatrics. Any conflicts have been resolved through a process approved by the American Academy of Pediatrics board of directors. Dr Allan reports a relationship with ADDitude Magazine; Dr Chan reports relationships with TriVox Health and Wolters Kluwer; Dr Lehmann reports relationships with International Medical Informatics Association, Springer Publishing, and Thieme Publishing Group; Dr Wolraich reports a Continuing Medical Education trainings relationship with the Resource for Advancing Children's Health Institute; the other authors have indicated they have no potential conflicts of interest to disclose.

REFERENCES

1. American Academy of Pediatrics. Subcommittee on Attention-Deficit/Hyperactivity Disorder, Steering Committee on Quality Improvement and Management. ADHD: Clinical guideline for the diagnosis, evaluation, and treatment of attention-deficit/hyperactivity disorder in children and adolescents. *Pediatrics*. 2011;128(5):1007–1022
2. American Academy of Pediatrics Task Force on Mental Health. *Addressing Mental Health Concerns in Primary Care: A Clinician's Toolkit [CD-ROM]*. Elk Grove Village, IL: American Academy of Pediatrics; 2010
3. Pastor PN, Reuben CA. Racial and ethnic differences in ADHD and LD in young school-age children: parental reports in the National Health Interview Survey. *Public Health Rep*. 2005;120(4):383–392
4. US Department of Health and Human Services; Health Resources and Services Administration. Designated health professional shortage areas statistics: designated HPSA quarterly summary. Rockville, MD: Health Resources and Services Administration; 2018
5. Pelech D, Hayford T. Medicare advantage and commercial prices for mental health services. *Health Aff (Millwood)*. 2019;38(2):262–267
6. Melek SP, Perlman D, Davenport S. *Differential Reimbursement of Psychiatric Services by Psychiatrists and Other Medical Providers*. Seattle, WA: Milliman;2017
7. Holbrook JR, Bitsko RH, Danielson ML, Visser SN. Interpreting the prevalence of mental disorders in children: tribulation and triangulation. *Health Promot Pract*. 2017;18(1):5–7
8. Thomas R, Sanders S, Doust J, Beller E, Glasziou P. Prevalence of attention-deficit/hyperactivity disorder: a systematic review and meta-analysis. *Pediatrics*. 2015;135(4). Available at: www.pediatrics.org/cgi/content/full/135/4/e994
9. Wolraich ML, McKeown RE, Visser SN, et al. The prevalence of ADHD: its diagnosis and treatment in four school districts across two states. *J Atten Disord*. 2014;18(7):563–575
10. Rowland AS, Skipper BJ, Umbach DM, et al. The prevalence of ADHD in a population-based sample. *J Atten Disord*. 2015;19(9):741–754
11. Danielson ML, Bitsko RH, Ghandour RM, Holbrook JR, Kogan MD, Blumberg SJ. Prevalence of parent-reported ADHD diagnosis and associated treatment among U.S. children and adolescents, 2016. *J Clin Child Adolesc Psychol*. 2018; 47(2):199–212
12. Visser SN, Zablotsky B, Holbrook JR, et al. *National Health Statistics Reports, No 81: Diagnostic Experiences of Children with Attention-Deficit/Hyperactivity Disorder*. Hyattsville, MD: National Center for Health Statistics; 2015
13. Molina BS, Hinshaw SP, Swanson JM, et al; MTA Cooperative Group. The MTA at 8 years: prospective follow-up of children treated for combined-type ADHD in a multisite study. *J Am Acad Child Adolesc Psychiatry*. 2009;48(5):484–500
14. Holbrook JR, Cuffe SP, Cai B, et al. Persistence of parent-reported ADHD symptoms from childhood through adolescence in a community sample. *J Atten Disord*. 2016;20(1):11–20

15. Mueller KL, Tomblin JB. Examining the comorbidity of language disorders and ADHD. *Top Lang Disord*. 2012;32(3): 228–246

16. Pastor PN, Reuben CA, Duran CR, Hawkins LD. *Association Between Diagnosed ADHD and Selected Characteristics Among Children Aged 4–17 Years: United States, 2011–2013. NCHS Data Brief, No. 201*. Hyattsville, MD: National Center for Health Statistics; 2015

17. Elia J, Ambrosini P, Berrettini W. ADHD characteristics: I. Concurrent co-morbidity patterns in children & adolescents. *Child Adolesc Psychiatry Ment Health*. 2008;2(1):15

18. Centers for Disease Control and Prevention (CDC). Mental health in the United States. Prevalence of diagnosis and medication treatment for attention-deficit/hyperactivity disorder--United States, 2003. *MMWR Morb Mortal Wkly Rep*. 2005;54(34):842–847

19. Cuffe SP, Visser SN, Holbrook JR, et al. ADHD and psychiatric comorbidity: functional outcomes in a school-based sample of children [published online ahead of print November 25, 2015]. *J Atten Disord*. doi:10.1177/1087054715613437

20. Gaub M, Carlson CL. Gender differences in ADHD: a meta-analysis and critical review. *J Am Acad Child Adolesc Psychiatry*. 1997;36(8):1036–1045

21. Tung I, Li JJ, Meza JI, et al. Patterns of comorbidity among girls with ADHD: a meta-analysis. *Pediatrics*. 2016;138(4): e20160430

22. Layton TJ, Barnett ML, Hicks TR, Jena AB. Attention deficit-hyperactivity disorder and month of school enrollment. *N Engl J Med*. 2018;379(22): 2122–2130

23. Kemper AR, Maslow GR, Hill S, et al. *Attention Deficit Hyperactivity Disorder: Diagnosis and Treatment in Children and Adolescents. Comparative Effectiveness Reviews, No. 203*. Rockville, MD: Agency for Healthcare Research and Quality; 2018

24. Pelham WE Jr, Wheeler T, Chronis A. Empirically supported psychosocial treatments for attention deficit hyperactivity disorder. *J Clin Child Psychol*. 1998;27(2):190–205

25. Evans SW, Owens JS, Wymbs BT, Ray AR. Evidence-based psychosocial treatments for children and adolescents with attention deficit/hyperactivity disorder. *J Clin Child Adolesc Psychol*. 2018;47(2):157–198

26. Pelham WE Jr, Fabiano GA. Evidence-based psychosocial treatments for attention-deficit/hyperactivity disorder. *J Clin Child Adolesc Psychol*. 2008;37(1): 184–214

27. American Academy of Pediatrics Steering Committee on Quality Improvement and Management. Classifying recommendations for clinical practice guidelines. *Pediatrics*. 2004;114(3):874–877

28. Visser SN, Lesesne CA, Perou R. National estimates and factors associated with medication treatment for childhood attention-deficit/hyperactivity disorder. *Pediatrics*. 2007;119(suppl 1):S99–S106

29. Centers for Disease Control and Prevention (CDC). Increasing prevalence of parent-reported attention-deficit/hyperactivity disorder among children–United States, 2003 and 2007. *MMWR Morb Mortal Wkly Rep*. 2010;59(44):1439–1443

30. Egger HL, Kondo D, Angold A. The epidemiology and diagnostic issues in preschool attention-deficit/hyperactivity disorder: a review. *Infants Young Child*. 2006;19(2):109–122

31. Wolraich ML, Wibbelsman CJ, Brown TE, et al. Attention-deficit/hyperactivity disorder among adolescents: a review of the diagnosis, treatment, and clinical implications. *Pediatrics*. 2005;115(6): 1734–1746

32. American Psychiatric Association. *Diagnostic and Statistical Manual of Mental Disorders (DSM-5)*. 5th ed. Arlington, VA: American Psychiatric Association; 2013

33. Lahey BB, Pelham WE, Stein MA, et al. Validity of DSM-IV attention-deficit/hyperactivity disorder for younger children. *J Am Acad Child Adolesc Psychiatry*. 1998;37(7):695–702

34. Pavuluri MN, Luk SL, McGee R. Parent reported preschool attention deficit hyperactivity: measurement and validity. *Eur Child Adolesc Psychiatry*. 1999;8(2):126–133

35. Harvey EA, Youngwirth SD, Thakar DA, Errazuriz PA. Predicting attention-deficit/hyperactivity disorder and oppositional defiant disorder from preschool diagnostic assessments. *J Consult Clin Psychol*. 2009;77(2): 349–354

36. Keenan K, Wakschlag LS. More than the terrible twos: the nature and severity of behavior problems in clinic-referred preschool children. *J Abnorm Child Psychol*. 2000;28(1):33–46

37. Gadow KD, Nolan EE, Litcher L, et al. Comparison of attention-deficit/hyperactivity disorder symptom subtypes in Ukrainian schoolchildren. *J Am Acad Child Adolesc Psychiatry*. 2000;39(12):1520–1527

38. Sprafkin J, Volpe RJ, Gadow KD, Nolan EE, Kelly K. A DSM-IV-referenced screening instrument for preschool children: the Early Childhood Inventory-4. *J Am Acad Child Adolesc Psychiatry*. 2002;41(5):604–612

39. Poblano A, Romero E. ECI-4 screening of attention deficit-hyperactivity disorder and co-morbidity in Mexican preschool children: preliminary results. *Arq Neuropsiquiatr*. 2006;64(4):932–936

40. American Academy of Pediatrics. *Mental Health Screening and Assessment Tools for Primary Care*. Elk Grove Village, IL: American Academy of Pediatrics; 2012. Available at: https://www.aap.org/en-us/advocacy-and-policy/aap-health-initiatives/Mental-Health/Documents/MH_ScreeningChart.pdf. Accessed September 8, 2019

41. DuPaul GJ, Power TJ, Anastopoulos AD, Reid R. *ADHD Rating Scale – 5 for Children and Adolescents: Checklists, Norms, and Clinical Interpretation*. 2nd ed. New York, NY: Guilford Press; 2016

42. McGoey KE, DuPaul GJ, Haley E, Shelton TL. Parent and teacher ratings of attention-deficit/hyperactivity disorder in preschool: the ADHD rating scale-IV preschool version. *J Psychopathol Behav Assess*. 2007;29(4):269–276

43. Young J. Common comorbidities seen in adolescents with attention-deficit/hyperactivity disorder. *Adolesc Med State Art Rev*. 2008;19(2):216–228, vii

44. Freeman RD; Tourette Syndrome International Database Consortium. Tic disorders and ADHD: answers from

a world-wide clinical dataset on Tourette syndrome. *Eur Child Adolesc Psychiatry*. 2007;16(suppl 1):15–23

45. Riggs PD. Clinical approach to treatment of ADHD in adolescents with substance use disorders and conduct disorder. *J Am Acad Child Adolesc Psychiatry*. 1998;37(3):331–332
46. Sibley MH, Pelham WE, Molina BSG, et al. Diagnosing ADHD in adolescence. *J Consult Clin Psychol*. 2012;80(1): 139–150
47. Kratochvil CJ, Vaughan BS, Stoner JA, et al. A double-blind, placebo-controlled study of atomoxetine in young children with ADHD. *Pediatrics*. 2011;127(4). Available at: www.pediatrics.org/cgi/content/full/127/4/e862
48. Harrison AG, Edwards MJ, Parker KC. Identifying students faking ADHD: preliminary findings and strategies for detection. *Arch Clin Neuropsychol*. 2007; 22(5):577–588
49. Wolraich ML, Felice ME, Drotar DD. *The Classification of Child and Adolescent Mental Conditions in Primary Care: Diagnostic and Statistical Manual for Primary Care (DSM-PC), Child and Adolescent Version*. Elk Grove Village, IL: American Academy of Pediatrics; 1996
50. Rowland AS, Lesesne CA, Abramowitz AJ. The epidemiology of attention-deficit/hyperactivity disorder (ADHD): a public health view. *Ment Retard Dev Disabil Res Rev*. 2002;8(3):162–170
51. Cuffe SP, Moore CG, McKeown RE. Prevalence and correlates of ADHD symptoms in the national health interview survey. *J Atten Disord*. 2005; 9(2):392–401
52. Pastor PN, Reuben CA. Diagnosed attention deficit hyperactivity disorder and learning disability: United States, 2004-2006. *Vital Health Stat 10*. 2008; 10(237):1–14
53. Biederman J, Faraone SV, Wozniak J, Mick E, Kwon A, Aleardi M. Further evidence of unique developmental phenotypic correlates of pediatric bipolar disorder: findings from a large sample of clinically referred preadolescent children assessed over the last 7 years. *J Affect Disord*. 2004; 82(suppl 1):S45–S58
54. Biederman J, Kwon A, Aleardi M, et al. Absence of gender effects on attention deficit hyperactivity disorder: findings in nonreferred subjects. *Am J Psychiatry*. 2005;162(6):1083–1089
55. Biederman J, Ball SW, Monuteaux MC, et al. New insights into the comorbidity between ADHD and major depression in adolescent and young adult females. *J Am Acad Child Adolesc Psychiatry*. 2008;47(4):426–434
56. Biederman J, Melmed RD, Patel A, McBurnett K, Donahue J, Lyne A. Long-term, open-label extension study of guanfacine extended release in children and adolescents with ADHD. *CNS Spectr*. 2008;13(12):1047–1055
57. Crabtree VM, Ivanenko A, Gozal D. Clinical and parental assessment of sleep in children with attention-deficit/hyperactivity disorder referred to a pediatric sleep medicine center. *Clin Pediatr (Phila)*. 2003;42(9):807–813
58. LeBourgeois MK, Avis K, Mixon M, Olmi J, Harsh J. Snoring, sleep quality, and sleepiness across attention-deficit/hyperactivity disorder subtypes. *Sleep*. 2004;27(3):520–525
59. Chan E, Zhan C, Homer CJ. Health care use and costs for children with attention-deficit/hyperactivity disorder: national estimates from the Medical Expenditure Panel Survey. *Arch Pediatr Adolesc Med*. 2002;156(5):504–511
60. Newcorn JH, Miller SR, Ivanova I, et al. Adolescent outcome of ADHD: impact of childhood conduct and anxiety disorders. *CNS Spectr*. 2004;9(9): 668–678
61. Sung V, Hiscock H, Sciberras E, Efron D. Sleep problems in children with attention-deficit/hyperactivity disorder: prevalence and the effect on the child and family. *Arch Pediatr Adolesc Med*. 2008;162(4):336–342
62. Froehlich TE, Fogler J, Barbaresi WJ, Elsayed NA, Evans SW, Chan E. Using ADHD medications to treat coexisting ADHD and reading disorders: a systematic review. *Clin Pharmacol Ther*. 2018;104(4):619–637
63. Rothenberger A, Roessner V. The phenomenology of attention-deficit/hyperactivity disorder in tourette syndrome. In: Martino D, Leckman JF, eds. *Tourette Syndrome*. New York, NY: Oxford University Press; 2013:26–49
64. Antshel KM, Zhang-James Y, Faraone SV. The comorbidity of ADHD and autism spectrum disorder. *Expert Rev Neurother*. 2013;13(10):1117–1128
65. Mahajan R, Bernal MP, Panzer R, et al; Autism Speaks Autism Treatment Network Psychopharmacology Committee. Clinical practice pathways for evaluation and medication choice for attention-deficit/hyperactivity disorder symptoms in autism spectrum disorders. *Pediatrics*. 2012;130(suppl 2):S125–S138
66. Larson K, Russ SA, Kahn RS, Halfon N. Patterns of comorbidity, functioning, and service use for US children with ADHD, 2007. *Pediatrics*. 2011;127(3): 462–470
67. Society for Developmental and Behavioral Pediatrics. ADHD special interest group. Available at: www.sdbp.org/committees/sig-adhd.cfm. Accessed September 8, 2019
68. Medical Home Initiatives for Children With Special Needs Project Advisory Committee. American Academy of Pediatrics. The medical home. *Pediatrics*. 2002;110(1 pt 1):184–186
69. Brito A, Grant R, Overholt S, et al. The enhanced medical home: the pediatric standard of care for medically underserved children. *Adv Pediatr*. 2008;55:9–28
70. Sibley MH, Swanson JM, Arnold LE, et al; MTA Cooperative Group. Defining ADHD symptom persistence in adulthood: optimizing sensitivity and specificity. *J Child Psychol Psychiatry*. 2017;58(6): 655–662
71. Chang Z, D'Onofrio BM, Quinn PD, Lichtenstein P, Larsson H. Medication for attention-deficit/hyperactivity disorder and risk for depression: a nationwide longitudinal cohort study. *Biol Psychiatry*. 2016;80(12):916–922
72. Biederman J, Monuteaux MC, Spencer T, Wilens TE, Faraone SV. Do stimulants protect against psychiatric disorders in youth with ADHD? A 10-year follow-up study. *Pediatrics*. 2009;124(1):71–78
73. Barbaresi WJ, Katusic SK, Colligan RC, Weaver AL, Jacobsen SJ. Modifiers of long-term school outcomes for children with attention-deficit/hyperactivity disorder: does treatment with

stimulant medication make a difference? Results from a population-based study. *J Dev Behav Pediatr*. 2007; 28(4):274–287

74. Scheffler RM, Brown TT, Fulton BD, Hinshaw SP, Levine P, Stone S. Positive association between attention-deficit/hyperactivity disorder medication use and academic achievement during elementary school. *Pediatrics*. 2009; 123(5):1273–1279
75. Barbaresi WJ, Colligan RC, Weaver AL, Voigt RG, Killian JM, Katusic SK. Mortality, ADHD, and psychosocial adversity in adults with childhood ADHD: a prospective study. *Pediatrics*. 2013;131(4):637–644
76. Chang Z, Lichtenstein P, Långström N, Larsson H, Fazel S. Association between prescription of major psychotropic medications and violent reoffending after prison release. *JAMA*. 2016; 316(17):1798–1807
77. Lichtenstein P, Halldner L, Zetterqvist J, et al. Medication for attention deficit-hyperactivity disorder and criminality. *N Engl J Med*. 2012;367(21):2006–2014
78. Chang Z, Quinn PD, Hur K, et al. Association between medication use for attention-deficit/hyperactivity disorder and risk of motor vehicle crashes. *JAMA Psychiatry*. 2017;74(6):597–603
79. Chang Z, Lichtenstein P, D'Onofrio BM, Sjölander A, Larsson H. Serious transport accidents in adults with attention-deficit/hyperactivity disorder and the effect of medication: a population-based study. *JAMA Psychiatry*. 2014;71(3):319–325
80. Harstad E, Levy S; Committee on Substance Abuse. Attention-deficit/hyperactivity disorder and substance abuse. *Pediatrics*. 2014;134(1). Available at: www.pediatrics.org/cgi/content/full/134/1/e293
81. Dalsgaard S, Leckman JF, Mortensen PB, Nielsen HS, Simonsen M. Effect of drugs on the risk of injuries in children with attention deficit hyperactivity disorder: a prospective cohort study. *Lancet Psychiatry*. 2015;2(8):702–709
82. Raman SR, Marshall SW, Haynes K, Gaynes BN, Naftel AJ, Stürmer T. Stimulant treatment and injury among children with attention deficit hyperactivity disorder: an application of the self-controlled case series study design. *Inj Prev*. 2013;19(3):164–170
83. Greenhill L, Kollins S, Abikoff H, et al. Efficacy and safety of immediate-release methylphenidate treatment for preschoolers with ADHD. *J Am Acad Child Adolesc Psychiatry*. 2006;45(11): 1284–1293
84. Children and Adults with Attention-Deficit/Hyperactivity Disorder. CHADD. Available at: www.chadd.org. Accessed September 8, 2019
85. Sonuga-Barke EJ, Daley D, Thompson M, Laver-Bradbury C, Weeks A. Parent-based therapies for preschool attention-deficit/hyperactivity disorder: a randomized, controlled trial with a community sample. *J Am Acad Child Adolesc Psychiatry*. 2001;40(4):402–408
86. Van Cleave J, Leslie LK. Approaching ADHD as a chronic condition: implications for long-term adherence. *J Psychosoc Nurs Ment Health Serv*. 2008;46(8):28–37
87. Webster-Stratton CH, Reid MJ, Beauchaine T. Combining parent and child training for young children with ADHD. *J Clin Child Adolesc Psychol*. 2011;40(2):191–203
88. Shepard SA, Dickstein S. Preventive intervention for early childhood behavioral problems: an ecological perspective. *Child Adolesc Psychiatr Clin N Am*. 2009;18(3):687–706
89. Evans SW, Langberg JM, Egan T, Molitor SJ. Middle school-based and high school-based interventions for adolescents with ADHD. *Child Adolesc Psychiatr Clin N Am*. 2014;23(4):699–715
90. McGough JJ, Sturm A, Cowen J, et al. Double-blind, sham-controlled, pilot study of trigeminal nerve stimulation for attention-deficit/hyperactivity disorder. *J Am Acad Child Adolesc Psychiatry*. 2019;58(4):403–411.e3
91. Robin AL, Foster SL. *The Guilford Family Therapy Series. Negotiating Parent–Adolescent Conflict: A Behavioral–Family Systems Approach*. New York, NY: Guilford Press; 1989
92. Barkley RA, Guevremont DC, Anastopoulos AD, Fletcher KE. A comparison of three family therapy programs for treating family conflicts in adolescents with attention-deficit hyperactivity disorder. *J Consult Clin Psychol*. 1992;60(3):450–462
93. Fabiano GA, Schatz NK, Morris KL, et al. Efficacy of a family-focused intervention for young drivers with attention-deficit hyperactivity disorder. *J Consult Clin Psychol*. 2016;84(12):1078–1093
94. Sibley MH, Graziano PA, Kuriyan AB, et al. Parent-teen behavior therapy + motivational interviewing for adolescents with ADHD. *J Consult Clin Psychol*. 2016;84(8):699–712
95. Evans SW, Langberg JM, Schultz BK, et al. Evaluation of a school-based treatment program for young adolescents with ADHD. *J Consult Clin Psychol*. 2016;84(1):15–30
96. Langberg JM, Dvorsky MR, Molitor SJ, et al. Overcoming the research-to-practice gap: a randomized trial with two brief homework and organization interventions for students with ADHD as implemented by school mental health providers. *J Consult Clin Psychol*. 2018; 86(1):39–55
97. Schultz BK, Evans SW, Langberg JM, Schoemann AM. Outcomes for adolescents who comply with long-term psychosocial treatment for ADHD. *J Consult Clin Psychol*. 2017;85(3): 250–261
98. Newcorn JH, Kratochvil CJ, Allen AJ, et al; Atomoxetine/Methylphenidate Comparative Study Group. Atomoxetine and osmotically released methylphenidate for the treatment of attention deficit hyperactivity disorder: acute comparison and differential response. *Am J Psychiatry*. 2008;165(6): 721–730
99. Cheng JY, Chen RY, Ko JS, Ng EM. Efficacy and safety of atomoxetine for attention-deficit/hyperactivity disorder in children and adolescents-meta-analysis and meta-regression analysis. *Psychopharmacology (Berl)*. 2007; 194(2):197–209
100. Michelson D, Allen AJ, Busner J, et al. Once-daily atomoxetine treatment for children and adolescents with attention deficit hyperactivity disorder: a randomized, placebo-controlled study. *Am J Psychiatry*. 2002;159(11): 1896–1901
101. Biederman J, Melmed RD, Patel A, et al; SPD503 Study Group. A randomized,

double-blind, placebo-controlled study of guanfacine extended release in children and adolescents with attention-deficit/hyperactivity disorder. *Pediatrics*. 2008;121(1). Available at: www.pediatrics.org/cgi/content/full/121/1/e73

102. Sallee FR, Lyne A, Wigal T, McGough JJ. Long-term safety and efficacy of guanfacine extended release in children and adolescents with attention-deficit/hyperactivity disorder. *J Child Adolesc Psychopharmacol*. 2009; 19(3):215–226

103. Jain R, Segal S, Kollins SH, Khayrallah M. Clonidine extended-release tablets for pediatric patients with attention-deficit/hyperactivity disorder. *J Am Acad Child Adolesc Psychiatry*. 2011; 50(2):171–179

104. Brown JT, Bishop JR. Atomoxetine pharmacogenetics: associations with pharmacokinetics, treatment response and tolerability. *Pharmacogenomics*. 2015;16(13):1513–1520

105. Kambeitz J, Romanos M, Ettinger U. Meta-analysis of the association between dopamine transporter genotype and response to methylphenidate treatment in ADHD. *Pharmacogenomics J*. 2014;14(1):77–84

106. Bruxel EM, Akutagava-Martins GC, Salatino-Oliveira A, et al. ADHD pharmacogenetics across the life cycle: new findings and perspectives. *Am J Med Genet B Neuropsychiatr Genet*. 2014;165B(4):263–282

107. Kieling C, Genro JP, Hutz MH, Rohde LA. A current update on ADHD pharmacogenomics. *Pharmacogenomics*. 2010;11(3): 407–419

108. Froehlich TE, McGough JJ, Stein MA. Progress and promise of attention-deficit hyperactivity disorder pharmacogenetics. *CNS Drugs*. 2010; 24(2):99–117

109. Joensen B, Meyer M, Aagaard L. Specific genes associated with adverse events of methylphenidate use in the pediatric population: a systematic literature review. *J Res Pharm Pract*. 2017;6(2): 65–72

110. Swanson JM, Elliott GR, Greenhill LL, et al. Effects of stimulant medication on growth rates across 3 years in the MTA follow-up. *J Am Acad Child Adolesc Psychiatry*. 2007;46(8):1015–1027

111. Mosholder AD, Gelperin K, Hammad TA, Phelan K, Johann-Liang R. Hallucinations and other psychotic symptoms associated with the use of attention-deficit/hyperactivity disorder drugs in children. *Pediatrics*. 2009; 123(2):611–616

112. Cortese S, Holtmann M, Banaschewski T, et al; European ADHD Guidelines Group. Practitioner review: current best practice in the management of adverse events during treatment with ADHD medications in children and adolescents. *J Child Psychol Psychiatry*. 2013;54(3):227–246

113. Avigan M. *Review of AERS Data From Marketed Safety Experience During Stimulant Therapy: Death, Sudden Death, Cardiovascular SAEs (Including Stroke). Report No. D030403*. Silver Spring, MD: Food and Drug Administration, Center for Drug Evaluation and Research; 2004

114. Perrin JM, Friedman RA, Knilans TK; Black Box Working Group; Section on Cardiology and Cardiac Surgery. Cardiovascular monitoring and stimulant drugs for attention-deficit/hyperactivity disorder. *Pediatrics*. 2008; 122(2):451–453

115. McCarthy S, Cranswick N, Potts L, Taylor E, Wong IC. Mortality associated with attention-deficit hyperactivity disorder (ADHD) drug treatment: a retrospective cohort study of children, adolescents and young adults using the general practice research database. *Drug Saf*. 2009;32(11):1089–1096

116. Gould MS, Walsh BT, Munfakh JL, et al. Sudden death and use of stimulant medications in youths. *Am J Psychiatry*. 2009;166(9):992–1001

117. Cooper WO, Habel LA, Sox CM, et al. ADHD drugs and serious cardiovascular events in children and young adults. *N Engl J Med*. 2011;365(20):1896–1904

118. Schelleman H, Bilker WB, Strom BL, et al. Cardiovascular events and death in children exposed and unexposed to ADHD agents. *Pediatrics*. 2011;127(6): 1102–1110

119. Garnock-Jones KP, Keating GM. Atomoxetine: a review of its use in attention-deficit hyperactivity disorder in children and adolescents. *Paediatr Drugs*. 2009;11(3):203–226

120. Reed VA, Buitelaar JK, Anand E, et al. The safety of atomoxetine for the treatment of children and adolescents with attention-deficit/hyperactivity disorder: a comprehensive review of over a decade of research. *CNS Drugs*. 2016;30(7):603–628

121. Bangs ME, Tauscher-Wisniewski S, Polzer J, et al. Meta-analysis of suicide-related behavior events in patients treated with atomoxetine. *J Am Acad Child Adolesc Psychiatry*. 2008;47(2): 209–218

122. Bangs ME, Jin L, Zhang S, et al. Hepatic events associated with atomoxetine treatment for attention-deficit hyperactivity disorder. *Drug Saf*. 2008; 31(4):345–354

123. Spencer TJ, Kratochvil CJ, Sangal RB, et al. Effects of atomoxetine on growth in children with attention-deficit/hyperactivity disorder following up to five years of treatment. *J Child Adolesc Psychopharmacol*. 2007;17(5):689–700

124. Elbe D, Reddy D. Focus on guanfacine extended-release: a review of its use in child and adolescent psychiatry. *J Can Acad Child Adolesc Psychiatry*. 2014; 23(1):48–60

125. Croxtall JD. Clonidine extended-release: in attention-deficit hyperactivity disorder. *Paediatr Drugs*. 2011;13(5): 329–336

126. Vaughan B, Kratochvil CJ. Pharmacotherapy of pediatric attention-deficit/hyperactivity disorder. *Child Adolesc Psychiatr Clin N Am*. 2012; 21(4):941–955

127. Hirota T, Schwartz S, Correll CU. Alpha-2 agonists for attention-deficit/hyperactivity disorder in youth: a systematic review and meta-analysis of monotherapy and add-on trials to stimulant therapy. *J Am Acad Child Adolesc Psychiatry*. 2014;53(2):153–173

128. Treuer T, Gau SS, Méndez L, et al. A systematic review of combination therapy with stimulants and atomoxetine for attention-deficit/hyperactivity disorder, including patient characteristics, treatment strategies, effectiveness, and tolerability. *J Child Adolesc Psychopharmacol*. 2013;23(3): 179–193

129. Greenhill LL, Posner K, Vaughan BS, Kratochvil CJ. Attention deficit hyperactivity disorder in preschool children. *Child Adolesc Psychiatr Clin N Am*. 2008;17(2):347–366, ix

130. Wilens TE, Spencer TJ. Understanding attention-deficit/hyperactivity disorder from childhood to adulthood. *Postgrad Med*. 2010;122(5):97–109

131. Foy JM, ed. Psychotropic medications in primary care. In: *Mental Health Care of Children and Adolescents: A Guide for Primary Care Clinicians*. Itasca, IL: American Academy of Pediatrics; 2018: 315–374

132. Wilens TE, Adler LA, Adams J, et al. Misuse and diversion of stimulants prescribed for ADHD: a systematic review of the literature. *J Am Acad Child Adolesc Psychiatry*. 2008;47(1): 21–31

133. American Academy of Pediatrics. Mental health initiatives. Available at: https://www.aap.org/en-us/advocacy-and-policy/aap-health-initiatives/Mental-Health/Pages/default.aspx. Accessed September 8, 2019

134. Levy S, Campbell MD, Shea CL, DuPont R. Trends in abstaining from substance use in adolescents: 1975-2014. *Pediatrics*. 2018;142(2):e20173498

135. Graff Low K, Gendaszek AE. Illicit use of psychostimulants among college students: a preliminary study. *Psychol Health Med*. 2002;7(3):283–287

136. Barkley RA, Cox D. A review of driving risks and impairments associated with attention-deficit/hyperactivity disorder and the effects of stimulant medication on driving performance. *J Safety Res*. 2007;38(1):113–128

137. Jerome L, Habinski L, Segal A. Attention-deficit/hyperactivity disorder (ADHD) and driving risk: a review of the literature and a methodological critique. *Curr Psychiatry Rep*. 2006;8(5): 416–426

138. Cox DJ, Merkel RL, Moore M, Thorndike F, Muller C, Kovatchev B. Relative benefits of stimulant therapy with OROS methylphenidate versus mixed amphetamine salts extended release in improving the driving performance of adolescent drivers with attention-deficit/hyperactivity disorder. *Pediatrics*. 2006;118(3). Available at: www.pediatrics.org/cgi/content/full/118/3/e704

139. The MTA Cooperative Group; Multimodal Treatment Study of Children with ADHD. A 14-month randomized clinical trial of treatment strategies for attention-deficit/hyperactivity disorder. *Arch Gen Psychiatry*. 1999;56(12):1073–1086

140. Jensen PS, Hinshaw SP, Swanson JM, et al. Findings from the NIMH Multimodal Treatment Study of ADHD (MTA): implications and applications for primary care providers. *J Dev Behav Pediatr*. 2001;22(1):60–73

141. Pelham WE Jr, Gnagy EM. Psychosocial and combined treatments for ADHD. *Ment Retard Dev Disabil Res Rev*. 1999; 5(3):225–236

142. Homer CJ, Klatka K, Romm D, et al. A review of the evidence for the medical home for children with special health care needs. *Pediatrics*. 2008;122(4). Available at: www.pediatrics.org/cgi/content/full/122/4/e922

143. Davila RR, Williams ML, MacDonald JT. Memorandum on clarification of policy to address the needs of children with attention deficit disorders within general and/or special education. In: Parker HC, ed. *The ADD Hyperactivity Handbook for Schools*. Plantation, FL: Impact Publications Inc; 1991:261–268

144. Harrison JR, Bunford N, Evans SW, Owens JS. Educational accommodations for students with behavioral challenges: a systematic review of the literature. *Rev Educ Res*. 2013;83(4): 551–597

145. Committee on Pediatric Workforce. Enhancing pediatric workforce diversity and providing culturally effective pediatric care: implications for practice, education, and policy making. *Pediatrics*. 2013;132(4). Available at: www.pediatrics.org/cgi/content/full/132/4/e1105

146. Berman RS, Patel MR, Belamarich PF, Gross RS. Screening for poverty and poverty-related social determinants of health. *Pediatr Rev*. 2018;39(5):235–246

147. Solanto MV. Neuropsychopharmacological mechanisms of stimulant drug action in attention-deficit hyperactivity disorder: a review and integration. *Behav Brain Res*. 1998;94(1):127–152

148. Wagner E. Chronic disease management: what will it take to improve care for chronic illness? *Effect Clin Pract*. 1998;1(1):2–4

149. Brinkman WB, Sucharew H, Majcher JH, Epstein JN. Predictors of medication continuity in children with ADHD. *Pediatrics*. 2018;141(6):e20172580

150. Pliszka SR, Crismon ML, Hughes CW, et al; Texas Consensus Conference Panel on Pharmacotherapy of Childhood Attention Deficit Hyperactivity Disorder. The Texas Children's Medication Algorithm Project: revision of the algorithm for pharmacotherapy of attention-deficit/hyperactivity disorder. *J Am Acad Child Adolesc Psychiatry*. 2006;45(6):642–657

151. Pringsheim T, Hirsch L, Gardner D, Gorman DA. The pharmacological management of oppositional behaviour, conduct problems, and aggression in children and adolescents with attention-deficit hyperactivity disorder, oppositional defiant disorder, and conduct disorder: a systematic review and meta-analysis. Part 1: psychostimulants, alpha-2 agonists, and atomoxetine. *Can J Psychiatry*. 2015; 60(2):42–51

152. Committee on Psychosocial Aspects of Child and Family Health and Task Force on Mental Health. Policy statement--The future of pediatrics: mental health competencies for pediatric primary care. *Pediatrics*. 2009;124(1):410–421

153. Foy JM, ed. Algorithm: a process for integrating mental health care into pediatric practice. In: *Mental Health Care of Children and Adolescents: A Guide for Primary Care Clinicians*. Itasca, IL: American Academy of Pediatrics; 2018:815

154. Cheng TL, Emmanuel MA, Levy DJ, Jenkins RR. Child health disparities: what can a clinician do? *Pediatrics*. 2015;136(5):961–968

155. Stein F, Remley K, Laraque-Arena D, Pursley DM. New resources and strategies to advance the AAP's values of diversity, inclusion, and health equity. *Pediatrics*. 2018;141(4):e20180177

156. American Academy of Pediatrics, Committee on Child Health Financing. Scope of health care benefits for children from birth through age 26. *Pediatrics*. 2012;129(1):185–189

Supplemental Information

ALGORITHM

IMPLEMENTING THE KEY ACTION STATEMENTS OF THE AAP ADHD CLINICAL PRACTICE GUIDELINES: AN ALGORITHM AND EXPLANATION FOR PROCESS OF CARE FOR THE EVALUATION, DIAGNOSIS, TREATMENT, AND MONITORING OF ADHD IN CHILDREN AND ADOLESCENTS

I. INTRODUCTION

Practice guidelines provide a broad outline of the requirements for high-quality, evidence-based care. The AAP "Clinical Practice Guideline: Diagnosis and Evaluation of the Child With Attention-Deficit/Hyperactivity Disorder" provides the evidence-based processes for caring for children and adolescents with ADHD symptoms or diagnosis. This document supplements that guideline. It provides a PoCA that details processes to implement the guidelines; describes procedures for the evaluation, treatment, and monitoring of children and adolescents with ADHD; and addresses practical issues related to the provision of ADHD-related care within a typical, busy pediatric practice. The algorithm is entirely congruent with the guidelines and is based on the practical experience and expert advice of clinicians who are experienced in the diagnosis and management of children and adolescents with ADHD. Unlike the guidelines, this algorithm is based primarily on expert opinion and has a less robust evidence base because of the lack of clinical studies specifically addressing this approach. Understanding that providing appropriate care to children with ADHD in a primary care setting faces a number of challenges and barriers, the subcommittee has also provided an additional article describing needed changes to address barriers to care (found in the Supplemental Information).

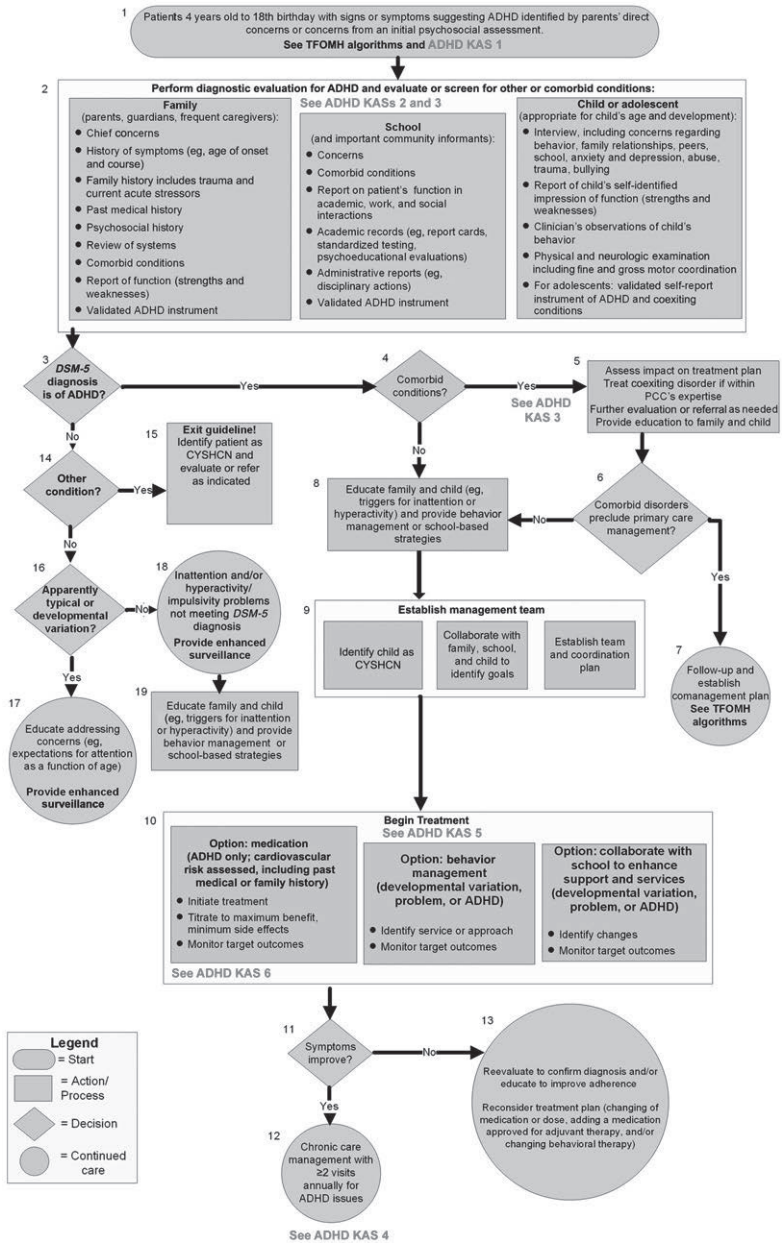
In this algorithm, we describe a continuous process; as such, its constituent steps are not intended to be completed in a single office visit or in a specific number of visits. Evaluation, treatment, and monitoring are ongoing processes to be addressed throughout the child's and adolescent's care within the practice and in transition planning as the adolescent moves into the adult care system. Many factors will influence the pace of the process, including the experience of the PCC, the practice's volume, the longevity of the relationship between the PCC and family, the severity of concerns, the availability of academic records and school input, the family's schedule, and the payment structure.

An awareness of the AAP "Primary Care Approach to Mental Health Care Algorithm," which is available on the AAP Mental Health Initiatives Web site, will enhance the integration of the procedures described in this document (http://www.aap.org/mentalhealth). That algorithm describes the process to integrate an initial psychosocial assessment at well visits and a brief mental health update at acute and chronic care visits. Mental health concerns, including symptoms of inattention and impulsivity, may present when (1) elicited during the initial psychosocial assessment at a routine well visit, (2) elicited during a brief mental health update at an acute or chronic visit, or (3) presented during a visit triggered by a family or school concern.

When concerns are identified, the algorithm describes the process of conducting a brief primary care intervention, secondary screening, diagnostic assessment, treatment, and follow-up. Like this document, the mental health algorithm is intended to present a process that may involve more than 1 visit and may be completed over time.

This algorithm assumes that the primary care practice has adopted the initial psychosocial assessment and mental health update, as described by the AAP Mental Health Initiatives.[153] It begins with steps paralleling the secondary assessment of the general mental health algorithm. Both algorithms focus on the care team and include the family as a part of that team.

In light of the prevalence of ADHD, the severe consequences of untreated ADHD, and the availability of effective ADHD treatments, the AAP recommends that every child and adolescent identified with signs or symptoms suggestive of ADHD be evaluated for ADHD or other conditions that may share its symptomatology. Documenting all aspects of the diagnostic and treatment procedures in the patient's records will improve the ability of the



SUPPLEMENTAL FIGURE 2
ADHD care algorithm. CYSHCN, children and youth with special health care needs; TFOMH, Task Force on Mental Health.

pediatrician to best treat children with ADHD.

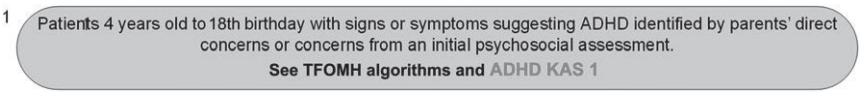
II. EVALUATION FOR ADHD

II a. A Child or Adolescent Presents With Signs and Symptoms Suggesting ADHD

The algorithm's steps can be implemented when a child or adolescent presents to a PCC for an assessment for ADHD. This may occur in a variety of ways.

Pediatricians and other PCCs traditionally have long-standing relationships with the child and family, which foster the opportunity to identify concerns early on. The young child may have a history of known ADHD risks, such as having parents who have been diagnosed with ADHD or having extremely low birth weight. In those instances, the PCC would monitor for emerging issues.

Many parents bring their child or adolescent to the PCC with specific concerns about the child's or adolescent's ability to sustain attention, curb activity levels, and/or inhibit impulsivity at home, school, or in the community. In many instances, the parents may express concerns about behaviors and characteristics



SUPPLEMENTAL FIGURE 3
Evaluate for ADHD. TFOMH, Task Force on Mental Health.

that are associated with ADHD but may not mention the core ADHD symptoms. For example, parents may report that their child is getting poor grades, does not perform well in team sports (despite being athletic), has few friends, or is moody and quick to anger. These children and adolescents may have difficulty remaining organized; planning activities; or inhibiting their initial thoughts, actions, or emotions, which are behaviors that fall under the umbrella of executive functioning (ie, planning, prioritizing, and producing) or cognitive control. Problems with executive functions may be correlated with ADHD and are common among children and adolescents with ADHD. As recommended by Bright Futures (a national health promotion and prevention initiative led by the AAP[157]), routine psychosocial screening at preventive visits may identify concerns on the part of parent or another clinician (see below for more information on co-occurring conditions.)

Finally, parents may bring a child to a PCC for ADHD evaluation on the basis of the recommendation of a teacher, tutor, coach, etc.

(See the ADHD guideline's KAS 1.)

II b. Perform a Diagnostic Evaluation for ADHD and Evaluate or Screen for Comorbid Disorders

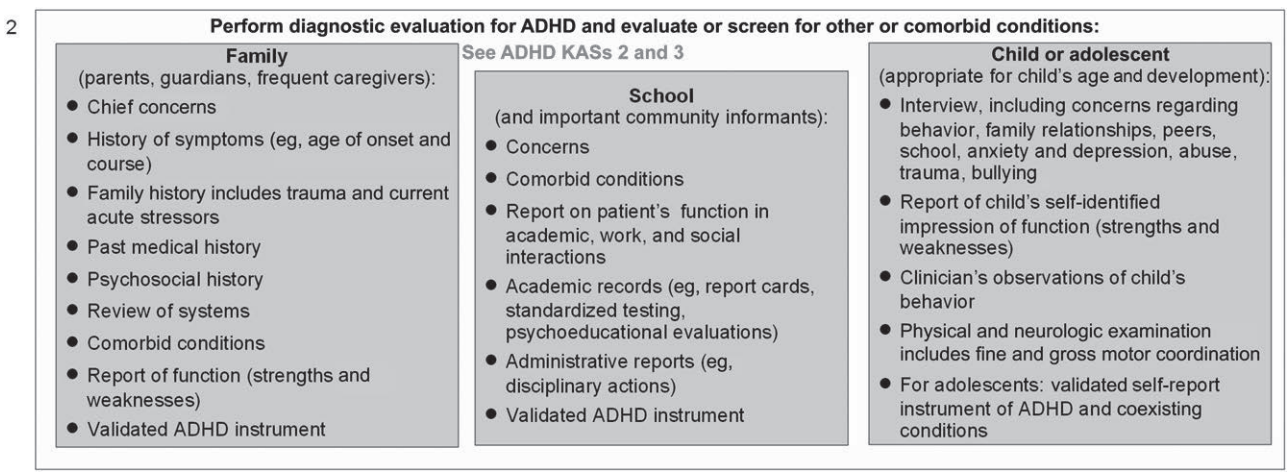
When a child or adolescent presents with concerns about ADHD, as described above, the clinician should initiate an evaluation for ADHD. (See the ADHD guideline's KASs 2 and 3.)

II c. Gather Information From the Family

As noted previously, the recommendations in the accompanying guideline are intended to be integrated with the broader mental health algorithm developed as part of the AAP Mental Health Initiatives.[2,133,153] It is also important for pediatricians and other PCCs to be aware of health disparities and social determinants that may affect patient outcomes and to provide culturally appropriate care to all children and adolescents in their practice, including during the initial evaluation and assessment of the patient's condition.[145,146,154,155,158]

Ideally, the PCC's office staff obtains information from the family about the visit's purpose at scheduling so that an extended visit or multiple visits can be made available for the initial ADHD evaluation. This also increases the efficiency of an initial evaluation. Data on the child's or adolescent's symptoms and functioning can be gathered from parents, school personnel, and other sources before the visit. Parents can be given rating scales that are to be completed before the visit by teachers, coaches, and others who interact with the child. This strategy allows the PCC to focus on the most pertinent issues for that child or adolescent and family at the time of the visit. (See later discussion for more information on rating scales.) Note that schools will not release data to pediatric providers without written parental consent.

During the office evaluation session, the PCC reviews the patient's medical, family, and psychosocial history. Developmental history is presumed to be part of the patient's medical



SUPPLEMENTAL FIGURE 4
Perform a diagnostic evaluation for ADHD and evaluate or screen for comorbid disorders

history. Family members (including parents, guardians, and other frequent caregivers) are asked to identify their chief concerns and provide a history of the onset, frequency, and duration of problem behaviors, situations that increase or decrease the problems, previous treatments and their results, and the caregivers' understanding of the issues. It is important to assess behaviors and conditions that are frequent side effects of stimulant medication (ie, sleep difficulties, tics, nail-biting, skin-picking, headaches, stomachaches, or afternoon irritability) and preexisting conditions, so they are not confused with the frequent side effects of stimulants. This enables the PCC to compare changes if medication is initiated later.

A sound assessment of symptoms and functioning in major areas can be used to construct an educational and behavioral profile that includes the child's strengths and talents. Many children with ADHD exhibit enthusiasm, exuberance, creativity, flexibility, the ability to detect and quickly respond to subtle changes in the environment, a sense of humor, a desire to please, etc. The most common areas of functioning affected by ADHD include academic achievement; relationships with peers, parents, siblings, and adult authority figures; participation in recreational activities, such as sports; and behavior and emotional regulation, including risky behavior.

The child's and family's histories can provide information about the status of symptoms and functioning and help determine age of onset and other factors that may be associated with the presenting problems. It also identifies any potential traumatic events that the child may have experienced, such as a family death, separation from the family, or physical or mental abuse.

The child or adolescent's medical history can help identify factors associated with ADHD, such as prenatal and perinatal complications and exposures (eg, preterm delivery, maternal hypertension, prenatal alcohol exposure), childhood exposures, and head trauma.

The family history includes any medical syndromes, developmental delays, cognitive limitations, learning disabilities, trauma or toxic stress, or mental illness in the patient and family members, including ADHD, mood, anxiety, and bipolar disorders. Ask what the family has already tried, what works, and what does not work to avoid wasting time on interventions that have already been attempted unsuccessfully. Parental tobacco and substance use, including their use prenatally, are relevant risk factors for, and correlate with, ADHD.[159] ADHD is highly heritable and is often seen in other family members who may or may not have been formally diagnosed with ADHD. For this reason, asking about family members' school experience, including time and task management, grades, and highest grade level achieved, can aid in treatment decisions.

The psychosocial history is important in any ADHD evaluation and usually includes queries about environmental factors, such as family stress and problematic relationships, which sometime contribute to the child or adolescent's overall functioning. The caregivers' current and past approaches to parenting and the child's misbehavior can provide important information that may explain discrepancies between reporters. For example, parents may reduce their expectations for their child with ADHD as a means to relieve parenting stress. When these expectations are reduced (eg, eliminating chores, not monitoring homework completion, etc), parents may experience far fewer problems with the child than do teachers who may have maintained expectations for the child to complete tasks and follow rules. Knowing the parents' approach to parenting may help the PCC understand differences in ratings completed by parents versus teachers.

Further evidence for an ADHD diagnosis includes an inability to independently complete daily routines in an age-appropriate manner as well as multiple and short-lasting friendships, trouble keeping and/or making friends, staying up late to complete assignments, and late, incomplete, and/or lost assignments. Somatic symptoms and school avoidance are more common among girls and may mask an ADHD diagnosis. With information obtained from the parents and school personnel, the PCC can make a clinical judgment about the effect of the core and associated ADHD symptoms on academic achievement, classroom performance, family and social relationships, independent functioning, and safety and/or unintentional injuries.

If other issues exist, such as self-injuries, comorbid mental health issues also need to be evaluated. Possible areas of functional impairment that require evaluation include domains such as self-perception, leisure activities, and self-care (ie, bathing, toileting, dressing, and eating). Additional guidance regarding functional assessment is available through the AAP ADHD Toolkit[2] and the AAP Mental Health Initiatives.[133,160] The ADHD Toolkit[2] is being revised concurrently with the development of these updated guidelines. After publication, the toolkit may be accessed at https://www.aap.org/en-us/professional-resources/quality-improvement/Pages/Quality-Improvement-Implementation-Guide.aspx. Additionally, a new Education in Quality Improvement for Pediatric Practice Module was developed on the basis of the new clinical recommendations and can also be accessed by using the same link above.

The patient needs to be screened for hearing and/or visual problems because these can mimic inattention. A full review of systems may reveal other symptoms or disorders, such as sleep disturbances, absence seizures, or tic disorders, which may assist in formulating a differential diagnosis and/or developing management plans. Internal feelings such as anxiety and depression can occur but may not be noticeable to parents and teachers, so it is important to elicit feedback about them from the patient as well.

The information gathered from this diagnostic interview, combined with the data from the rating scales (see below), provides an excellent foundation for determining the presence of symptoms and impairment criteria needed to diagnose ADHD.

II d. Use Parent Rating Scales and Other Tools

Rating scales that use the *DSM-5* criteria for ADHD can help obtain the information that will contribute to making a diagnosis. Rating scales for parents that use *DSM-5* criteria for ADHD are helpful in obtaining the core symptoms required to make a diagnosis on the basis of the *DSM-5*.[161] Because changes in the 18 core symptoms are essentially unchanged from *DSM-IV* criteria, *DSM-IV*–based rating scales can be used if *DSM-5* rating scales are not readily available. Some of these symptom rating scales include symptoms of commonly comorbid conditions and measures of impairment in a variety of domains that are also required for a diagnosis.[41,162] Some available measures are limited because they provide only a global rating.[163,164]

Caregiver and teacher endorsement of the requisite number of ADHD symptoms on the rating scales is not sufficient for diagnosis. A rating scale documents the presence of inattention, hyperactivity, and impulsivity symptoms but not whether these symptoms are actually attributable to ADHD versus a mimicking condition. Caregivers may misread or misunderstand some of the behaviors. Furthermore, rating scales do not inform the PCC about contextual influences that may account for the symptoms and impairment. Likewise, broadband rating scales that assess general mental health functioning do not provide reliable and valid indications of ADHD diagnoses, although they can help to screen for concurrent behavioral conditions.[165]

Nevertheless, parent ratings provide valuable information on their perspective of the child's symptoms and impairment and add information about normative levels of the parents' perspectives, which help the PCC determine the degree with which the problems are or are not in the typical range for the child's age and sex. Finally, broad rating scales that assess general mental health functioning do not provide sufficient information about all the ADHD core symptoms but may help screen for the concurrent behavioral conditions.[165]

To address the rating scales' limitations, pediatricians and other PCCs need to interview parents and may need to review documents such as report cards and standardized test results and historical records of detentions, suspensions, and/or expulsions from school, which can serve as evidence of functional impairment. Further evidence may include difficulty developing and maintaining lasting friendships. This information is discussed below.

II e. Gather Information From School and Community Informants

Information from parents is not the only source that informs diagnostic decisions for children and adolescents because a key criterion for an ADHD diagnosis is the display of symptoms and impairments in multiple settings. Gathering data from other adults who regularly interact with the child or adolescent being evaluated provides rich additional information for the evaluation.

The information from various sources may be inconsistent because parents and teachers observe the children at different times and under different circumstances, as described previously.[166] Disagreement may result from differences in students' behavior and performance in different classrooms, their relationship with the teachers, or variations in teachers' expectations, as well as training in or experience with behavior management. Classes with high homework demands or classes with less structure are often the most problematic for students with ADHD. Investigating these inconsistencies can lead to hypotheses about the child that help inform the eventual clinical diagnoses and treatment decisions.[167]

Teachers and Other School Personnel

Teachers and other school personnel can provide critically important information because they develop a rich sense of the typical range of behaviors within a specific age group over time. School and classrooms settings provide the greatest social and performance expectations that potentially tax children and adolescents with ADHD. Parents and older children may be the best sources for identifying the school personnel who can best complete rating scales for an ADHD evaluation.

The value of school ratings increases as children age because parents often have less detailed information about their child's behavior and performance at school as the student moves into the higher grades. With elementary and middle school children, the classroom teacher is usually the best source; he or she may be the only source necessary. Other school staff, such as a special education teacher or school counselor, may be valuable sources of information. Direct communication

with a school psychologist and/or school counselor may provide additional information on the child's functioning within the context of the classroom and school.

In secondary schools, students interact with many teachers who often instruct >100 students daily. As a result, high school teachers may not know the students as well as elementary and middle school teachers do. Parents and students may be encouraged to choose the 2 or 3 teachers who they believe know the student best and solicit their input (eg, math and English teachers or, for children or adolescents with learning disabilities, a teacher in an area of strong function and a teacher in an area of weak function). Regardless of the presence of a learning disability, it is helpful to obtain feedback from the teacher of the class in which the child or adolescent is having the most difficulty. The ADHD Toolkit provides materials relevant to school data collection.

Teachers may communicate their major concerns using questionnaires or verbally in person, via secure e-mail (if available), or over the telephone. It is important to ask an appropriate school representative to complete a validated ADHD instrument or behavior scale based on the *DSM-5* criteria for ADHD. A school representative's report might include information about any comorbid or alternative conditions, including disruptive behavior disorders, depression and anxiety disorders, tics, or learning disabilities. As noted, some parent rating scales have a version for teachers and assess symptoms and impairment in multiple domains.[41] Teacher rating scales exist that specifically target behavior and performance at school,[168] which provide a comprehensive and detailed description of a student's school functioning relative to normative data.

In addition to the academic information, it is important to request information characterizing the child or adolescent's level of functioning with regard to peer, teacher, and other authority figure relationships, ability to follow directions, organizational skills, history of classroom disruption, and assignment completion.

Academic Records

In addition to ratings from teachers and other school staff, academic records are sometimes available to inform a PCC's evaluation. These records include report cards; results from reading, math, and written expression standardized tests; and other assessments of academic competencies. If a child were referred for an evaluation for special education services, his or her file is likely to contain a report on the evaluation, which can be useful during an ADHD evaluation. School records pertaining to office discipline referrals, suspensions, absences, and detentions can provide valuable information about social function and behavioral regulation. Parents often keep report cards from early grades, which can provide valuable information about age of onset for children older than 12 years. Teachers in primary grades often provide information pertaining to important information about the history of the presenting problems.

Other Community Sources

It can be helpful to obtain information not only from school professionals but also from additional sources, such as grandparents, faith-based organization group leaders, scouting leaders, sports coaches, and others. Depending on the areas in which the child or adolescent exhibits impairment, these adults may be able to provide a valuable perspective on the nature of the presenting problems, although the accuracy of their reporting has not been studied.

II f. Gather Information From the Child or Adolescent

Another source of information is from the child or adolescent. This information is often collected but carries less weight than information from other sources because of children's and adolescents' limited ability to accurately report their strengths and weaknesses, including those associated with ADHD.[169] As a result, information gathered from the child about specific ADHD behaviors may do little to inform the presence or absence of symptoms and impairments because evidence suggests that children tend to minimize their problems and blame others for concerns.[170]

Nevertheless, self-report may provide other values. First, self-report is the primary means by which one can screen for internalizing conditions such as depression and anxiety. The AAP Mental Health Initiatives[133] and the *Guidelines for Adolescent Depression in Primary Care*[171–173] recommend the use of validated diagnostic rating scales for adolescent mood and anxiety disorders for clinicians who wish to use this format.[174–178] As measures of internal mental disorders, these data are likely to be more valid than the reports of adults about their children's behaviors.

Second, youth with ADHD are prone to talk impulsively and excessively when adults show an interest in them. They may share useful information about the home or classroom that parents and teachers do not know or impart. In addition, many share their experience with risky and dangerous behaviors that may be unknown to the adults in their lives. This information can be critical in both determining a diagnosis and designing treatment.

Third, even if little information of value is obtained, the fact that the PCC takes the time to meet alone and ask questions of the child or adolescents demonstrates respect and lays the foundation for

collaboration in the decision-making and treatment process to follow. This relationship building is particularly important for adolescents.

Fourth, by gaining an understanding of the child's perspective, the PCC can anticipate the likely acceptance or resistance to treatment.

Interviewing the child or adolescent provides many important benefits beyond the possibility of informing the diagnosis and warrants its inclusion in the evaluation. For example, part of this interview includes asking the child or adolescent to identify personal goals (eg, What do you want to be when you grow up? What do you think that requires? How can we help you get there?). It is helpful when children perceive the pediatrician and other PCCs as seeking to help them achieve their goals rather than arbitrarily labeling them as deficient, defective, or needing to be fixed in some way.

II g. Clinical Observations and Physical Examination of the Child or Adolescent

The physical and neurologic examination needs to be comprehensive to determine if further medical or developmental assessments are indicated. Baseline height, weight, BP, and pulse measurements are required to be recorded in the medical record. It is important to look for behaviors that are consistent with ADHD's symptoms, including the child's level of attention, activity, and impulsivity during the encounter. Yet, ADHD is context dependent, and for this reason, behaviors and core symptoms that are seen in other settings are often not observed during an office visit.[179] Although the presence of hyperactivity and inattention during an office visit may provide supporting evidence of ADHD symptoms, their absence is not considered evidence that the child does not have ADHD.

Observations of a broad range of behaviors can be important for considering their contribution to the presenting problems and the potential diagnosis of other conditions. Careful attention to these various behaviors can provide useful information when beginning the next step involving making diagnostic decisions. For example, hearing and visual acuity problems can often lead to inattention and overactivity at school. Attending to concerns about anxiety is also important given that young children may become overactive when they are in anxiety-provoking situations like a clinic visit.

In addition, observing the child's language skills is important because difficulties with language can be a symptom of a language disorder and predictor of subsequent reading problems. This observation is particularly important with young children given that language disorders may present as problems with sustaining attention and impulsivity. A language disorder may also involve pragmatic usage or the social use of language, which can contribute to social impairment. If the PCC, family, and/or school have concerns about receptive, expressive, or pragmatic language, it is important to make a referral for a formal speech and language evaluation. Dysmorphic features also need to be noted because symptoms of ADHD are similar to characteristics of children with some prenatal exposures and genetic syndromes (eg, fetal alcohol exposure,[180,181] fragile X syndrome).

Many children with ADHD have poor coordination, which may be severe enough to warrant a diagnosis of developmental coordination disorder and referral to occupational and/or physical therapy. Findings of poor coordination can affect how well the child performs in competitive sports, a frequent source of social interactions for children, and can adversely affect the child's writing skills. Detecting any motor or verbal tics is important as well, particularly because the use of stimulant medications may cause or exacerbate tics.

Finally, it is important to evaluate the child's cardiovascular status because cardiovascular health must be considered if ADHD medication becomes an option. Cardiac illness is rare, and more evidence is required to determine if children or adolescents with ADHD are at increased risk when taking ADHD medications. Nevertheless, before initiating therapy with stimulant medications, it is important to obtain the child or adolescent's history of specific cardiac symptoms, as well as the family history of sudden death, cardiovascular symptoms, Wolff-Parkinson-White syndrome, hypertrophic cardiomyopathy, and long QT syndrome. If any of these risk factors are present, clinicians should obtain additional evaluation with an ECG and possibly consult with a pediatric cardiologist.

II h. Gather Information About Conditions That Mimic or Are Comorbid With ADHD

It is important for the PCC to obtain information about the status and history of conditions that may mimic or are comorbid with ADHD, such as depression, anxiety disorders, and posttraumatic stress disorder. Several validated rating scales are within the public domain and can help identify comorbid conditions. Examples include the Pediatric Symptom Checklist-17 as a screen for depression and anxiety[182]; the Screen for Child Anxiety Related Emotional Disorders, more specifically for anxiety disorders[176]; the Patient Health Questionnaire modified for adolescents; the Screening to Brief Intervention tool[183,184]; and the Child and Adolescent Trauma Screen for exposure to trauma.[185] All include questionnaire forms for both parents and patients.[2] The results help the PCC assess the extent to which reported impairment and/or distress are associated with ADHD versus

comorbid conditions. These conditions are described in greater detail later.

Safety and Serious Mental Illness Concerns

PCCs may be asked to complete mental health or safety assessments, particularly for adolescents. Assessment requests may come from schools or other settings after a behavioral crisis, aggressive behavior, or destructive behaviors have occurred. With patient or guardian consent, information may be shared regarding diagnosis and current treatment strategies. Pediatricians and other PCCs are encouraged to exercise caution when asked to predict the likelihood of future behaviors in the absence of detailed understanding of the environment in which the behaviors occurred. Self-injurious behaviors or threats of self-harm are serious concerns that, when possible, should immediately be referred to community mental health crisis services or experienced child mental health professionals. PCCs are encouraged to provide further monitoring of the child or adolescent with these comorbidities.

III. MAKING DIAGNOSTIC DECISIONS

After gathering all of the relevant available information, the PCC will consider an ADHD diagnosis as well as a diagnosis of other related and/or comorbid disorders. The primary decision-making process involves comparing the information obtained to the *DSM-5* criteria for ADHD. Although this assessment is straightforward, there are some issues the PCC needs to consider, including development, sex, and other disorders that may fit the presenting problems better than ADHD (see below for more on these issues).

SUPPLEMENTAL FIGURE 5
Making diagnostic decisions.

III a. DSM-5 Criteria for ADHD

The *DSM-5* criteria define 4 dimensions of ADHD:

1. ADHD/I (314.00 [F90.0]);
2. ADHD/HI (314.01 [F90.1]);
3. ADHD/C (314.01 [F90.2]); and
4. ADHD other specified and unspecified ADHD (314.01 [F90.8]).

To make a diagnosis of ADHD, the PCC needs to establish that 6 or more (5 or more if the adolescent is 17 years or older) core symptoms are present in either or both of the inattention dimension and/or the hyperactivity-impulsivity dimension and occur inappropriately often. The core symptoms and dimensions are presented in Supplemental Table 2.

- ADHD/I: having at least 6 of 9 inattention behaviors and less than 6 hyperactive-impulsive behaviors;
- ADHD/HI: having at least 6 of 9 hyperactive-impulsive behaviors and less than 6 inattention behaviors;
- ADHD/C: having at least 6 of 9 behaviors in both the inattention and hyperactive-impulsive dimensions; and
- ADHD other specified and unspecified ADHD: These categories are meant for children who meet many of the criteria for ADHD, but not the full criteria, and who have significant impairment. "ADHD other specified" is used if the PCC specifies those criteria that have not been met; "unspecified ADHD" is used if the PCC does not specify these criteria.

In school-aged children and adolescents, diagnostic criteria for ADHD include documentation of the following criteria:

- At least 6 of the 9 behaviors described in the inattentive domain occur often, and to a degree, that is inconsistent with the child's developmental age. (For adolescents 17 years and older, documentation of at least 5 of the 9 behaviors is required.)
- At least 6 of the 9 behaviors described in the hyperactive-impulsive domain occur often, and to a degree, that is inconsistent with the child's developmental age. (For adolescents 17 years and older, documentation of at least 5 of the 9 behaviors is required.)
- Several inattentive or hyperactive-impulsive symptoms were present before age 12 years.
- There is clear evidence that the child's symptoms interfere with or reduce the quality of his or her social, academic, and/or occupational functioning.
- The symptoms have persisted for at least 6 months.
- The symptoms are not attributable to another physical, situational, or mental health condition.

Clear evidence exists that these criteria are appropriate for preschool-aged children (ie, age 4 years to the sixth birthday), elementary and middle school-aged children (ie, age 6 years to the 12th birthday), and adolescents (ie, age 12 years to the 18th birthday).[30,31] *DSM-5* criteria have also been updated to better describe how inattentive and hyperactive-impulsive symptoms present in older adolescents and adults.

DSM-5 criteria require evidence of symptoms before age 12 years. In some cases, however, parents and teachers may not recognize ADHD symptoms until the child is older than 12 years, when school tasks and

responsibilities become more challenging and exceed the child's ability to perform effectively in school. For these children, history can often identify an earlier age of onset of some ADHD symptoms. Delayed recognition may also be seen more often in ADHD/I, which is more commonly diagnosed in girls.

If symptoms arise suddenly without previous history, the PCC needs to consider other conditions, including mood or anxiety disorders, substance use, head trauma, physical or sexual abuse, neurodegenerative disorders, sleep disorders (including sleep apnea), or a major psychological stress in the family or school (such as bullying). In adolescents and young adults, PCCs are encouraged to consider the potential for false reporting and misrepresentation of symptoms to obtain medications for other than appropriate medicinal use (ie, diversion, secondary gain). The majority of states now require prescriber participation in prescription drug monitoring programs, which can be helpful in identifying and preventing diversion activities. Pediatricians and other PCCs may consider prescribing nonstimulant medications that minimize abuse potential, such as atomoxetine and extended-release guanfacine or extended-release clonidine.

In the absence of other concerns and findings on prenatal or medical history, further diagnostic testing will not help to reach an ADHD diagnosis. Compared to clinical interviews, standardized psychological tests, such as computerized attention tests, have not been found to reliably differentiate between youth with and without ADHD.[187,188] Appropriate further assessment is indicated if an underlying etiology is suspected. Imaging studies or screening for high lead levels and abnormal thyroid hormone levels can be pursued if they are suggested by other historic or physical information, such as history or symptoms of a tumor or significant brain injury. When children experience trauma, their evaluation needs to include the consideration of both the trauma and ADHD because they can co-occur and can exacerbate ADHD symptoms. Toxic stress has shown to be associated with the incidence of pediatric ADHD, but the conclusion that ADHD is a manifestation of this stress has not been demonstrated.[188]

Patients with ADHD commonly have comorbid conditions, such as oppositional defiant disorder, anxiety, depression, and language and learning disabilities. These conditions may present with ADHD symptoms and need evaluation because their treatment may relieve symptoms. Additionally, some conditions may present with ADHD symptoms and respond to treatment of the primary condition, such as sleep disorders, absence seizures, and hyperthyroidism. (Comorbid conditions are discussed later in this document.)

In addition, the behavioral characteristics specified in the *DSM-5* remain subjective and may be interpreted differently by various observers. Rates of ADHD and its treatment have been found to be different for different racial and/or ethnic groups.[50,189] Cultural norms and the expectations of parents or teachers may influence reporting of symptoms. Hence, the clinician benefits from being sensitive to cultural differences about the appropriateness of behaviors and perceptions of mental health conditions.[145,155]

After the diagnostic evaluation, a PCC will be able to answer the following questions:

- How many inattentive and hyperactive/impulsive behavior criteria for ADHD does the child or adolescent manifest across major settings of his or her life?
- Have these criteria been present for 6 months or longer?
- Was the onset of these or similar behaviors present before the child's 12th birthday?
- What functional impairments are caused by these behaviors?
- Could any other condition be a better explanation for the behaviors?
- Is there evidence of comorbid problems or disorders?

On the basis of this information, the clinician is usually able to arrive at a preliminary diagnosis of whether the child or adolescents has ADHD or not. (For children and adolescents who do not receive an ADHD diagnosis, see below.)

III b. Developmental Considerations

Considerations About the Child or Adolescent's Age

Although the diagnostic criteria for ADHD are the same for children up to age 17 years, developmental considerations affect the interpretation of whether a symptom is present. Before school age, the primary set of distinguishing symptoms involve hyperactivity, although this can be difficult to identify as outside of the normal range given the large variability in this young age group. Similarly, difficulties sustaining attention are difficult to determine with young children because of considerable variability in presentation and the limited demands for children in this age group to sustain attention over time. (See below for more information on developmental delays.)

Some children demonstrate hyperactivity and inattention that are clearly beyond the normal range. They may experience substantial impairment to an extent that baby-sitters or child care agencies refuse to care for them, parents are unable to take them shopping or to restaurants, or they routinely engage in dangerous or risky behaviors. In these extreme cases, the PCC may be able to make

the decision for an ADHD diagnosis more quickly than other scenarios that require a thorough assessment. For other young children, the diagnosis will be less obvious, and developmental and environmental issues may lead the PCC to be cautious in making an ADHD diagnosis. In these situations, monitoring for the emergence or clarification of ADHD symptoms and/or providing a diagnosis of other specified *ADHD* or unspecified *ADHD* are appropriate options.

Adolescence is another developmental period when developmental considerations are warranted. Beginning at age 17 years, there are only 5 symptoms of inattention and/or 5 symptoms of hyperactivity/impulsivity required for an ADHD diagnosis. Hyperactivity typically diminishes for most children during adolescence, but problems associated with impulsivity can be dangerous and can include impaired driving, substance use, risky sexual behavior, and suicide. Disorganization of time and resources can be associated with substantial academic problems at school. Parent-child conflict and disengagement from school can provide a context that contributes toward poor long-term outcomes. Comorbid depression and conduct disorder are common but do not negate the importance of diagnosing ADHD when the developmental path warrants it and the ADHD symptoms exacerbate problems associated with the comorbid conditions.

Adolescence is the first developmental period for which age of onset of symptoms must be documented before 12 years. School records and parent reports are often the richest source for making this determination. It is important to try to identify adolescents (or their parents) who are pursuing a diagnosis of ADHD for secondary gains such as school accommodations, standardized testing accommodations, and/or stimulant prescriptions. In addition, impairment sometimes emerges when expectations for the adolescent markedly increase or when accommodations are removed. The teenager's level of functioning may stay the same, but when faced with the expectations of advanced placement courses or a part-time job, failure to keep pace with increasing expectations may lead to concerns that warrant an evaluation for ADHD. These examples emphasize the importance of determining an early age of onset.

Considerations About the Child or Adolescent's Sex

ADHD is diagnosed in boys about twice as often as it is diagnosed in girls. There are many hypotheses about reasons for this difference; the primary reason appears to simply be that the disorder is more common in boys than girls. Some have raised concerns that the difference may be attributable to variances in society's expectations for boys versus girls or underdiagnosis in girls, but these reasons are unlikely to account for the large difference in diagnoses. Hence, no adjustment is needed in terms of the standards for girls to meet the criteria for an ADHD diagnosis compared with boys.

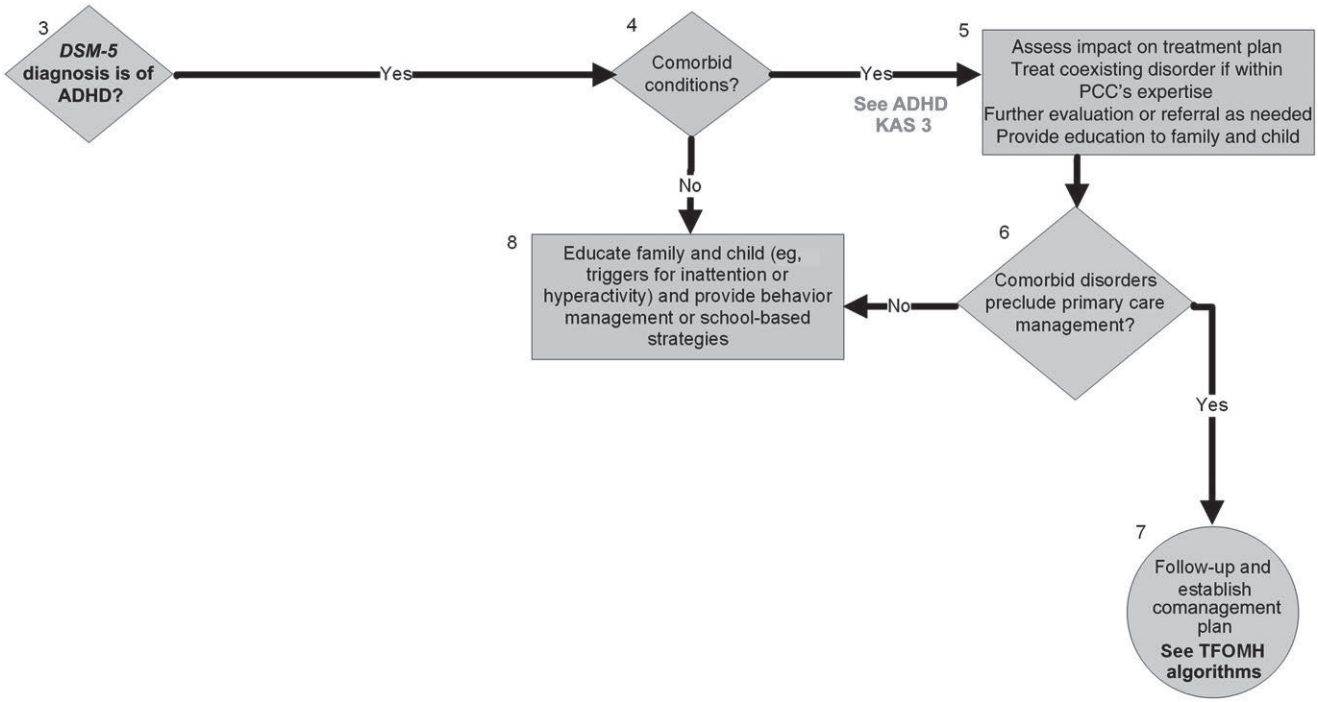
Girls are less likely to exhibit hyperactivity symptoms, which are the most easily observable of all ADHD symptoms, particularly in younger patients. This fact may account for a portion of the difference in diagnosis between girls and boys. As a result, it is important to fully consider a diagnosis of ADHD, predominantly inattentive presentation, when evaluating girls.

Symptoms of inattention alone can complicate the diagnosis because inattention is 1 of the most common symptoms across all disorders in the *DSM-5*. After puberty, it is more common for depression and anxiety to be diagnosed in girls than in boys, and symptoms of inattention may be a result of these disorders as well as ADHD. Examining the age of onset and considering other distinguishing features, such as avoidance and anhedonia, can help the PCC clarify this challenging differential when evaluating girls for ADHD. For example, does the inattention occur primarily in anxiety-provoking situations or when the child or adolescent is experiencing periods of low mood and then remit when the anxiety or mood improves?

III c. Consideration of Comorbid Conditions

If other disorders are suspected or detected during the diagnostic evaluation, an assessment of the urgency of these conditions and their impact on the ADHD treatment plan should be made. Comorbid conditions provide unique challenges for treatment planning. Urgent conditions need to be addressed immediately with services capable of handling crisis situations. These conditions include suicidal thoughts or acts and other behaviors with the potential to severely injure the child, adolescent, and/or other people, including severe temper outbursts or child abuse. Note that adolescents are potentially more likely to provide honest answers if the PCC asks sensitive questions in the absence of the parents and may respond more readily to rating scales that assess mood or anxiety. In addition, substance use disorders require immediate attention and may precede or coincide with beginning treatment of ADHD. Additional information is available in the complex ADHD guideline published by the SDBP.[67]

Evidence shows that comorbid conditions may improve with treatment of ADHD, including oppositional behaviors and anxiety.[140] For example, children with ADHD and comorbid anxiety disorders may find that addressing the ADHD symptoms with



SUPPLEMENTAL FIGURE 6
Consideration of comorbid conditions. TFOMH, Task Force on Mental Health.

medications also decreases anxiety or mood symptoms. Other children may require additional therapeutic treatments to treat the ADHD adequately and treat comorbid conditions, including cognitive behavioral therapy (CBT), academic interventions, or different and/or additional medications.

The PCC may evaluate and treat the comorbid disorder if it is within his or her training and expertise. In addition, the PCC can provide education to the family and child or adolescent about triggers for inattention and/or hyperactivity. If the PCC requires the advice of a subspecialist, the clinician is encouraged to consider carefully when to initiate treatment of ADHD. In some cases, it may be advisable to delay the start of medication until the role of each member of the treatment team is established (see below). Integrated care models can be helpful (see www.integratedcareforkids.org).

The following are brief discussions of sleep disorders, psychiatric disorders, emotion dysregulation, exposure to trauma, and learning disabilities, all of which can manifest in manners similar to ADHD and can complicate making a diagnosis.

(See the ADHD guideline's KAS 3.)

Sleep Disorders

Sleepiness impairs most people's ability to sustain attention and often leads to caffeine consumption to counter these effects. In the same way, sleep disturbance can lead to symptoms and impairment that mimic or exacerbate ADHD symptoms. A child with ADHD may have difficulty falling asleep because of the busy thoughts caused by ADHD. Some sleep disorders are frequently associated with ADHD or present as symptoms of inattention, hyperactivity, and impulsivity, such as obstructive sleep apnea syndrome and restless legs syndrome and/or periodic limb movement disorder (RLS/PLMD).[190–193]

The differential diagnosis of insomnia in children and adolescents with ADHD includes the following:

- inadequate sleep hygiene (eg, inconsistent bedtimes and wake times, absence of a bedtime routine, electronics in the bedroom, caffeine use)[194];
- ADHD medication (stimulant and nonstimulant) effects:
  - o direct effects on sleep architecture: prolonged sleep onset, latency, and decreased sleep duration, increased night wakings[195–197]; and
  - o indirect effects: inadequate control of ADHD symptoms in the evening and medication withdrawal or rebound symptoms[198,199];
- sleep problems associated with comorbid psychiatric conditions (eg, anxiety and mood disorders, disruptive behavior disorders)[200];
- circadian-based phase delay in sleep-wake patterns, which have been shown to occur in some children with ADHD, resulting in both prolonged sleep onset and difficulty waking in the morning[201]; and

- intrinsic deficit associated with ADHD. Authors of numerous studies have reported that nonmedicated children with ADHD without comorbid mood or anxiety disorders have significantly greater bedtime resistance, more sleep onset difficulties, and more frequent night awakenings when compared with typically developing children in control groups.[202] In addition, some children with ADHD appear to have evidence of increased daytime sleepiness, even in the absence of a primary sleep disorder.[202–204]

For this reason, all children and adolescents who are evaluated for ADHD need to be systematically screened for symptoms of primary sleep disorders, such as frequent snoring, observed breathing pauses, restless sleep, urge to move one's legs at night, and excessive daytime sleepiness. (Issues of access to these services are discussed in the accompanying section, Systemic Barriers to the Care of Children and Adolescents with ADHD.) In addition, screenings generally include primary sleep disorders' risk factors, such as adenotonsillar hypertrophy, asthma and allergies, obesity, a family history of RLS/PLMD, and iron deficiency.[199] Sleep assessment measures that have been shown to be useful in the pediatric primary care practice setting include brief screening tools[205] and parent-report surveys.[206,207] Overnight polysomnography is generally required for children who have symptoms suggestive of and/or risk factors for obstructive sleep apnea syndrome and RLS/PLMD.[208,209]

If the results suggest the presence of a sleep disorder, the PCC needs to obtain a comprehensive sleep history, including assessment of the environment in which the child sleeps; the cohabitants in the room; the bedtime routine, including its initiation, how long it takes for the child fall asleep, sleep duration, and any night-time awakenings; and what time the child wakes up in the morning and his or her state when awakening. It is important to determine sleep interventions attempted and their results. Even when no primary sleep disorders occur, modest reductions in sleep duration or increases in sleep disruption may be associated with increased, detectable problems with attention in children and adolescents with ADHD.[210] Although fully disentangling sleep disruption from ADHD may not be possible because significant sleep problems and their associated impairment are often comorbid with ADHD, sleep disruptions often warrant consideration as an additional target for treatment. In addition, some children with ADHD appear to show evidence of increased daytime sleepiness, even in the absence of a primary sleep disorder.[203,204] Significant sleep problems and their associated impairment are often comorbid with ADHD and, for many children, are considered as an additional target for treatment.

A variety of issues need to be considered when determining if sleep problems constitute an additional diagnosis of insomnia disorder or are linked to ADHD-related treatment issues. First, a child's sleep can be affected if he or she is already taking stimulant medication or regularly consuming caffeine. The dosage and timing of this consumption needs to be tracked and manipulated to examine its effects; simple modifications of timing and dosage of stimulant consumption can improve sleep onset, duration, and quality. Second, sleep problems can occur from inadequate sleep health and/or hygiene[194] or from other disorders, such as anxiety and mood disorders, when the rumination and worry associated with them impairs or disrupts the child's sleep. Restructuring behavior preceding and at bedtime can dramatically improve sleep and diminish associated impairments. These potential causes of sleep disturbance and the related impairments that mimic or exacerbate ADHD symptoms need to be considered before diagnosing ADHD, related problems, or insomnia disorder.

Trauma

Children with ADHD are at higher-than-normal risk of experiencing some forms of trauma, including corporal punishment and accidents (often because of their risk-taking behaviors). In addition, posttraumatic stress disorder may manifest some similar symptoms. Depending on the child, the trauma may have been a one-time event or one to which they are consistently exposed. Exposure to trauma may exacerbate or lead to symptoms shared by trauma disorders and ADHD (eg, inattention). As a result, when evaluating a child for ADHD, obtaining a brief trauma history and screening for indicators of impairing responses to trauma can be helpful. Although a trauma history does not inform the diagnosis of ADHD, it may identify an alternative diagnosis and inform treatment and other interventions, including referral for trauma-focused therapy and reporting suspected abuse.

Mental Health Conditions

In children or adolescents who have coexisting mild depression, anxiety, or obsessive-compulsive disorder, the PCC may undertake the treatment of all disorders if doing so is within his or her abilities. Another option is to collaborate with a mental health clinician to treat the coexisting condition while the PCC oversees the ADHD treatment. As a third option, the consulting specialists may advise about the treatment of the coexisting condition to the extent that the PCC is comfortable treating both ADHD and the coexisting problems. With some coexisting psychiatric disorders, such as severe anxiety, depression, autism, schizophrenia, obsessive-compulsive

disorder, oppositional defiant disorder, conduct disorder, and bipolar disorder, a comanaging developmental-behavioral pediatrician or child and adolescent psychiatrist might take responsibility for treatment of both ADHD and the coexisting illness.

Many children with ADHD exhibit emotion dysregulation, which is considered to be a common feature of the disorder and one that is potentially related to other executive functioning deficits.[211] A child exhibiting emotion dysregulation with either or both positive (eg, exuberance) or negative (eg, anger) emotions along with symptoms of ADHD can be considered as a good candidate for an ADHD diagnosis. Sometimes behavior related to emotion dysregulation can lead the PCC to consider other diagnoses such as disruptive mood dysregulation disorder, intermittent explosive disorder, and bipolar disorder. All 3 may be diagnosed with ADHD. Intermittent explosive disorder and bipolar disorder are rare in children, and data are currently inadequate to know the prevalence of disruptive mood dysregulation disorder. Given the base rates, these other diagnoses are unlikely, although they do occur in childhood. If the PCC has any uncertainty about making these distinctions, referring the child to a clinical child psychologist or child mental health professionals may be warranted.

Learning Disabilities

Learning disabilities frequently co-occur with ADHD and can lead to symptoms and impairment that are similar to those in children with ADHD. As a result, screening for learning disabilities' presence, such as via the Vanderbilt ADHD Rating Scale,[212] is important given that treatment of ADHD and learning disabilities differ markedly.

Learning disabilities involve impairment related to learning specific academic content, usually reading or math, although there is increased awareness about disorders of written expression. The impairment is not attributable to difficulties with sustaining attention; however, some children with learning disabilities have trouble sustaining attention in class because they cannot keep up and then disengage. A careful evaluation for learning disabilities includes achievement testing, cognitive ability testing, and measures of the child's learning in response to evidence-based instruction. Such thorough evaluations are typically not available in a PCC practice. If screening suggests the possibility of learning disabilities, the PCC can help advise parents on how to obtain school psychoeducational evaluations or refer the child to a psychologist or other specialist trained in conducting these evaluations.

The PCC's attention is directed to language skills in preschool-aged and young school-aged children because difficulties in language skills can be a symptom of a language disorder and predictor of subsequent reading problems. Language disorders may present as problems with attention and impulsivity. Likewise, social interactions need to be noted during the examination because they may be impaired when the child or adolescent's language skills are delayed or disordered.

Children who have intellectual or other developmental disabilities may have ADHD, but assessment of these patients is more difficult because a diagnosis of ADHD would only be appropriate if the child or adolescent's level of inattention or hyperactivity/impulsivity is disproportionate to his or her developmental rather than chronological age. Therefore, assessment of ADHD in individuals with intellectual disabilities requires input from the child or adolescent's education specialists, school psychologists, and/or independent psychologists. Although it is important to attempt to differentiate whether the presenting problems are associated with learning disabilities, ADHD, or something else, it is important to consider the possibility that a child has multiple disorders. Pediatricians and other PCCs who are involved in assessing ADHD in children with intellectual disabilities will need to collaborate closely with school or independent psychologists.

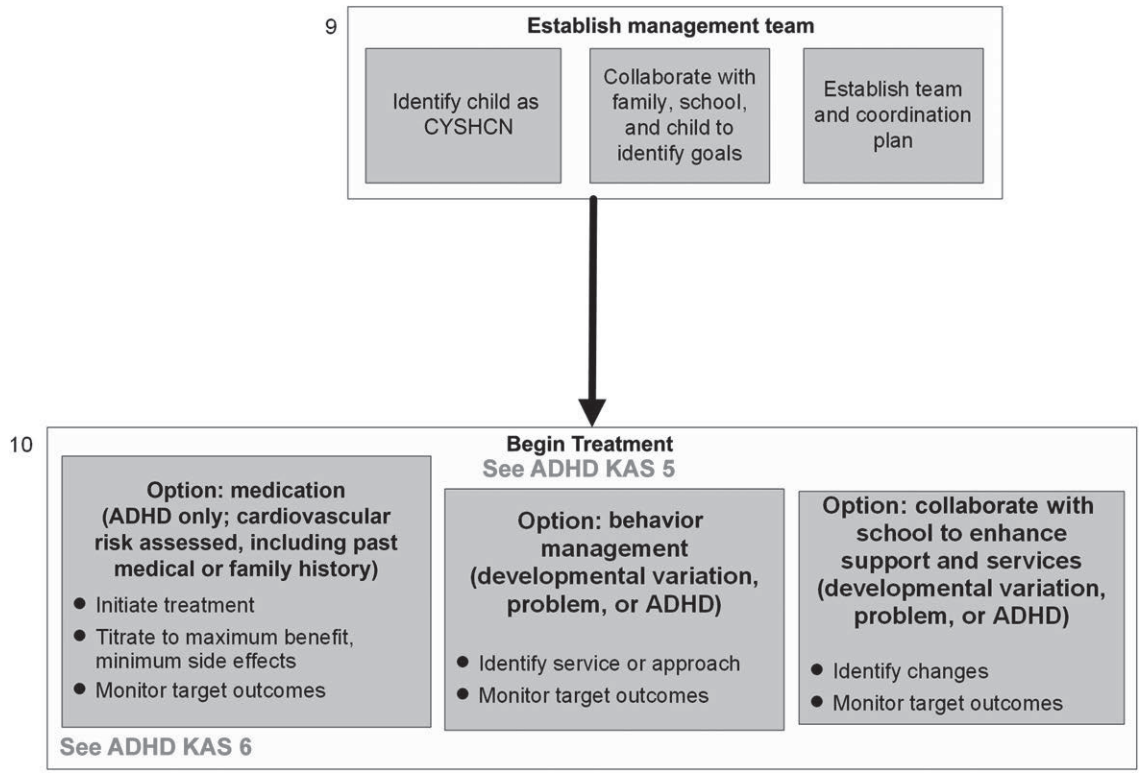
Summary

Overall, there are many factors that influence a diagnostic decision. Frequently, these decisions must be made without the benefit of all of the relevant information described. Family and cultural issues that affect parents' expectations for their child and perceptions about mental health can further complicate this process. Poverty, family history, access to care, and many other factors that a PCC will probably not know when making the diagnosis can also be formative in the child's presenting problems.[145,146,154,155,158] The PCC will wisely remain sensitive to individual variations in parents' beliefs, values, and perception of their culture and community when completing the assessment and determining a diagnosis. These factors add complexities to the assessment and diagnostic process and make a good evaluation and diagnosis a function of clinical experience, judgment, and a foundation in science.

IV. TREATMENT

If the child meets the *DSM-5* criteria for ADHD, including commensurate functional disabilities, progress through the PoCA.

(See the AHDH guideline's KASs 5 and 6.)



SUPPLEMENTAL FIGURE 7
Treatment. CYSHCN, children and youth with special health care needs.

IV a. Establish Management Team: Identify the Patient as a Child With Special Health Care Needs

Any child who meets the criteria for ADHD is considered a "child or youth with special health care needs"; these children are best managed in a medical home.[213–217] In addition, the AAP encourages clinicians to develop systems to allow the medical home to meet all needs of children with chronic illnesses. These needs and strategies for meeting them are discussed in further detail in AAP resources such as the Building Your Medical Home toolkit and Addressing Concerns in Primary Care: A Clinician's Toolkit. Care in the medical home is reviewed in the AAP publication *Bright Futures: Guidelines for Health Supervision of Infants, Children, and Adolescents, Fourth Edition*. Pediatricians and other PCCs who provide effective medical homes identify family strengths and recognize the importance of parents in the care team.[218–221] The PCC may provide education about the disorder and treatment options, medication, and/or psychosocial treatment and monitor response to treatments over time as well as the child's development.

IV b. Establish Management Team: Collaborate With Family, School, and Child to Identify Target Goals

ADHD is a chronic illness; hence, education for both the child or adolescent and other family members is a critical element in the care plan. Family education involves all members of the family, including the provision of developmentally age-appropriate information for the affected child or adolescent and any siblings. Topics may include the disorder's potential causes and typical symptoms, the assessment process; common coexisting disorders; ADHD's effect on school performance and social participation; long-term sequelae; and treatment options and their potential benefits, adverse effects, and long-term outcomes. It is important to address the patient's self-concept and clarify that having ADHD does not mean that the child is less smart than others. At every stage, education must continue in a manner consistent with the child or adolescent's level of understanding.

The emphasis for parental education is on helping parents understand the disorder, how to obtain additional accurate information about ADHD and treatments, and how to effectively advocate for their child. This may include addressing parental concerns about labeling the child or adolescent with a disorder by providing information

on the benefits of diagnosis and treatment.

Some guidance about effective parenting strategies may be helpful, but PTBM is likely to be most beneficial for most parents (see the section on Psychosocial Treatments). Pediatricians and other PCCs are encouraged to be cognizant of the challenges families may face to attend such training, including taking time off from work and covering the costs associated with the intervention.

Parents may benefit from learning about optimal ways to partner with schools, particularly their child's teachers, and become part of the educational and intervention teams. Educating parents about special education and other services can be helpful, but school interventions and advocacy may be best aided by partnering closely with an advocate or clinician experienced in working with schools (see the Psychosocial Treatment section). With the parent's permission, the clinician may provide educators at the school with information from the evaluation that will help the school determine eligibility for special education services or accommodations and/or develop appropriate services.

In addition, it is helpful to provide assistance to the parent or other caregiver in understanding and using any relevant electronic health record (EHR) system. Sometimes, the health literacy gap around EHRs can lead to confusion and frustration on the family's side. Also, providing information on community resources, such as other health care providers or specialists, can be beneficial in addressing fragmentation and communication barriers.

Family education continues throughout the course of treatment and includes anticipatory guidance in areas such as transitions (eg, from elementary to middle school, middle to high school, and high school to college or employment); working with schools; and developmental challenges that may be affected by ADHD, including driving, sexual activity, and substance use and abuse. For parents who are interested in understanding the developmental aspects of children's understanding about ADHD (ie, causes, manifestations, treatments), several AAP publications may be useful.[222–224]

Although having a child diagnosed with ADHD can sometimes provide relief for families, it is important to check on the parents' well-being. Having a disruptive child who has trouble interacting with others can be stressful for parents, and learning that their child has a disorder sometimes gives them something to blame other than themselves. Helping families cope with parenting challenges or making referrals for services to address their stress or depression can be an important part of care. These concerns are particularly relevant when a parent has ADHD or associated conditions. Parents may require support balancing the needs of their child with ADHD and their other children's needs. Advocacy and support groups such as the National Resource on ADHD (a program of CHADD: https://chadd.org/about/about-nrc/) and the Attention Deficit Disorder Association (www.add.org) can provide information and support for families. There also may be local support organizations. The ADHD Toolkit provides lists of educational resources including Internet-based resources, organizations, and books that may be useful to parents and children.

IV c. Establish Management Team: Establish Team and Coordination Plan

Treatment Team

The optimal treatment team includes everyone involved in the care of the child: the child, parents, teachers, PCC, therapists, subspecialists, and other adults (such as coaches or faith leaders) who will be actively engaged in supporting and monitoring the treatment of ADHD.[218–221] It is helpful for the PCC or another assigned care coordinator to make each team member aware of his or her role, the process and timing of routine and as-needed communication strategies, and expectations for reports (ie, frequency, scope). Collaboration with school personnel goes beyond the initial report of diagnosis and is best facilitated by agreement on a standardized, reliable communication system. Although there are obstacles to achieving this level of coordination, if successful, it enhances care and improves outcomes for the child. (See Systemic Barriers to the Care of Children and Adolescents With ADHD section in the Supplemental Information for a discussion of systemic challenges.)

Treatment Goals

Management plans include the establishment of treatment goals for the areas of concern, such as those most commonly affected by ADHD: academic performance; relationships with peers, parents, and siblings; and safety. It is not necessary to develop goals in every area at once. Families might be encouraged to identify up to 3 of the most impairing areas to address initially. Parents and the child or adolescent can add other targets as indicated by their relative importance. Other goals may be identified using the International Classification of Function, Disability, and Health analysis conducted in the diagnostic phase of the clinical pathway. This process increases the understanding of ADHD's effects on each family member and may lead to improved collaboration in developing a few specific and measurable outcomes. It is helpful to incorporate a child's strengths and resilience when considering target goals and generating the treatment plan. Academic or school goals require the input of teachers and other personnel

for both identification and measurement.

Establishing measurable goals in interpersonal domains and improving behavior in unstructured settings may be particularly important. Wherever possible, progress should be quantifiable to monitor the frequency of behaviors. The number of achieved and missed goals per day can be recorded by the parent, child, and/or teacher. Charts may be suggested as strategies to record events so that parents, teachers, children, and PCCs can agree on how much progress has been made building success in a systematic and measurable way. Keeping the focus on progress toward the identified goals can keep all family members engaged, provide a rubric for measuring response to various treatments, and offer a vehicle for rewarding success. Such strategies can help a family accurately assess and see progress of behavior changes. A single-page daily report card can be used to identify and monitor 4 or 5 behaviors that affect function at school and the card can be shared with parents. Other strategies and tools are available to clinicians in the AAP *ADHD Provider Toolkit, Third Edition*,[225] and for parents, *ADHD: What Every Parent Needs to Know.*[226]

As treatment proceeds, in addition to using a *DSM-5*–based ADHD rating scale to monitor core symptom changes, formal and informal queries can be made in the areas affected by ADHD. At every visit, it is helpful for the PCC to gradually further empower children and adolescents so they are able to be full partners in the treatment plan by adolescence. Data from school are helpful at these visits, including rating scales completed by the child or adolescent's teacher, grades, daily behavior ratings (when available), and formal test results.

Management Plan

In addition to educating the family, the PCC can consider developing a management plan that, over time, addresses the following questions:

- Does the family need further assistance in understanding the core symptoms of ADHD and the child or adolescent's target symptoms and coexisting conditions?
- Does the family need support in learning how to establish, measure, and monitor target goals?
- Have the family's goals been identified and addressed in the care plan?
- Does the family have an understanding of effective behavior management techniques for responding to tantrums, oppositional behavior, and/or poor compliance with requests or commands?
- Does the family need help on normalizing peer and family relationships?
- Does the child need help in academic areas? If so, has a formal evaluation been performed and reviewed to distinguish work production problems secondary to ADHD or attributable to coexisting learning or language disabilities?
- Does the child or adolescent need assistance in achieving independence in self-help or schoolwork?
- Does the child or adolescent or family require help with optimizing, organizing, planning, or managing schoolwork?
- Does the family need help in recognizing, understanding, or managing coexisting conditions?
- Does the family have a plan to educate the child or adolescent systematically about ADHD and its treatment, as well as the child's own strengths and weaknesses?
- Does the family have a plan to empower the child or adolescent with the knowledge and understanding that will increase their adherence to treatments? Has that plan been initiated, and is it pitched at the child or adolescent's developmental level?
- Does the family have a copy of a care plan that summarizes the evaluation findings and treatment recommendations?
- Does the follow-up plan provide comprehensive, coordinated, family-centered, and culturally competent ongoing care?
- Does the family have any needed referrals to specialists to provide additional evaluations, treatments, and support?
- Does the family have a plan for the transition from pediatric to adult care that provides the transitioning youth with the necessary ADHD self-management skills, understanding of health care and educational privacy laws, identified adult clinician to continue his or her ADHD care, and health insurance coverage?

IV d. Treatment: Medication, Psychosocial Treatment, and Collaboration With the School to Enhance Support Services

The decision about the most acceptable treatment of the child rests with the family and its decisions about treatment. The PCC needs to encourage that this decision is based on accurate and adequate information, which often involves correcting misinformation or unwarranted concerns about medication. If the family still declines medication treatment, the PCC can encourage all other types of effective treatment and provide appropriate monitoring (families who decline medication are discussed in more detail below).

Pediatricians and other PCCs need to educate families about the benefits and characteristics of evidence-based ADHD psychosocial treatment and explicitly communicate that play therapy and sensory-related therapies have not been

demonstrated to be effective. Likewise, for children younger than 7 years, individual CBT lacks demonstrated effectiveness; CBT has some, but not strong, evidence for children 7 to 17 years of age. Families should be made aware that for psychosocial treatments to be effective, the therapist needs to work with the family (not just the child or adolescent) on setting and maintaining routines, discipline and reward-related procedures, training programs, and creating a home environment that will bring out the best in the child and minimize ADHD-related dysfunction.

(See the ADHD guideline KASs 5 and 6.)

Treatment: Medication

This treatment option is restricted to children and adolescents who meet diagnostic criteria for ADHD.

The FDA has approved stimulant medications (ie, methylphenidate and amphetamines) and several nonstimulant medications for the treatment of ADHD in children and adolescents. New brands of methylphenidate and amphetamines continue to be introduced, including longer-acting products, various isomeric products, and delayed-release products. Hence, it is increasingly unlikely that pediatricians and other PCCs need to consider the off-label use of other medications. A free and continually updated list of medications is available at www.adhdmedicationguide.com. (See the ADHD guideline for information on off-label use.)

With the expanded choices and considerations of the clinical effects comes the reality that clinical choices are often heavily restricted by insurance coverage. Some, but not all, of the problems include changes in insurance and formulary that preclude the use of certain medications or force a stable patient to change medications, step therapy requirements that may delay effective treatment, and financial barriers that preclude a patient's use of newer drugs or those not preferred by the payer. (See Systemic Barriers to the Care of Children and Adolescents with ADHD section in the Supplemental Information for a discussion of this issue.)

The choice of stimulant medication formulation depends on such factors as the efficacy of each agent for a given child, the preferred length of coverage, whether a child can swallow pills or capsules, and out-of-pocket costs. The extended-release formulations are generally more expensive than the immediate-release formulations. Families and children may prefer them, however, because of the benefits of consistent and sustained coverage with fewer daily administrations. Long-acting formulations usually avoid the need for school-based administration of ADHD medication. Better coverage with fewer daily administrations leads to greater convenience to the family and is linked with increased adherence to the medication management plan.[227]

Some patients, particularly adolescents, may require more than 12 hours of coverage daily to ensure adequate focus and concentration during the evening, when they are more likely to be studying and/or driving. In these cases, a nonstimulant medication or short-acting preparation of stimulant medication may be used in the evening in addition to a long-acting preparation in the morning. Of note, stimulant medication treatment of individuals with ADHD has been linked to better driving performance and a significant reduced risk of motor vehicle crashes.[78]

The ease with which preparations can be administered and the minimization of adverse effects are key quality-of-life factors and are important concerns for children, adolescents, and their parents. When making medication recommendations, PCCs have to consider the time of day when the targeted symptoms occur, when homework is usually done, whether medication remains active when teenagers are driving, whether medication alters sleep initiation, and risk status for substance use or stimulant misuse or diversion.

All FDA-approved stimulant medications are methylphenidate or amphetamine compounds and have similar desired and adverse effects. Given the extensive evidence of efficacy and safety, these drugs remain the first choice in medication treatment. The decision about what compound a PCC prescribes first should be made on the basis of individual clinician and family preferences and the child's age. Some children will respond better to, or experience more adverse effects with, 1 of the 2 stimulants groups (ie, methylphenidate or amphetamine) over another. Because this cannot be determined in advance, medication trials are appropriate. If a trial with 1 group is unsuccessful because of poor efficacy or significant adverse effects, a medication trial with medication from the other group should be undertaken. At least half of children who fail to respond to 1 stimulant medication have a positive response to the alternative medication.[228]

Of note, recent meta-analyses have documented some subtle group-level differences in amphetamine and/or dextroamphetamine and methylphenidate response. Authors of 1 such analysis found that, on average, youth with ADHD who were treated with either amphetamine- or methylphenidate-based medications showed improvement in ADHD symptoms.[229] There was a marginally larger improvement in clinicians' ADHD symptom ratings for amphetamine-based versus methylphenidate-based

preparations.[229] This meta-analysis indicated that overall adverse effects (including sleep problems and emotional side effects) were more prominent among those using amphetamine-based preparations. The findings were corroborated by a 2018 meta-analysis in which authors found that amphetamine and/or dextroamphetamine worsened emotional lability compared to the premedication baseline. Authors of the meta-analysis found there was a tendency for methylphenidate to reduce irritability and anxiety compared to the patients' premedication ratings.[230] Among individual patients, medication's efficacy and adverse effects can vary from these averages.

Families who are concerned about the use of stimulants or the potential for their abuse and/or diversion may choose to start with atomoxetine, extended-release guanfacine, or extended-release clonidine. In addition, those not responding to either stimulant group may still respond to atomoxetine, extended-release guanfacine, or extended-release clonidine.

There is a black box warning on atomoxetine about the possibility of suicidal ideation when initiating medication management. Early symptoms of suicidal ideation may include thinking about self-harm and increasing agitation. If there are any concerns about suicidal ideation in children prescribed atomoxetine, further evaluation (ie, using the Patient Health Questionnaire-9 rating scale, asking about suicidal ideation, reviewing presence of firearms in the home, determining if there is good communication between the patient and parents or trusted adults, etc), reconsideration about the use of atomoxetine, and more frequent monitoring should be considered; referral to a mental health clinician may be necessary.

Atomoxetine is a selective norepinephrine reuptake inhibitor that may demonstrate maximum response after approximately 4 to 6 weeks of use, although some patients experience modest benefits after 1 week of atomoxetine treatment. Extended-release guanfacine and extended-release clonidine are α-2A adrenergic agonists that may demonstrate maximum response in about 2 to 4 weeks. It is worth making families aware that symptom change is more gradual with atomoxetine and α-2A adrenergic agonists than the rapid effect seen with stimulant medications. Atomoxetine may cause gastrointestinal tract symptoms and sedation early on, so it is recommended to prescribe half the treatment dose (0.5 mg/kg) for the first week. Appetite suppression can also occur. Both α-2A agonists can cause the adverse effect of somnolence. It is recommended that α-2A agonists be tapered when discontinued to prevent possible rebound hypertension.

In patients who only respond partially to stimulant medications, it is possible to combine stimulant and nonstimulant α-2 agonist medications to obtain better efficacy (see Medication for ADHD section in the clinical practice guideline). It is helpful to ask the family if they have any previous experience with any of the medications because a previous good or bad experience in other family members may indicate a willingness or reluctance to use 1 type or a specific stimulant medication. When there is concern about possible use or diversion of the medication or a strong family preference against stimulant medication, an FDA-approved nonstimulant medication may be considered as the first choice of medication.

Medications that use a microbead technology can be opened and sprinkled on food and are, therefore, suitable for children who have difficulty swallowing tablets or capsules. For patients who are unable to swallow pills, alternative options include immediate- and extended-release methylphenidate and amphetamine in a liquid and chewable form, a methylphenidate transdermal patch, and an orally disintegrating tablet.

It is often helpful to inform families that the initial medication titration process may take several weeks to complete, medication changes can be made on a weekly basis, and subsequent changes in medication may be necessary. Completion of ADHD rating scales before dose adjustment helps promote measurement-based treatment. The usual procedure is to begin with a low dose of medication and titrate to the dose that provides maximum benefit and minimal adverse effects. Core symptom reduction can be seen immediately with stimulant medication initiation, but improvements in function require more time to manifest. Stimulant medications can be effectively titrated with changes occurring in a 3- to 7-day period. During the first month of treatment, the medication dose may be titrated with a weekly or biweekly follow-up. The increasing doses can be provided either by prescriptions that allow dose adjustments upward or, for some of medications, by 1 prescription of tablets or capsules of the same strength with instructions to administer progressively higher amounts by doubling or tripling the initial dose.

Another approach, similar to the one used in the MTA study,[228] is for parents to be directed to administer different doses of the same preparation, each for 1 week at a time (eg, Saturday through Friday). At the end of each week, feedback from parents and teachers and/or *DSM-5*–based ADHD rating scales can be obtained through a phone interview, fax, or a secure electronic system. In addition to the ADHD rating scale, parents and teachers can be asked to

review adverse effects and progress on target goals.

Follow-up Visits

A face-to face follow-up visit is recommended at about the fourth week after starting the medication. At this visit, the PCC reviews the child or adolescent's responses to the varying doses and monitors adverse effects, pulse, BP, and weight. To promote progress in controlling symptoms is maintained, PCCs will continue to monitor levels of core symptoms and improvement in specified target goals. ADHD rating scales should be completed at each visit, particularly before any changes in medication and/or dose.

In the first year of treatment, face-to-face visits to the PCC are recommended to occur on a monthly basis until consistent and optimal response has been achieved, then they should occur every 3 months. Subsequent face-to-face visits will be dependent on the response; they typically occur quarterly but need to occur at least twice annually until it is clear that target goals are progressing and that symptoms have stabilized. Thereafter, visits occur periodically as determined by the family and the PCC. After several years, if the child or adolescent is doing well and wants to attempt a trial off of the medication, this can be initiated.

Results from the MTA study suggest that there are some children who, after 3 years of medication treatment, continue to improve even if the medication is discontinued.[13] These findings suggest that children who are stable in their improvement of ADHD symptoms may be given a trial off medication after extended periods of use to determine if medication is still needed. This process is best undertaken with close monitoring of the child's core symptoms and function at home, in school, and in the community. If pharmacologic interventions do not improve the child or adolescent's symptoms, the diagnosis needs to be reassessed (see Treatment Failure section).

Whenever possible, improvements in core symptoms and target goals should be monitored in an objective way (eg, an increase from 40% goal attainment to 80% per week; see the ADHD Toolkit for more information). Core symptoms can be monitored with 1 of the *DSM-5*–based ADHD rating scales.

Pediatricians and other PCCs are encouraged to educate parents that although medications can be effective in facilitating schoolwork, they have not been shown to be effective in addressing learning disabilities or a child's level of motivation. A child or adolescent who continues to experience academic underachievement after attaining some control of his or her ADHD behavioral symptoms needs to be assessed for a coexisting condition. Such coexisting conditions include learning and language disabilities, other mental health disorders, and other psychosocial stressors. This assessment is part of the initial assessment in children who present with difficulties in keeping up with their schoolwork and grades and who are rated as having problems in the 3 academic areas (ie, reading, writing, and math).

Treatment: Psychosocial Treatment

Two types of psychosocial treatments are well established for children and adolescents with ADHD, including some behavioral treatments and training.[25]

Behavioral Treatments

There is a great deal of evidence supporting the use of behavioral treatments for preschool-aged and elementary and middle school–aged children, including several types of PTBM and classroom interventions (see the clinical practice guideline for more information). There are multiple PTBM programs available, which are reviewed in the ADHD Toolkit.[225]

Evidence-based PTBM training typically begins with 7 to 12 weekly group or individual sessions with a trained or certified therapist. Although PTBM treatments differ, the primary focus is on helping parents improve the methods they use to reward and motivate their child to reduce the behavioral difficulties posed by ADHD and improve their child's behavior. Therapists help parents establish consistent relationships or contingencies between the child's specific behaviors and the parents' use of rewards or logical consequences for misbehavior. These treatments typically use specific directed praise, point systems, time-outs, and privileges to shape behavior. Parents learn how to effectively communicate expectations and responses to desirable and undesirable behaviors.

PTBM programs offer specific techniques for reinforcing adaptive and positive behaviors and decreasing or eliminating inappropriate behaviors, which alter the motivation of the child or adolescent to control attention, activity, and impulsivity. These programs emphasize establishing positive interactions between parents and children, shaping children's behaviors through praising and strengths spotting, giving successful commands, and reinforcing positive behaviors. They help parents to extinguish inappropriate behaviors through ignoring, to identify behaviors that are most appropriately handled through natural consequences, and to use natural consequences in in a responsible way.

These programs all emphasize teaching self-control and building positive family relationships. If parents strongly disagree about behavior management or have contentious relationships, parenting programs will likely be unsuccessful.

Depending on the severity of the child or adolescent's behaviors and the capabilities of the parents, group or individual training programs will be required. Programs may also include support for maintenance and relapse prevention.

Although all effective parenting uses behavioral techniques, applying these strategies to children or adolescents with ADHD requires additional rigor, adherence, and persistence, compared with children without the disorder. Some PTBM programs include additional components such as education about ADHD, development and other related issues, motivational interviewing, and support for parents coping with a child with ADHD.

PTBM training has been modified for use with adolescents to incorporate a family therapy approach that includes communication, problem-solving, and negotiation. Initially developed for adolescents with a wide range of problems,[94,231] this approach has been modified for adolescents with ADHD.[94,233] The approach's effects are not as large as with PTBM training with children, but clear benefits have been reported; this is a feasible clinic-based approach that warrants a referral, if available.

Although PTBM training is typically effective, such programs may not be available in many areas (see Systemic Barriers to the Care of Children and Adolescents with ADHD section in the Supplemental Information for further discussion of this issue[153]). Factors that may diminish PTBM's effects and/or render them ineffective include the time commitment required to attend sessions and practice the recommendations at home, particularly given other competing demands for the family's time. Parental disagreements about implementing the PTBM program, conflicts between parents, and separated parents who share caretaking responsibilities can adversely affect the results. Careful monitoring of progress and follow-up by the therapist or PCC can reduce the likelihood of these risks. PTBM training may not be covered by health insurance (insurance issues are discussed in the Systemic Barriers to the Care of Children and Adolescents With ADHD section).

Training Interventions

Training interventions are likely to be effective with children and adolescents with ADHD. These interventions involve targeting specific deficiencies in skills such as study, organization, and interpersonal skills. Effective training approaches involve targeting a set of behaviors that are useful to the child in daily life and providing extensive training, practice, and coaching over an extended period of time. For some children, the combination of behavioral treatments and training may be most effective. Psychosocial treatments are applicable for children who have problems with inattentive or hyperactive/impulsive behaviors but do not meet the *DSM-5* criteria for a diagnosis of ADHD.

Many of the behavioral and training treatments described above can be provided at school. Coaching, which has emerged as a treatment modality over the last decade, can be a useful alternative to clinic- or school-based treatments. There has yet to be rigorous studies to support its benefits, although it has good face validity. Currently, there is no standardized training or certification for coaches.

Other Considerations

PCCs can make recommendations about treatments that are most likely to help a child or adolescent with ADHD and discourage the use of nonmedication treatments that are unlikely to be effective. Pediatricians and other PCCs are encouraged to discuss what parents have tried in the past and what has been beneficial for the child and his or her family.

Treatments for which there is insufficient evidence include large doses of vitamins and other dietary alterations, vision and/or visual training, chelation, EEG biofeedback, and working memory (ie, cognitive training) programs.[25] To date, there is insufficient evidence to determine that these therapies lead to changes in ADHD's core symptoms or functioning. There is a lack of information about the safety of many of these alternative therapies. Although there is some minimal information that significant doses of essential fatty acids may help with ADHD symptoms, further study on effectiveness, negative impacts, and adverse effects is needed before it can be considered a recommended treatment.[233]

As noted, some therapies that are effective for other disorders are not supported for use with children or adolescents with ADHD. These include CBT (which has documented effectiveness for the treatment of anxiety and depressive disorders), play therapy, social skills training, and interpersonal talk therapy. Although it is possible that these treatments may improve ADHD symptoms in a specific child or adolescent, they are less likely to do so compared to evidence-based treatments. As a result, the PCC should discourage use of these approaches. If these ineffective treatments are attempted before evidence-based modalities, parents may erroneously conclude that all mental health treatments are ineffective. For example, if CBT or play therapy does not help their child's ADHD, parents may dismiss other treatments, like PTBM, which could be helpful. Parents also may discount CBT if it subsequently is recommended for an emerging anxiety disorder.

Pediatricians and other PCCs are unlikely to be effective in providing

psychosocial treatment unless they are specifically trained, have trained staff, are colocated with a therapist, or dedicate multiple visits to providing this treatment. Clinicians may have difficulty determining if the therapists listed in the patient's health insurance plan have the requisite skills to provide evidence-based, psychosocial ADHD-related treatment. This determination is important because many therapists focus on a play therapy or interpersonal talk therapy, which have not been shown to be effective in treating the impairments associated with ADHD.

Pediatricians and other PCCs may want to develop a resource list of local therapists, agencies, and other mental health clinicians who can treat these impairments. Clinicians might request references from other parents of children with ADHD, professional organizations (eg, the Association for Behavioral and Cognitive Therapies), and ADHD advocacy organizations (eg, CHADD). Parents who have read authoritatively written books about psychosocial treatment may be in a better position to know what they are looking for in a therapist. Some of these resources are available in the ADHD Toolkit[225] and in *ADHD: What Every Parent Needs to Know*[226] as well as other online sources.[226,234–236] Unfortunately, lack of insurance coverage, availability, and accessibility of effective services may limit the implementation of this process (see Systemic Barriers to the Care of Children and Adolescents with ADHD section in the Supplemental Information for further discussion).

Treatment: Collaborate With School to Enhance Support and Services

School-based approaches have demonstrated both short- and long-term benefits for at least 1 year beyond treatment.[95,97] Schools can implement behavioral or training interventions that directly target ADHD symptoms and interventions to enhance academic and social functioning. Schools may use strategies to enhance communication with families, such as daily behavior report cards. All schools should have specialists (eg, school psychologists, counselors, special educators) who can observe the child or adolescent, identify triggers and reinforcers, and support teachers in improving the classroom environment. School specialists can recommend accommodations to address ADHD symptoms, such as untimed testing, testing in less distracting environments, and routine reminders. As children and adolescents get older, their executive functioning skills continue developing. Thus, their delays may decrease, and they may no longer need the accommodations. Alternatively, further intervention may be indicated to facilitate the development of these independent skills.

It is helpful for PCCs to be aware of the eligibility criteria for 504 Rehabilitation Act and the IDEA support in their state and local school districts.[143] It is helpful to understand the process for referral and the specific individuals to contact about these issues. Providing this information to parents will support their efforts to secure classroom adaptations for their child or adolescent, including the use of empirically supported academic interventions to address the achievement difficulties that are often associated with ADHD symptoms.

Educate Parents About School Services

School is often the place where many problems of a child or adolescent with ADHD occur. Although services are available through special education, IDEA, and Section 504 plans, classroom teachers can help students with ADHD. Students with ADHD are most likely to succeed in effectively managed classrooms in which teachers provide engaging instruction, support their students, and implement rules consistently. School staff can sometimes consult with classroom teachers to help them improve their skills in these areas. In many schools, parents can ask the principal for a specific teacher for their child the following academic year.

In some schools, teachers may implement activities to help a student before he or she is considered for special services, including a daily report card, organization interventions, behavioral point systems, and coordinating with the parents, such as using Web sites or portal systems for communication. Individualized behavioral interventions, if implemented well and consistently, are some of the most effective interventions for children with ADHD. In addition to individualized interventions, encouraging parents to increase communication with the teacher can help parents reinforce desirable behavior at school.

If these approaches are not adequate or teachers are unwilling to provide them, parents can be encouraged to write to the principal or the director of special education requesting an evaluation for special education services. An evaluation from a PCC can help this evaluation process but is unlikely to replace it. A child who has an ADHD diagnosis may be eligible for special education services in the category of "other health impaired." Depending on the specific nature of a child's impairment at school, he or she may be eligible for the categories of "emotional and behavioral disorders" or "specific learning disability." The category of eligibility does not affect the services available to the child but usually reflect the nature of the problems that resulted in his or her eligibility for special education services.

Although a PCC may recommend that a child is eligible for special education

and specific services, these are only recommendations, as specific evaluation procedures and criteria for eligibility are determined by each school district within federal guidelines. If the ADHD is severe and interfering with school performance, services are usually provided under the other health impaired category. It is important for PCCs to avoid using language in the report that could alienate people in the school or create conflict between the parents and school staff. After school staff complete the evaluation, a meeting will be held to review the results of all evaluation information (including the PCC report) and determine the student's eligibility for an IEP or a 504 plan. If they wish, the parents may invite others to attend the meeting. Some communities have individuals who are trained to help parents effectively advocate for services; being aware of existing resources, if they exist, can help the PCC refer parents to them. Additional details about eligibility are usually available on the Web sites of the school district and the state department of education.

A PCC can help educate the parents about the types of services they can request at the meeting. There are generally 2 categories of services. Some of the most common services are often referred to as accommodations, including extending time on tests, reducing homework, or providing a child with class notes from the teacher or a peer. These services reduce the expectations for a child and can quickly eliminate school problems. For example, if a child is failing classes because he or she is not completing homework and the teacher stops assigning the child homework, then the child's grade in the class is likely to improve quickly. Similarly, parent-child conflict regarding homework will quickly cease. Although these outcomes are desirable, if discontinuing the expectation for completing homework results does not help improve the student's ability to independently complete tasks outside school, which is an important life skill, it may not be beneficial. Although appealing, these services may not improve and in some cases may decrease the child's long-term competencies. They need to be considered with this in mind.

The second set of services consists of interventions that enhance the student's competencies. These take much more work to implement than the services described above and do not solve the problem nearly as quickly. Although appealing, these services may decrease the child's long-term competencies if they are not combined with interventions that are aimed at improving the student's skills and behaviors. Accommodations need to be considered with this broader context in mind. The advantage of interventions is that many students improve their competencies and become able to independently meet age-appropriate expectations over time (for more information on this approach, see information on the Life Course Model[237]).[238] Interventions include organization interventions, daily report cards, and training study skills. The following school-based interventions have been found to be effective in improving academic and interpersonal skills for students with ADHD: Challenging Horizons Program,[95] Child Life and Attention Skills Program,[239] and Homework and Organization Planning Skills.[96] If these are available in area schools, it is important to encourage their use.

V. AGE-RELATED ISSUES

V a. Preschool-Aged Children (Age 4 Years to the Sixth Birthday)

Clinicians can initiate treatment of preschool-aged children with ADHD (ie, children age 4 years to the sixth birthday) with PTBM training and assess for other developmental problems, especially with language. If children continue to have moderate-to-severe dysfunction, the PCC needs to reevaluate the extent to which the parents can implement the therapy; the PCC can also consider prescribing methylphenidate, as described previously. Titration should start with a small dose of immediate-release methylphenidate because preschool-aged children metabolize medication at a slower rate. They have shown lower optimal milligrams-per-kilogram daily doses than older children and may be more sensitive to emotional side effects such as irritability and crying.[83,98]

Currently, dextroamphetamine is the only FDA-approved ADHD medication to treat preschool-aged children. However, when dextroamphetamine received FDA approval, the criteria were less stringent than they are now, so there is only sparse evidence to support its safety and efficacy in this age group. There is more abundant evidence that methylphenidate is safe and efficacious for preschool-aged children with ADHD. For this reason, methylphenidate is the first-line recommended ADHD medication treatment of this age group despite not having FDA approval.[28]

The Preschool ADHD Treatment Study,[83] the landmark trial documenting methylphenidate's safety and efficacy in this age group, included children with moderate-to-severe dysfunction. Therefore, the recommendation for methylphenidate treatment is reserved for children with significant, rather than mild, ADHD-related impairment. In the Preschool ADHD Treatment Study trial, moderate-to-severe impairment was defined as having symptoms present for at least 9 months and clear impairment in both the home and child care and/or preschool settings that did not respond to an appropriate intervention.

There is limited published evidence of the safety and efficacy for the preschool-aged group of atomoxetine,

extended-release guanfacine, or extended-release clonidine. None of these nonstimulant medications have FDA approval for this age group.[47]

V b. Adolescents (Age 12 Years to the 18th Birthday)

Pediatricians and other PCCs may increase medication adherence and engagement in the treatment process by closely involving adolescents (age 12 years to the 18th birthday) in medication treatment decisions. Collaborating with the adolescent to determine if the medication is beneficial can help align outcome measures with the adolescent's own goals. Special attention ought to be paid to provide medication coverage at times when the adolescent may exhibit risky behaviors, such as when he or she is driving or spending unsupervised time with friends. Longer-acting or late-afternoon administration of nonstimulant medications or short-acting medications may be helpful.

If pediatricians and other PCCs begin transitioning children to be increasingly responsible for treatment decisions during early adolescence, then transitioning to a primary care physician who specializes in care for adults will be a natural continuation of that process when the adolescent reaches the highest grades in high school. Preparation for the transition to adulthood is an important step that includes planning for transferring care, adapting treatment to new activities and schedules, and educating the patient about effective ways to obtain insurance and engage in services.

Counseling for adolescents around medication issues needs to include dealing with resistance to treatment and empowering the patient to take charge of and own his or her medication management as much as possible. Techniques of motivational interviewing may be useful in improving adherence.[240]

In addition to the numerous developmental changes encountered when working with adolescents, PCCs should assess adolescent patients with ADHD for symptoms of substance use or abuse before beginning medication treatment. If substance use is revealed, the patient should stop the use. Referral for treatment of substance use must be provided before beginning treatment of ADHD (see the clinical practice guideline). Pediatricians and other PCCs should pay careful attention to potential substance use and misuse and diversion of medications. Screening for signs of substance use is important in the care of all adolescents and, depending on the amount of use, may lead a PCC to recommend treatment of substance use. Extensive use or abuse may result in concerns about continuing medication treatment of ADHD until the abuse is resolved. Similar concerns and consideration of discontinuing medication treatment of ADHD could emerge if there is evidence that the adolescent is misusing or diverting medications for other than its intended medical purposes. Pediatricians and other PCCs are encouraged to monitor symptoms and prescription refills for signs of misuse or diversion of ADHD medication. Diversion of ADHD medication is a special concern among adolescents.[132]

When misuse or diversion is a concern, the PCC might consider prescribing nonstimulant medications with much less abuse potential, such as atomoxetine, extended-release guanfacine, or extended-release clonidine. It is more difficult but not impossible to extract the methylphenidate or amphetamine for abuse from the stimulant medications lisdexamfetamine, dermal methylphenidate, and osmotic-release oral system methylphenidate, although these preparations still have some potential for abuse or misuse.

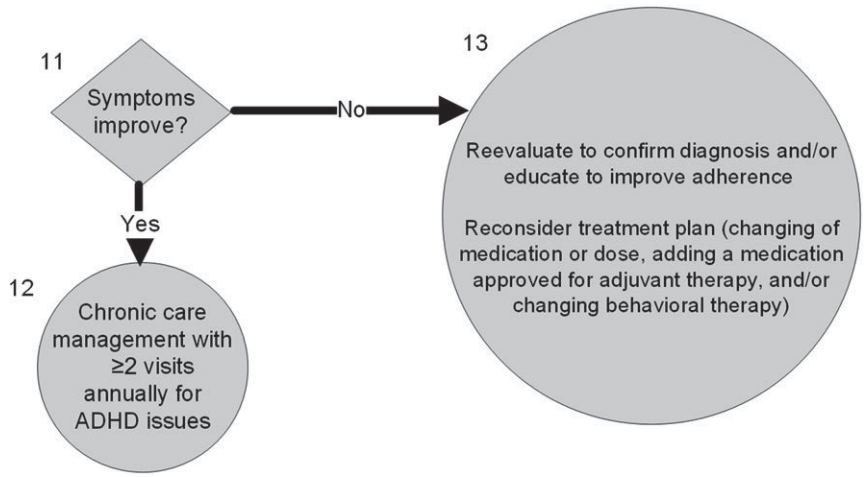
PCCs should be aware that short-acting, mixed amphetamine salts are the most commonly misused or diverted ADHD medication. It is important to note that diversion and misuse of ADHD medications may be committed by individuals who have close contact with or live in the same house as the adolescent, not necessarily by the adolescent him- or herself; this is especially true for college-aged adolescents. Pediatricians and other PCCs are encouraged to discuss safe storage practices, such as lockboxes for controlled substances, when used by college-aged adolescents.

VI. MONITORING

Pediatricians and other PCCs should regularly monitor all aspects of ADHD treatment, including the following:

- systematic reassessment of core symptoms and function;
- regular reassessment of target goals;
- family satisfaction with the care it is receiving from other clinicians and therapists, if applicable;
- provision of anticipatory guidance, further child or adolescent and family education, and transition planning as needed and appropriate;
- occurrence and quality of care coordination to meet the needs of the child or adolescent and family;
- confirmation of adherence to any prescribed medication regimen, with adjustments made as needed;
- HR, BP, height, and weight monitoring; and
- furthering the therapeutic relationship with the child or adolescent and empowering families and children or adolescents to be strong, informed advocates.

Some treatment monitoring can occur during general health care visits if the PCC inquires about the child or adolescent's progress toward target goals, adherence to medication and behavior therapy, concerns, and



SUPPLEMENTAL FIGURE 8
Monitoring.

changes. This extra time and evaluation effort may generate an evaluate and management (E/M) code along with the well-child care code and may result in an additional cost to the family (see the section on barriers, specifically the compensation section[153]). Monitoring of a child or adolescent with inattention or hyperactivity/impulsivity problems can help to ensure prompt treatment should symptoms worsen to the extent that a diagnosis of ADHD is warranted.

As treatment proceeds, in addition to using a *DSM-5*–based ADHD rating scale to monitor core symptom changes, the PCC can make formal and informal queries in the areas of function most commonly affected by ADHD: academic achievement; peer, parent, or sibling relationships; and risk-taking behavior. Progress can be measured by monitoring the target goals established in collaboration with the child and family. Checklists completed by the school can facilitate medication monitoring. Data from the school, including ADHD symptom ratings completed by the teacher as well as grades and any other formal testing, are helpful at these visits. Screening for substance use and sleep problems is best continued throughout treatment because these problems can emerge at any time. At every visit, it is helpful to gradually further empower children to become full partners in their treatment plan by adolescence.

In the early stages of treatment, after a successful titration period, the frequency of follow-up visits will depend on adherence, coexisting conditions, family willingness, and persistence of symptoms. As noted, a general guide for visits to the PCC is for these visits to occur initially on a monthly basis, then at least quarterly for the first year of treatment. More frequent visits may be necessary if comorbid conditions are present. Visits then need be held preferably quarterly but at least twice each year, with additional phone contact monitoring at the time of medication refill requests. Ongoing communication with the school regarding medication and services is needed.

There is little evidence establishing the optimal, practical follow-up regimen. It is likely that the regimen will need to be tailored to the individual child or adolescent and family needs on the basis of clinical judgment. Follow-up may incorporate electronic collection of rating scales, telehealth, or use of remote monitoring of symptoms and impairment. The time-intensive nature of this process, insurance restrictions, and lack of payment may be significant barriers to adoption (see Systemic Barriers to the Care of Children and Adolescents with ADHD section in the Supplemental Information for more information on this issue).

(See the ADHD guideline's KAS 4.)

VI A. TREATMENT FAILURE

ADHD treatment failure may be a sign of inadequate dosing, lack of patient or family information or compliance, and/or incorrect or incomplete diagnosis. Family conflict and parental psychopathology can also contribute to treatment failure.

In the event of treatment failure, the PCC is advised to repeat the full diagnostic evaluation with increased attention to the possibility of another condition or comorbid conditions that mimic or are associated with ADHD, such as sleep disorders, autism spectrum disorders, or epilepsy (eg, absence epilepsy or partial seizures). Treatment failure may also arise from a new acute stressor or from an unrecognized or underappreciated traumatic event. A coexisting learning disability may cause an apparent treatment failure. In the case of a child or adolescent previously

diagnosed with problem-level inattention or hyperactivity, repeating the diagnostic evaluation may result in a diagnosis of ADHD, which would allow for increased school support and the inclusion of medication in the treatment plan. A forthcoming complex ADHD guideline from the SDBP will provide additional information on diagnostic evaluation and treatment of children and adolescents with ADHD treatment failure and/or ADHD that is complicated by coexisting developmental or mental health conditions.

Treatment failure could result from poor adherence to the treatment plan. Increased monitoring and education, especially by including the patient, may increase adherence. It is helpful to try to identify the issues restricting adherence, including lack of information about or understanding of the treatment plan. It is also important to recognize that cultural factors may impact the patient's treatment and outcomes.

If the child continues to struggle despite the school's interventions and treatment of ADHD, further psychoeducational, neuropsychological, and/or language assessments are necessary to evaluate for a learning, language, or processing disorder. The clinician may recommend evaluation by an independent psychologist or neuropsychologist.

VII. CHILDREN AND ADOLESCENTS FOR WHOM AN ADHD DIAGNOSIS IS NOT MADE

If the evaluation identifies or suggests another disorder is the cause of the concerning signs and symptoms, it is appropriate to exit this algorithm.

VII a. Other Condition

The subsequent approach is dictated by the evaluation's results. If the PCC has the expertise and ability to evaluate and treat the other or comorbid condition, he or she may do so. Many collaborative care models exist to help facilitate a pediatrician's comfort with comorbidity, as well as programs that teach pediatricians to manage comorbidities. It is important for the PCC to frame the referral questions clearly if a referral is made. A comanagement plan must be established that addresses the family's and child or adolescent's ongoing needs for education and general and specialty health care. Resources from the AAP Mental Health Initiatives and the forthcoming complex ADHD clinical practice guideline from the SDBP may be helpful.[67,133,241]

VII b. Apparently Typical or Developmental Variation

Evaluation may reveal that the child or adolescent's inattention, activity level, and impulsivity are within the typical range of development, mildly or inconsistently elevated in comparison with his or her peers, or is not associated with any functional impairment in behavior, academics, social skills, or other domains. The clinician can probe further to determine if the parents' concerns are attributable to other issues in the family, such as parental tension or drug use by a family member; whether they are caused by other issues in school, such as social pressures or bullying; or whether they are within the spectrum of typical development.

In talking with parents, it may help to explain that ADHD differs from a condition like pregnancy, which is a "yes" or "no" condition. With ADHD, behaviors follow a spectrum from variations on typical behavior, to atypical behaviors that cause problems but are not severe enough to be considered a disorder, to consistent behaviors that are severe enough to be considered a disorder. With problematic behaviors, it is helpful for the PCC to provide education about both the range of typical development and strategies to improve the child or adolescent's behaviors. A schedule of enhanced surveillance absolves the family of the need to reinitiate contact if the situation deteriorates. If a recommendation for continued routine systematic surveillance is made by the PCC, it is important to provide reassurance that ongoing concerns can be revisited at future primary care visits.

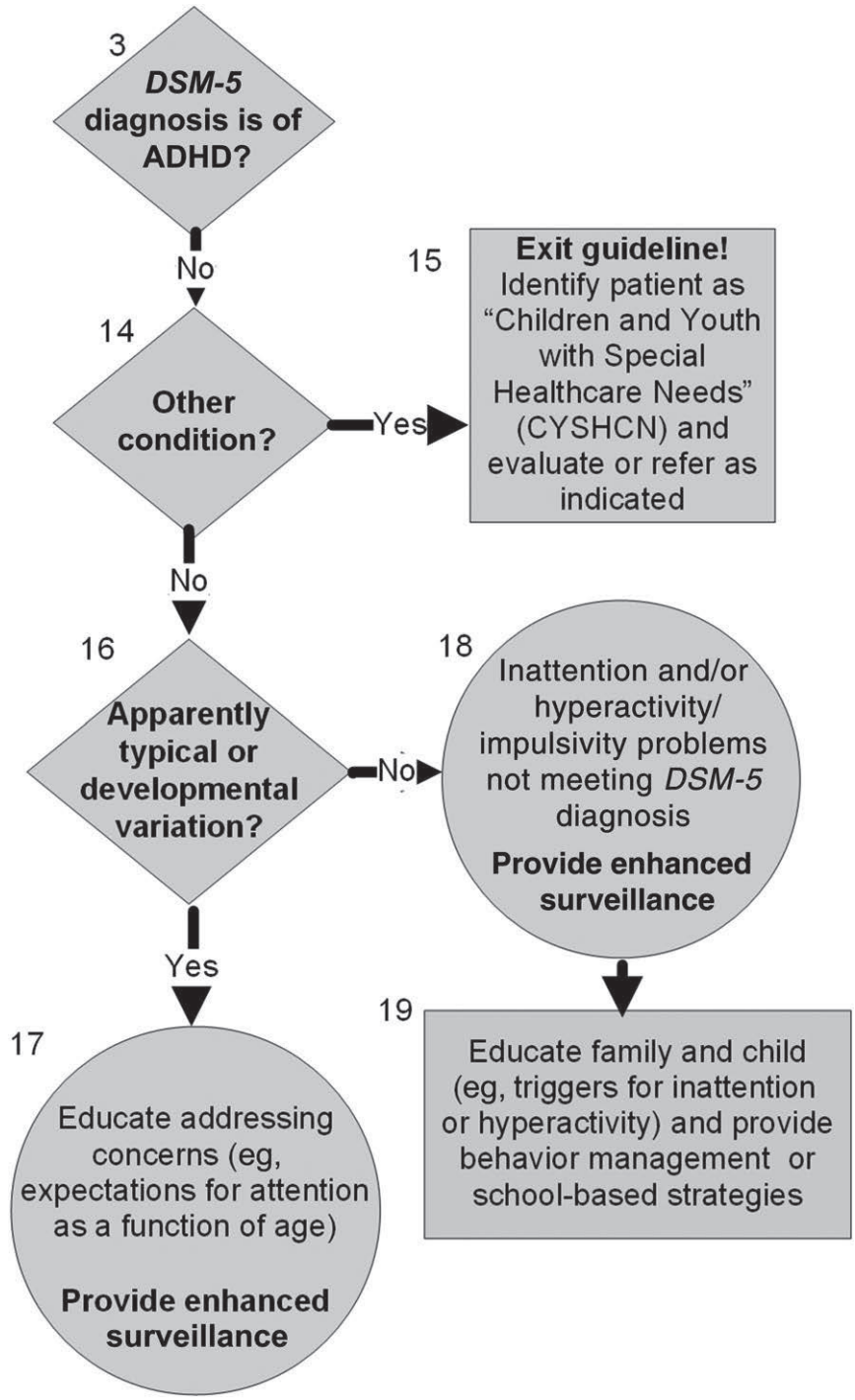
VII c. Children and Adolescents With Inattention or Hyperactivity/Impulsivity (Problem Level)

Children and adolescents whose symptoms do not meet the criteria for diagnosis of ADHD may still encounter some difficulties or mild impairment in some settings, as described in the *DSM-PC*, *Child and Adolescent Version*.[49] For these patients, enhanced surveillance is recommended. PCCs are encouraged to provide education for both the patient and his or her family, specifically about triggers for inattention and/or hyperactivity as well as behavior management strategies.

Medication is not appropriate for children and adolescents whose symptoms do not meet *DSM-5* criteria for diagnosis of ADHD, but PTBM does not require a diagnosis of ADHD to be recommended.

VIII. COMPLEMENTARY AND ALTERNATIVE THERAPIES AND/OR INTEGRATIVE MEDICINE

Families of children and adolescents with ADHD increasingly ask their pediatrician and other PCCs about complementary and alternative therapies. These include megavitamins and other dietary alterations, vision and/or visual training, chelation, EEG biofeedback, and working memory (eg, cognitive training) programs.[242] As noted, there is insufficient evidence to suggest that these therapies lead to changes in ADHD's core symptoms or function.



SUPPLEMENTAL FIGURE 9
Children and adolescents for whom an ADHD diagnosis is not made. CYSHCN, children and youth with special health care needs.

For many complementary and alternative therapies, limited information is available about their safety. Both chelation and megavitamins have been proven to cause adverse effects and are contraindicated.[243,244] For these reasons, complementary and alternative therapies are not recommended.

Pediatricians and other PCCs can play a constructive role in helping families make thoughtful treatment choices by reviewing the goals and/or effects claimed for a given treatment, the state of evidence to support or discourage use of the treatment, and known or potential adverse effects. If families are interested in trying complementary and alternative treatments, it is helpful to have them

define specific measurable goals to monitor the treatment's impact. Families also need to be strongly encouraged to use evidence-based interventions while they explore complementary and alternative treatments. PCCs have to respect families' interests and preferences while they address and answer questions about complementary and alternative therapies.

Pediatricians and other PCCs should ask about additional therapies that families may be administering to adequately monitor for drug interactions. Parents and children or adolescents who do not feel that their choices in health care are respected by their PCCs may be less likely to communicate about complementary or alternative therapies and/or integrative medicine.

IX. IMPLEMENTATION ISSUES: PREPARING THE PRACTICE

Implementation of the process described in this algorithm can be enhanced with preparation of the practice to meet the needs of children and adolescents with ADHD. This preparation includes both internal practice characteristics and relationships within the community. (More detail can be found in the AAP Mental Health Initiatives' resources.[133,245])

The following office procedures and resources will help practices facilitate the steps in this algorithm:

- developing a packet of ADHD questionnaires and rating scales for parents and teachers to complete before a scheduled visit;
- allotting adequate time for ADHD-related visits;
- determining billing and documentation procedures and monitoring insurance payments to appropriately capture the services rendered to the extent possible;
- implementing methods to track and follow patients (see Systemic Barriers to the Care of Children and Adolescents with ADHD section in the Supplemental Information for more information on this issue);
- asking questions during all clinical encounters and promoting patient education materials (ie, brochures and posters) that alert parents and patients that appropriate issues to discuss with the PCC include problem behaviors, school problems, and concerns about attention and hyperactivity;
- developing an office system for monitoring and titrating medication, including communication with parents and teachers. For stimulant medications, which are controlled substances requiring new, monthly prescriptions, it is necessary to develop a monitoring and refill process including periodic review of the state's database of controlled substance prescriptions (any such system is based on the PCC's assessment of family organization, phone access, and parent-teacher communication effectiveness); and
- using the ADHD Toolkit resources.

Establishing relations with schools and other agencies can facilitate communication and establish clear expectations when collaborating on care for a child. A community-level system that reflects consensus among district school staff and local PCCs for key elements of diagnosis, interventions, and ongoing communication can help to provide consistent, well-coordinated, and cost-effective care. A community-based system with schools relieves the individual PCC from negotiating with each school about care and communication regarding each patient. Offices that have incorporated medical home principles are ideal for establishing this kind of community-level system. Although achieving the level of coordination described below is ideal and takes consistent effort over the years, especially in areas with multiple separate school systems, some aspects may be achieved relatively quickly and will enhance services for children.

The key elements for a community-based collaborative system include consensus on the following:

- a clear and organized process by which an evaluation can be initiated when concerns are identified either by parents or school personnel;
- a packet of information completed by parents and teachers about each child and/or adolescent referred to the PCC;
- a contact person at the practice to receive information from parents and teachers at the time of evaluation and during follow-up;
- an assessment process to investigate coexisting conditions;
- a directory of evidence-based interventions available in the community;
- an ongoing process for follow-up visits, phone calls, teacher reports, and medication refills;
- availability of forms for collecting and exchanging information;
- a plan for keeping school staff and PCCs up to date on the process; and
- awareness of the network of mental health providers in your area and establishments of collaborative relationships with them.

The PCC may face challenges to developing such a collaborative process. For example, a PCC is typically caring for children from more than 1 school system, a school system may be large and not easily accessed, schools may have limited staff and resources to complete assessments, or scheduling may make it difficult for the PCC to communicate with school personnel. Further complicating these efforts is

the fact that many providers encounter a lack of recognition and payment for the time involved in coordinating care. These barriers may hamper efforts to provide the internal resources within a practice and coordination across schools and other providers that are described above; nevertheless, some pediatricians and other PCCs have found ways to lessen some of these obstacles (see Systemic Barriers to the Care of Children and Adolescents with ADHD section in the Supplemental Information for more information on overcoming challenges).

In the case of multiple or large school systems in a community, the PCC may want to begin with 1 school psychologist or principal, or several practices can initiate contact collectively with a community school system. Agreement among the clinicians on the components of a good evaluation process facilitates cooperation and communication with the school toward common goals. Agreement on behavior rating scales used can facilitate completion by school personnel. Standard communication forms that monitor progress and specific interventions can be exchanged among the school and the pediatric office to share information. Collaborative systems can extend to other providers who may comanage care with a PCC. Such providers may include a mental health professional who sees the child or adolescent for psychosocial interventions or a specialist to address difficult cases, such as a developmental-behavioral pediatrician, child and adolescent psychiatrist, child neurologist, neurodevelopmental disability physician, or psychologist. The AAP Mental Health Initiatives provide a full discussion of collaborative relationships with mental health professionals, including colocation and integrated models, in its Chapter Action Kit and PediaLink Module.[133,241]

Achieving this infrastructure in the practice and the coordination across schools and other providers will enhance the PCC's ability to implement the treatment guidelines and this algorithm. Achieving these ideals is not necessary for providing care consistent with these practices, however.

X. CONCLUSIONS

ADHD is the most common neurobiological disorder of children and adolescents. Untreated or undertreated ADHD can have far-reaching and serious consequences for the child or adolescent's health and well-being. Fortunately, effective treatments are available, as are methods for assessing and diagnosing ADHD in children and adolescents. The AAP is committed to supporting primary care physicians in providing quality care to children and adolescents with ADHD and their families. This algorithm represents a portion of that commitment and an effort to assist pediatricians and other PCCs to deliver care that meets the quality goals of the practice guideline. This PoCA, in combination with the guideline and Systemic Barriers to the Care of Children and Adolescents With ADHD section below, is intended to provide support and guidance in what is currently the best evidence-based care for their patients with ADHD. Additional support and guidance can be obtained through the work and publications of the AAP Mental Health Initiatives.[133,241]

BARRIERS

SYSTEMIC BARRIERS TO THE CARE OF CHILDREN AND ADOLESCENTS WITH ADHD

INTRODUCTION

The AAP strives to improve the quality of care provided by PCCs through quality improvement initiatives including developing, promulgating, and regularly revising evidence-based clinical practice guidelines. The AAP has published a revision to its 2011 guideline on evaluating, diagnosing, and treating ADHD on the basis of the latest scientific evidence (see main article). This latest revision of the clinical practice guideline is accompanied by a PoCA (also found in the Supplemental Information), which outlines the applicable diagnostic and treatment processes needed to implement the guidelines. This section, which is a companion to the clinical guideline and PoCA, outlines common barriers that impede ADHD care and provides suggested strategies for clinicians seeking to improve care for children and adolescents with ADHD and work with other concerned public and private organizations, health care payers, government entities, state insurance regulators, and other stakeholders.

ADHD is the most common childhood neurobehavioral disorder in the United States and the second most commonly diagnosed childhood condition after asthma.[246] The *DSM-5* criteria define 4 dimensions of ADHD:

1. ADHD/I (314.00 [F90.0]);
2. ADHD/HI (314.01 [F90.1]);
3. ADHD/C (314.01 [F90.2]); and
4. ADHD other specified and unspecified ADHD (314.01 [F90.8]).

National survey data from 2016 reveal that 9.4% of 2- to 17-year-old US children received an ADHD diagnosis during childhood, and 8.4% currently have ADHD.[247] Prevalence estimates from community-based samples are somewhat higher, ranging from 8.7% to 15.5%.[9,10] Most children with ADHD (67%) had at least 1 other comorbidity, and 18% had 3 or more comorbidities, such as mental health disorders and/or learning disorders. These comorbidities increase the complexity of the diagnostic and treatment processes.[66]

The majority of care for children and adolescents with ADHD is provided by the child's PCC, particularly when the ADHD is uncomplicated in nature. In addition, families typically have a high degree of confidence and trust in pediatricians' ability to provide this professional care. Because of the high prevalence of ADHD in children and adolescents, it is essential that PCCs, particularly pediatricians, be able to diagnose, treat, and coordinate this care or identify an appropriate clinician who can provide this needed care. Despite having a higher prevalence than other conditions that PCCs see and manage, such as urinary tract infections and sports injuries, ADHD is often viewed as different from other pediatric conditions and beyond the purview of primary care. In addition, several barriers to care hamper effective and timely diagnosis and treatment of these children and adolescents and must be addressed and corrected to achieve optimum outcomes for these children.[153] These barriers include the following:

1. limited access to care because of inadequate developmental-behavioral and mental health care training during residencies and other clinical training and shortages of consultant specialists and referral resources;
2. inadequate payment for needed services and payer coverage limitations for needed medications;
3. challenges in practice organization and staffing; and
4. fragmentation of care and resulting communication barriers.

Addressing these barriers from a clinical and policy standpoint will enhance clinicians' ability to provide high-quality care for children and adolescents who are being evaluated and/or treated for ADHD. Strategies for improvement in the delivery of care to patients with ADHD and their families are offered for consideration for practice and for advocacy.

BARRIERS TO HIGH-QUALITY CARE FOR CHILDREN AND ADOLESCENTS WITH ADHD

Multiple barriers exist in the primary medical care of children and adolescents that are impediments to excellent ADHD care.

Limited Access to Care Because of Inadequate Developmental-Behavioral and Mental Health Care Training During Pediatric Residency and Other Clinical Training Programs and Shortages of Consultant Specialists and Referral Resources

There is an overall lack of adequate pediatric residency and other training programs for pediatric clinicians on developmental-behavioral and mental health conditions, including ADHD. The current curriculum and the nature of pediatric training still focus on the diagnosis and treatment of inpatient and intensive care conditions despite the fact that many primary care pediatricians spend less and less time providing these services, which are increasingly managed by pediatric hospitalists and intensive care specialists. Pediatric and family medicine residents do not receive sufficient training in the diagnosis and treatment of developmental-behavioral and mental health conditions, including ADHD, despite the high frequency in which they will encounter these conditions in their practices.[152,248]

SUPPLEMENTAL TABLE 2 Core Symptoms of ADHD From the *DSM-5*

Inattention Dimension	Hyperactivity-Impulsivity Dimension	
	Hyperactivity	Impulsivity
Careless mistakes	Fidgeting	Blurting answers before questions completed
Difficulty sustaining attention	Unable to stay seated	Difficulty awaiting turn
Seems not to listen	Moving excessively (restless)	Interrupting and/or intruding on others
Fails to finish tasks	Difficulty engaging in leisure activities quietly	—
Difficulty organizing	"On the go"	—
Avoids tasks requiring sustained attention	Talking excessively	—
Loses things	—	—
Easily distracted	—	—
Forgetful	—	—

Adapted from American Psychiatric Association. *Diagnostic and Statistical Manual of Mental Disorders. 5th ed.* Washington, DC: American Psychiatric Association; 2000:59–60. —, *not applicable.*

In addition, many experienced pediatric clinicians believe that general pediatric and family medicine residencies do not fully ensure that clinicians who enter primary care practice have the organizational tools to develop, join, or function in medical home settings and address chronic developmental and behavioral conditions like ADHD.[152] The current funding of residency and other training programs for pediatric clinicians and the needs of hospitals tend to limit those aspects of training. The training challenges are subsequently not sufficiently addressed by practicing pediatric and family medicine practitioners, in part because of the limited number and varying quality of continuing medical education (CME) opportunities and quality improvement projects focused on medical home models and/or the chronic care of developmental and behavioral pediatric and mental health conditions.

The lack of training is compounded by the national shortage of child and adolescent psychiatrists and developmental-behavioral pediatricians: the United States has only 8300 child psychiatrists[249] and 662 developmental-behavioral pediatricians.[250] The additional training required for child psychiatry and developmental-behavioral pediatrics certification increases education time and costs yet results in little or no return on this investment in terms of increased compensation for these specialists.[249] Given the high cost of medical school and the increasing educational debt incurred by graduating medical students, physicians lack a financial incentive to add the extra years of training required for these specialties.[251] As a result, there are insufficient numbers of mental health professionals, including child psychiatrists and developmental-behavioral pediatricians, to serve as subspecialty referral options and/or provide PCCs with consultative support to comanage their patients effectively.

The specialist shortage is exacerbated by the geographically skewed distribution of extant child psychiatrists and developmental-behavioral pediatricians who are concentrated in academic medical centers and urban environments. Almost three quarters (74%) of US counties have no child and adolescent psychiatrists; almost half (44%) do not even have any pediatricians.[252] As a result, many PCCs lack an adequate pool of pediatric behavioral and mental health specialists who can accept referrals to treat complicated pediatric ADHD patients and an adequate pool of behavioral therapists to provide evidence-based behavioral interventions. The result is that patients must often travel untenable distances and endure long waits to obtain these specialty services.

Suggested Strategies for Change to Address Limited Access to Care: Policy-Oriented Strategies for Change

- Promote changes in pediatric and family medicine residency curricula to devote more time to developmental, behavioral, learning, and mental health issues with a focus on prevention, early detection, assessment, diagnosis, and treatment. Changes in the national and individual training program requirements and in funding of training should foster practitioners' understanding of the family perspective; promote communication skills, including motivational interviewing; and bolster understanding and readiness in the use of behavioral interventions and medication as treatment options for ADHD.
- Emphasize teaching and practice activities within general pediatric residencies and other clinical training, so pediatricians and other PCCs gain the skills and ability they need to function within a medical home setting.
- Support pediatric primary care mental health specialist certification for advanced practice registered nurses through the

Pediatric Nursing Certification Board to provide advanced practice care to help meet evidence-based needs of children or adolescents with ADHD.

- Encourage the development and maintenance of affordable programs to provide CME and other alternative posttraining learning opportunities on behavioral and developmental health, including ADHD. These opportunities will help stakeholders, including PCCs, mental health clinicians, and educators, become more comfortable in providing such services within the medical home and/or educational settings.
- Develop, implement, and support collaborative care models that facilitate PCCs' rapid access to behavioral and mental health expertise and consultation. Examples include integration (such as collaborative care or colocation), on-call consultation, and support teams such as the Massachusetts Child Psychiatry Access Program,[253] the "Project Teach Initiative" of the New York State Department of Mental Health,[254] and Project Extension for Community Healthcare Outcomes, a collaborative model of medical education and care management that can be targeted to pediatric mental health.[255] In addition, federal funding had provided grants to18 states to develop Child Psychiatry Access Programs through Health Resources and Services Administration's Pediatric Mental Health Care Access Program.[256,257] Promote incentives such as loan forgiveness to encourage medical students to enter the fields of child and adolescent psychiatry and developmental and behavioral pediatrics, particularly for those who are willing to practice in underserved communities.
- Expand posttraining opportunities to include postpediatric portal programs, which provide alternative ways to increase number of child and adolescent psychiatrists.

Inadequate Payment for Needed Services and Payer Coverage Limitations for Needed Medications

Although proper diagnostic and procedure codes currently exist for ADHD care in pediatrics, effective and adequate third-party payment is not guaranteed for any covered services.[258] In addition, many payment mechanisms impede the delivery of comprehensive ADHD care. These impediments include restrictions to medication treatment choices such as step therapy, previous approval, narrow formularies, and frequent formulary changes. Some payers define ADHD as a "mental health problem" and implement a "carve-out" health insurance benefit that bars PCCs from participation.[259] This designation results in denial of coverage for primary care ADHD services. Some payers have restrictive service and/or medication approval practices that prevent patients from receiving or continuing needed care and treatment. Examples include approval of only a limited number of specialist visits, limited ADHD medication options, mandatory step therapy, frequent formulary changes resulting in clinical destabilization, and disproportionally high out-of-pocket copays for mental health care or psychotropic medications.

Payments for mental health and cognitive services are frequently lower than equivalents (by relative value unit measurement) paid for physical health care services, particularly those entailing specific procedures.[258] Longer and more frequent visits are often necessary to successfully address ADHD, yet time-based billing yields lower payment compared to multiple shorter visits. These difficulties financially limit a practice's ability to provide these needed services. Payments for E/M codes for chronic care are often insufficient to cover the staff and clinician time needed to provide adequate care. Furthermore, many payers deny payment for the use of rating scales, which are the currently recommended method for monitoring ADHD patients. The use of rating scales takes both the PCC's time and the practice's organizational resources. Arbitrary denial of payment is a disincentive to the provisions of this essential and appropriate service.

Finally, payers commonly decline to pay or provide inadequate payment for care coordination services. Yet, office staff and clinicians are asked to spend large amounts of uncompensated time on these activities, including communicating with parents, teachers, and other stakeholders. Proposed new practice structures such as accountable care organizations (ACOs) are predicated on value-based services and may provide new financial mechanisms to support expanded care coordination services. Originally implemented for Medicare, all-payer ACO models are under development in many states. To date, however, the specifics of these ACO models have not been delineated, and their effectiveness has not yet been documented.[260]

The seemingly arbitrary and ever-changing standards for approval of services; the time-consuming nature of previous approval procedures; and restrictive, opaque pharmacy rules combine to create substantial barriers that result in many PCCs declining to care for children and adolescents with ADHD.[252] According to a recent AAP Periodic Survey of Fellows, 41% of pediatricians reported that "inadequate reimbursement is

a major barrier to providing mental health counseling."[258] Of note, 46% reported that they would be interested in hiring mental health clinicians in their practice "if payment and financial resources were not an issue."[258]

Payers' practices regarding medication approval also create challenges for treating pediatric ADHD. In conflict with best-practice or evidence-based guidelines, payers commonly favor 1 ADHD medication and refuse to approve others, even when the latter may be more appropriate for a specific patient. Decisions seem to be made on cost, which at times can be variable. Certain drugs may be allowed only after review processes; others are refused for poorly delineated reasons. Reviewers of insurance denial appeals often lack pediatric experience and are unfamiliar with the effect of the patient's coexisting condition(s) or developmental stage on the medication choice. Step therapy protocols that require specific medications at treatment initiation may require patients to undergo time-consuming treatment failures before an effective therapy can be started. Changes to formularies may force medication changes on patients whose ADHD had been well-controlled, leading to morbidity or delays in finding alternative covered medications that might be equally effective in restoring clinical control.

Similarly, payers may inappropriately insist that a newer replacement drug be used in a patient whose ADHD has been well-controlled by another drug of the same or similar class. The assumption that generic psychoactive preparations are equal to brand-name compounds in efficacy and duration of action is not always accurate.[261] Although generic substitution is generally appropriate, a change in a patient's response may necessitate return to the nongeneric formulation. In addition, because of the variation in covered medications across insurance companies, when a family changes health plans, clinicians have to spend more time to clarify treatments and reduce family stress and their economic burden.

Suggested Strategies for Change to Address Inadequate Payment and Payer Coverage Limitations: Policy-Oriented Strategies

- Revise payment systems to reflect the time and cognitive effort required by primary care, developmental-behavioral, and mental health clinicians to diagnose, treat, and manage pediatric ADHD and compensate these services at levels that incentivize and support their use.
- Support innovative partnerships between payers and clinicians to facilitate high-quality ADHD care. As new payment models are proposed, include input from practicing clinicians to inform insurance plans' understanding of the resources needed to provide comprehensive ADHD care.
- Require that payers' medical directors who review pediatric ADHD protocols and medication formularies either have pediatric expertise or seek such expertise before making decisions that affect the management of pediatric patients with ADHD.
- Advocate that health care payers' rules for approval of developmental-behavioral and mental health care services and medications are consistent with best-practice recommendations based on scientific evidence such as the AAP ADHD guideline. Payers should not use arbitrary step-based medication approval practices or force changes to a patient's stable and effective medication plans because of cost-based formulary changes.
- Advocate for better monitoring by the FDA of ADHD medication generic formulations to verify their equivalency to brand-name preparations in terms of potency and delivery.
- Partner with CHADD and other parent support groups to help advocate for positive changes in payers' rules; these organizations provide a strong voice from families who face the challenges on a day-to-day basis.

Challenges in Practice Organization

ADHD is a chronic condition. Comprehensive ADHD care requires additional clinician time for complex visits, consultation and communication with care team members, and extended staff time to coordinate delivery of chronic care. Children and adolescents with ADHD have a special health care condition and should be cared for in a manner similar to that of other children and youth with special health care needs.[262] Such care is ideally delivered by practices that are established as patient- and family-centered medical homes. Yet, the number of patient- and family-centered medical homes is insufficient to meet the needs of many children with ADHD and their families. Pediatricians and other PCCs who have not adopted a patient- and family-centered medical home model may benefit from the use of similar systems to facilitate ADHD management. For more information, see the recommendations and descriptions from the AAP and the American Academy of Family Medicine regarding medical homes.[262]

Caring for children and adolescents with ADHD requires practices to modify office systems to address their patients' mental health care needs. Specifically, practices need to be

familiar with local area mental health referral options, where available, and communicate these options to families. Once a referral has been made, the office flow needs to support communication with other ADHD care team members.[263] Other team members, especially those in mental health, need to formally communicate with the referring clinician in a bidirectional process.

Making a referral does not always mean that the patient is able to access care, however. Practices need to consider that many families face difficulties in following through with referrals for ADHD diagnosis and treatment. These difficulties may arise for a variety of reasons, including lack of insurance coverage, lengthy wait lists for mental health providers, transportation difficulties, reluctance to engage with an unfamiliar care system, cultural factors, and/or the perceived stigma of receiving mental health–specific services.[145,146,155,158]

Many of these barriers can be addressed by the integration of mental health services within primary care practices and other innovative collaborative care models. These models can help increase the opportunities for families to receive care in a familiar and accessible location and provide a "warm hand off" of the patient into the mental health arena. The implementation of these models can be hindered by cost; collaboration with mental health agencies may be fruitful.

Another challenge is the difficulty in determining which mental health subspecialists use evidence-based treatments for ADHD. Pediatricians and other PCCs can increase the likelihood that families receive evidence-based services by establishing a referral network of clinicians who are known to use evidence-based practices and educating parents about effective psychosocial treatments for children and adolescents to help them be wise consumers. It is also important to be cognizant of the fact that for some families, accessing these services may present challenges, such as the need to take time off from work or cover any program costs.

Finding professionals who use evidence-based treatments is of the utmost importance, because exposure to non–evidence-based treatments has the potential to harm patients in several ways. First, the treatment is less likely to be effective and may be harmful (eg, adverse events can and do occur in psychosocial treatments).[264] Second, the effort and money spent on ineffective treatment interferes with the ability to meaningfully engage in evidence-based treatments. Finally, when a treatment does not yield benefits, families are likely to become disillusioned with psychosocial treatments generally, even those that are evidence-based, decreasing the likelihood of future engagement. Each of these harms may place the child at greater risk of problematic outcomes over time.

Suggested Strategies to Address Challenges in Practice Organization

Clinician-Focused Implementation Strategies

- Develop ADHD-specific office workflows, as detailed in the Preparing the Practice section of the PoCA (see Supplemental Information).
- Ensure that the practice is welcoming and inclusive to patients and families of all backgrounds and cultures.
- Enable office systems to support communication with parents, education professionals, and mental health specialists, possibly through electronic communication systems (discussed below).
- Consider office certification as a patient- and family-centered medical home.
- If certification as a patient- and family-centered medical home is not feasible, implement medical home policies and procedures, including care conferences and management. Explore care management opportunities, including adequate resourcing and payment, with third-party payers.
- Identify and establish relationships with mental health consultation and referral sources in the community and within region, if available, and investigate integration of services as well as the resources to support them.
- Promote communication between ADHD care team members by integrating health and mental health services and using collaborative care model treatments when possible.
- Be aware of the community mental health crisis providers' referral processes and be prepared to educate families about evidence-based psychosocial treatments for ADHD across the life span.

Policy-Oriented Suggested Strategies

- Encourage efforts to support the development and maintenance of patient- and family-centered medical homes or related systems to enable patients with chronic complex disorders to receive comprehensive care.
- Support streamlined, coordinated ADHD care across systems by providing incentives for the integration of health and mental health services and collaborative care models.

Fragmentation of Care and Resulting Communication Barriers

Multiple team members provide care for children and adolescents with ADHD, including those in the fields of physical health, mental health, and education. Each of these systems has its own professional standards and terminologies, environments, and hierarchical systems. Moreover, they protect communication via different privacy rules: the Health Insurance Portability and Accountability Act (HIPAA)[265] for the physical and mental health systems and the Family Educational Rights and Privacy Act (FERPA)[266] for the education system. These factors complicate communication not only within but also across these fields. The lack of communication interferes with clinicians' abilities to make accurate diagnoses of ADHD and co-occurring conditions, monitor progress in symptom reduction when providing treatment, identify patient resources, and coordinate the most effective services for children and adolescents with ADHD.

Electronic systems can help address these communication barriers by facilitating asynchronous communication among stakeholders. This is particularly useful for disparate stakeholders, such as parents, teachers, and clinicians, who often cannot all be available simultaneously for a telephone or in-person conference. Electronic systems can also facilitate the timely completion and submission of standardized ADHD rating scales, which are the best tools to assess and treat the condition.[267] Because implementation of electronic systems lies partially within the PCC's control, additional information is provided below on the strengths and weaknesses of a variety of such systems, including telemedicine.

Stand-alone Software Platforms and EHRs

Stand-alone software platforms and EHRs have the potential to improve communication and care coordination among ADHD care team members. Commercially available stand-alone software platforms typically use electronic survey interfaces (either Web or mobile) to collect rating data from parents and teachers, use algorithms to score the data, and display the results cross-sectionally or longitudinally for the clinician's review. Advantages of stand-alone platforms include the fact that they are designed specifically for ADHD care and can be accessed via the Internet through computers and mobile devices. Once implemented, these user-friendly systems allow parents, teachers, and practitioners from multiple disciplines or practices to conveniently complete rating scales remotely. Stand-alone platforms also offer the ability to customize rating scales and their frequency of use for individual patients. Submitted data are stored automatically in a database, mitigating the transcription errors that are often associated with manual data entry. Data are available for clinical care, quality improvement, or research, including quality metrics.

A substantial downside to stand-alone ADHD care systems is the lack of data integration into EHRs. Practitioners must log in to disparate systems for different facets of patient care: the stand-alone system to track ADHD symptoms and the EHR to track medications records, visit notes, and patient or family phone calls. To achieve data accuracy in the 2 different systems, the practitioner must copy medication information from the EHR into the stand-alone system and ADHD symptom and adverse effect ratings from the stand-alone system into the EHR. In addition, stand-alone systems require clinicians to log in before each visit to review the relevant ADHD care data. Patients may use a variety of ADHD stand-alone tracking systems, requiring the PCC to remember several accounts and passwords in addition to his or her own office and hospital EHR systems, creating an added burden that may reduce enthusiasm for such platforms. Finally, stand-alone systems typically charge fees to support the maintenance of servers, cybersecurity, and technical and customer support functionalities.

An issue over which the PCC has little control is the fact that other stakeholders may use stand-alone systems inconsistently. Parents (who may themselves have ADHD) must log in to the platform and complete the requisite ADHD rating scales. Teachers may be required to log in and complete the evaluation process, often for several students, on top of their other obligations. The fact that different pediatricians may use different systems, each with their own log-in and interface, adds to the activity's complexity, particularly for teachers who need to report on multiple students to a variety of PCCs.

EHRs for ADHD Management

EHRs can be adapted to improve the timely collection of parent and teacher ratings of ADHD symptoms, impairment, and medication adverse effects. Some EHRs use an electronic survey functionality or patient portal, similar to that provided by ADHD care stand-alone systems, to allow parents' access to online rating scales. A clear advantage of these EHR systems is that they increase the ability to access documentation about an individual patient's past treatment modalities and medications in the same place as information about his or her ADHD symptoms. The functionality of these EHRs may facilitate other care-related

activities, including evidence-based decision support, quality improvement efforts, and outcomes reporting.[268]

Despite these benefits, there are numerous limitations to managing ADHD care with EHRs. First, health care systems' confidentiality barriers often prevent teachers from entering ratings directly into the child's medical record. The large number and heterogeneity of EHR systems and their lack of interoperability are additional barriers to their use for ADHD care.[269] Even when institutions use the same vendor's EHR, exchanging respective ADHD documentation among a variety of clinicians and therapists is frequently impossible.[270] The inability to share information and the lack of interoperability often results in incomplete information in the EHR about a given patient's interventions, symptoms, impairments, and adverse effects over time. Systems for tracking and comparing these aspects of a patient's care are not standard for most EHR packages. The ability to construct templates that are congruent with a clinician's workflow may be limited by the EHR itself. ADHD functionality must often be custom-built for each organization, a cumbersome, expensive, and lengthy process, resulting in lost productivity, clinical effectiveness, and revenue.

General Issues With ADHD Electronic Tracking Systems

EHRs have been linked to increased clinician stress. For this reason, it is important to consider the potential for added burden when either stand-alone or EHR-embedded systems are used to facilitate ADHD care.[271] Although the use of electronic ADHD systems to monitor patients remotely may be advantageous, clinicians and practices may not be equipped or staffed to manage the burden of additional clinical information arriving between visits (ie, intervisit data).

Clinicians must also consider the liability associated with potentially actionable information that families may report electronically without realizing the information might not be reviewed in real time. Examples of such liabilities include a severe medication adverse effect, free-text report of suicidal ideation, and sudden deterioration in ADHD symptoms and/or functioning. In addition, parents and teachers may receive numerous requests to complete rating scales, leading them to experience "survey fatigue" and ignore the requests to complete these scales. Conversely, they may forget how to use the system if they engage with it on an infrequent basis. Some parents or teachers may be uncomfortable using electronic systems and within the medical home might prefer paper rating scales, and others may not have ready access to electronic systems or the Internet.

Telemedicine for ADHD Management

Telemedicine is a new and rapidly growing technology that has the potential, when properly implemented within the medical home, to expand access to care and to improve clinicians' ability to communicate with schools, consultants, care management team members, and especially patients and parents.[213,272,273] Well-run telemedicine programs offer some promise as a way to deliver evidence-based psychosocial treatments, although few evidence-based programs have been tested via telemental health trials.[274,275] Telemedicine is one of the foundations of the new advanced medical home and offers advantages as follows:

- offering communication opportunities (either face-to-face and synchronous as a conversation or asynchronous as messaging), which can be prescheduled to minimize interruption of office flow;
- enabling communication on a one-on-one basis or one-to-many basis (for conference situations);
- replacing repeated office visits for patient follow-up and monitoring, which reduces time and the need for patients to travel to the PCC's office;
- facilitating digital storage of the telemedicine episode and its incorporation into multiple EHR systems as part of the patient record; and
- enhancing cooperation among all parties in the evaluation and treatment processes.

Telemedicine has great potential but needs to be properly implemented and integrated into the practice workflow to achieve maximum effectiveness and flexibility. Although some new state insurance regulations mandate payment for telemedicine services, such mandates have not yet been implemented in all states, limiting telemedicine's utility. Finally, payment for services needs to include the added cost of equipment and staff to provide them.

Suggested Strategies to Address Fragmentation of Care and Resulting Communication Barriers

Clinician-Focused Implementation Strategies

- Ensure the practice is aware of, and in compliance with, HIPAA and FERPA policies, as well as confidentiality laws and cybersecurity safeguards that impact EHRs' communication with school personnel and parents.[276]
- Maintain open lines of communication with all team members involved in the patient's ADHD care within the practical limits of existing systems, time, and economic constraints. As noted,

team members include teachers, other school personnel, clinicians, and mental health practitioners. This activity involves a team-based approach and agreeing on a communication method and process to track ADHD interventions, symptoms, impairments, and adverse effects over time. Communication can be accomplished through a variety of means, including electronic systems, face-to-face meetings, conference calls, emails, and/or faxes.

- Consider using electronic communication via stand-alone ADHD management systems and electronic portals, after evaluating EHR interoperability and other administrative considerations.
- Integrate electronic ADHD systems into the practice's clinical workflow: decide who will review the data and when, how actionable information will be flagged and triaged, how information and related decision-making will be documented in the medical record, etc.
- Set and clarify caregivers' expectations about the practice's review of information provided electronically versus actionable information that should be communicated directly by phone.
- Promote the implementation of telemedicine for ADHD management in states where payment for such services is established; ensure the telemedicine system chosen is patient centered, HIPAA and FERPA compliant, and practice enhancing.

Policy-Oriented Suggested Strategies

- Promote the development of mechanisms for online communication to enhance ADHD care collaboration, including electronic portals and stand-alone ADHD software systems, to serve as communication platforms for families, health professionals, mental health professionals, and educators. Ideally, these portals would be integrated with the most commonly used EHR systems.
- Advocate for regulations that mandate a common standard of interoperability for certified EHR systems. Interoperability facilitates the use of EHRs as a common repository of ADHD care information and communication platform for ADHD care team members.[276]
- Advocate for exceptions to HIPAA and FERPA regulations to allow more communication between education and health and mental health practitioners while maintaining privacy protections.
- Ensure that billing, coding, and payment systems provide adequate resources and time for clinicians to communicate with teachers and mental health clinicians, as discussed previously.
- Provide incentives for integration of health and mental health services, collaborative care models, and telemedicine to facilitate communication among ADHD care team members, including telemedicine services that cross state lines.
- Fund research in telehealth to learn more about who responds well to these approaches and whether telehealth is feasible for underserved populations.

CONCLUSIONS

Appropriate and comprehensive ADHD care requires a well-trained and adequately resourced multidisciplinary workforce, with office workflows that are organized to provide collaborative services that are consistent with a chronic care model and to promote communication among treatment team members.[277–280] Many barriers in the current health care system must be addressed to support this care.

First and foremost, the shortage of clinicians, such as child and adolescent psychiatrists and developmental-behavioral pediatricians who provide consultation and referral ADHD care, must also be addressed. The shortages are driven by the lack of residency and other training programs for pediatric clinicians in the management of ADHD and other behavioral health issues, the lack of return on investment in the additional training and debt required to specialize in this area, and inadequate resourcing at all levels of ADHD care. The shortage is exacerbated by geographic maldistribution of practitioners and lack of adequate mental health training as a whole during residency and in CME projects. These challenges must be addressed on a system-wide level.

A significant review and change in the ADHD care payment for cognitive services is required to ensure that practitioners are backed by appropriate resources that support the provision of high-quality ADHD care. The lack of adequate compensation for ADHD care is a major challenge to reaching children and adolescents with the care they need. Improved payment is a major need to encourage primary care clinicians to train in ADHD subspecialty care and incentivize child and adolescent psychiatry and developmental-behavioral pediatrics practitioners to provide ADHD care in the primary care setting, so the provision of such care does not result in financial hardship for the families or the practice. Improvement should also include changes to payer policies to improve compensation for care

coordination services and mental health care.

Because the pediatrician is often the first contact for a parent seeking help for a child with symptoms that may be caused by ADHD, barriers to payment need to be addressed before providing these time-consuming services. Some insurance plans direct all claims with a diagnosis reported by *International Classification of Diseases, 10th Revision, Clinical Modification* codes F01–F99 to their mental and behavioral health benefits system. Because pediatricians are generally not included in networks for mental and behavioral health plans, this can create delays or denials of payment. This is not always the case, though, and with a little preventive footwork, practices can identify policy guidelines for plans that are commonly seen in the practice patient population.

The first step in identifying coverage for services to diagnose or treat ADHD is to determine what payment guidelines have been published by plans that contract with your practice. Many health plans post their payment guidelines on their Web sites, but even when publicly available, the documents do not always clearly address whether payment for primary care diagnosis and management of ADHD are covered. It may be necessary to send a written inquiry to provider relations and the medical director of a plan seeking clarification of what diagnoses and procedure codes should pass through the health benefit plan's adjudication system without denial or crossover to a mental health benefit plan. It is important to recognize that even with documentation that the plan covers primary care services related to ADHD, claims adjudication is an automated process that may erroneously cause denials. Billing and payment reconciliation staff should always refer such denials for appeal.

Once plans that do and do not provide medical benefits for the diagnosis and treatment of ADHD have been identified, advocacy to the medical directors of those plans that do not recognize the role of the medical home in mental health care can be initiated. The AAP template letter, Increasing Access to Mental Health Care, is a resource for this purpose. Practices should also be prepared to offer advance notice to parents when their plan is likely to deny or pay out of network for services. A list of referral sources for mental and behavioral health is also helpful for parents whose financial limitations may require alternative choices and for patients who may require referral for additional evaluation.

For services rendered, identify the codes that represent covered diagnoses and services and be sure that these codes are appropriately linked and reported on claims.

When ADHD is suspected but not yet diagnosed, symptoms such as attention and concentration deficit (R41.840) should be reported. Screening for ADHD in the absence of signs or symptoms may be reported with code Z13.4, encounter for screening for certain developmental disorders in childhood. *Current Procedural Terminology* codes 96110 and 96112 to 96113 should be reported for developmental screening and testing services.

Services related to diagnosis and management of ADHD are more likely to be paid under the patient's medical benefits when codes reported are not those for psychiatric or behavioral health services. Reporting of E/M service codes based on face-to-face time of the visit when more than 50% of that time was spent in counseling or coordination of care will likely be more effective than use of codes such as 90791, psychiatric diagnostic evaluation. *Current Procedural Terminology* E/M service guidelines define counseling as a discussion with a patient or family concerning 1 or more of the following areas:

- diagnostic results, impressions, or recommended diagnostic studies;
- prognosis;
- risks and benefits of management (treatment) options;
- instructions for management (treatment) or follow-up;
- importance of compliance with chosen management (treatment) options;
- risk factor reduction; and
- patient and family education.

Finally, staff should track claim payment trends for services related to ADHD, including the number of claims requiring appeal and status of appeal determinations to inform future advocacy efforts and practice policy.

Many AAP chapters have developed pediatric councils that meet with payers on pediatric coding issues. Sharing your experiences with your chapter pediatric council will assist in its advocacy efforts. AAP members can also report carrier issues on the AAP Hassle Factor Form.

These system-wide barriers are challenging, if not impossible, for individual practitioners to address on their own. Practice organization and communication changes can be made, however, that have the potential to improve access to ADHD care. Clinicians and other practitioners can implement the office work-flow recommendations made in the Preparing the Practice section of the updated PoCA (see Supplemental Information). Implementing a patient- and family-centered medical home model, colocating health and mental health services, and adopting collaborative care models can also help overcome communication barriers and minimize fragmentation of care. It is noted that these models must be adequately resourced to be effective.

Finally, practitioners can implement innovative communication and record-keeping solutions to overcome barriers to ADHD care. Potential solutions could include the use of EHRs, other electronic systems, and high-quality telemedicine to support enhanced communication and record-keeping on the part of myriad ADHD care team members. These solutions can also aid with monitoring treatment responses on the part of the child or adolescent with ADHD. Telemedicine also has the distinct benefit of compensating for the maldistribution of specialists and other clinicians who can treat pediatric ADHD.

Many stakeholders have a role in addressing the barriers that prevent children and adolescents from receiving needed evidenced-based treatment of ADHD. Pediatric councils, the national AAP, and state and local AAP chapters must be advocates for broad changes in training, CME, and payment policies to overcome the systemic challenges that hamper access to care. On an individual level, practitioners can effect change in their own practice systems and professional approaches and implement systems that address fragmentation of care and communication. Practitioners are important agents for change in ADHD care. The day-to-day interactions that practitioners have with patients, families, educators, payers, state insurance regulators, and others can foster comprehensive, contemporary, and effective care that becomes a pillar of advocacy and change.

SUBCOMMITTEE ON CHILDREN AND ADOLESCENTS WITH ATTENTION-DEFICIT/HYPERACTIVITY DISORDER

The Council on Quality Improvement and Patient Safety oversees the Subcommittee

Mark L. Wolraich, MD, FAAP (Chairperson: Section on Developmental Behavioral Pediatrics).

Joseph F. Hagan, Jr, MD, FAAP (Vice Chairperson: Section on Developmental Behavioral Pediatrics).

Carla Allan, PhD (Society of Pediatric Psychology).

Eugenia Chan, MD, MPH, FAAP (Implementation Scientist).

Dale Davison, MSpEd, PCC (Parent Advocate, Children and Adults with ADHD).

Marian Earls, MD, MTS, FAAP (Mental Health Leadership Work Group).

Steven W. Evans, PhD (Clinical Psychologist).

Tanya Froehlich, MD, FAAP (Section on Developmental Behavioral Pediatrics/Society for Developmental and Behavioral Pediatrics).

Jennifer L. Frost, MD, FAAFP (American Academy of Family Physicians).

Herschel R. Lessin, MD, FAAP, Section on Administration and Practice Management).

Karen L. Pierce, MD, DFAACAP (American Academy of Child and Adolescent Psychiatry).

Christoph Ulrich Lehmann, MD, FAAP (Partnership for Policy Implementation).

Jonathan D. Winner, MD, FAAP (Committee on Practice and Ambulatory Medicine).

William Zurhellen, MD, FAAP (Section on Administration and Practice Management).

STAFF

Kymika Okechukwu, MPA, Senior Manager, Evidence-Based Medicine Initiatives

Jeremiah Salmon, MPH, Program Manager, Policy Dissemination and Implementation

CONSULTANT

Susan K. Flinn, MA, Medical Editor

SUPPLEMENTAL REFERENCES

157. Bright Futures Available at: https://brightfutures.aap.org. Accessed September 8, 2019

158. American Academy of Pediatrics. AAP Diversity and Inclusion Statement. *Pediatrics*. 2018;141(4): e20180193

159. Chronis AM, Lahey BB, Pelham WE Jr, Kipp HL, Baumann BL, Lee SS. Psychopathology and substance abuse in parents of young children with attention-deficit/hyperactivity disorder. *J Am Acad Child Adolesc Psychiatry*. 2003;42(12):1424–1432

160. Foy JM, ed. Iterative Mental Health Assessement, Appendix 2: Mental Health Tools for Pediatrics. In: *Mental Health Care of Children and Adolescents: A Guide for Primary Care Clinicians*. Itasca, IL: American Academy of Pediatrics; 2018:817–868

161. Wolraich ML, Bard DE, Neas B, Doffing M, Beck L. The psychometric properties of the Vanderbilt attention-deficit hyperactivity disorder diagnostic teacher rating scale in a community population. *J Dev Behav Pediatr*. 2013;34(2):83–93

162. Bard DE, Wolraich ML, Neas B, Doffing M, Beck L. The psychometric properties of the Vanderbilt attention-deficit hyperactivity disorder diagnostic parent rating scale in a community population. *J Dev Behav Pediatr*. 2013;34(2):72–82

163. Goodman R. The extended version of the Strengths and Difficulties Questionnaire as a guide to child psychiatric caseness and consequent burden. *J Child Psychol Psychiatry*. 1999;40(5):791–799

164. Shaffer D, Gould MS, Brasic J, et al. A children's global assessment scale (CGAS). *Arch Gen Psychiatry*. 1983; 40(11):1228–1231

165. Brown RT, Freeman WS, Perrin JM, et al. Prevalence and assessment of attention-deficit/hyperactivity disorder in primary care settings. *Pediatrics*. 2001;107(3). Available at:

www.pediatrics.org/cgi/content/full/107/3/E43

166. Evans SW, Allen J, Moore S, Strauss V. Measuring symptoms and functioning of youth with ADHD in middle schools. *J Abnorm Child Psychol*. 2005;33(6):695–706

167. Wolraich ML, Lambert EW, Bickman L, Simmons T, Doffing MA, Worley KA. Assessing the impact of parent and teacher agreement on diagnosing attention-deficit hyperactivity disorder. *J Dev Behav Pediatr*. 2004;25(1):41–47

168. DiPerna JC, Elliott SN. *Academic Competence Evaluation Scales (ACES)*. San Antonio, TX: The Psychological Corporation; 2000

169. Smith BH, Pelham WE, Gnagy E, Molina B, Evans S. The reliability, validity, and unique contributions of self-report by adolescents receiving treatment for attention-deficit/hyperactivity disorder. *J Consult Clin Psychol*. 2000;68(3):489–499

170. Hoza B, Pelham WE Jr, Dobbs J, Owens JS, Pillow DR. Do boys with attention-deficit/hyperactivity disorder have positive illusory self-concepts? *J Abnorm Psychol*. 2002;111(2):268–278

171. Zuckerbrot RA, Cheung AH, Jensen PS, Stein RE, Laraque D; GLAD-PC Steering Group. Guidelines for adolescent depression in primary care (GLAD-PC): I. Identification, assessment, and initial management. *Pediatrics*. 2007;120(5). Available at: www.pediatrics.org/cgi/content/full/120/5/e1299

172. Cheung AH, Zuckerbrot RA, Jensen PS, Ghalib K, Laraque D, Stein RE; GLAD-PC Steering Group. Guidelines for adolescent depression in primary care (GLAD-PC): II. Treatment and ongoing management. *Pediatrics*. 2007;120(5). Available at: www.pediatrics.org/cgi/content/full/120/5/e1313

173. Foy JM, ed. Low Mood, Appendix 2: Mental Health Tools for Pediatrics. In: *Mental Health Care of Children and Adolescents: A Guide for Primary Care Clinicians*. Itasca, IL: American Academy of Pediatrics; 2018:817–868

174. The Center for Adolescent Substance Use Research, Children's Hospital Boston. *CRAFFT: Screening Adolescents for Alcohol and Drugs*. Boston, MA: Children's Hospital Boston; 2001. Available at: http://www.childrenshospital.org/~/media/microsites/ceasar/2016-2sided-crafft-card_clinician-interview.ashx?la=en. Accessed September 8, 2019

175. Levy S, Weiss R, Sherritt L, et al. An electronic screen for triaging adolescent substance use by risk levels. *JAMA Pediatr*. 2014;168(9):822–828

176. University of Pittsburgh Child and Adolescent Bipolar Spectrum Services. Instruments: Screen for Child Anxiety Related Emotional Disorders (SCARED). Available at: https://www.pediatricbipolar.pitt.edu/resources/instruments. Accessed September 8, 2019

177. Kovacs M. *CDI 2: Children's Depression Inventory*. 2nd ed. North Tonawanda, NY: Multi-Health Systems Assessments; 2018. Available at: https://www.mhs.com/MHS-Assessment?prodname=cdi2. Accessed September 8, 2019

178. Richardson LP, McCauley E, Grossman DC, et al. Evaluation of the Patient Health Questionnaire-9 Item for detecting major depression among adolescents. *Pediatrics*. 2010;126(6):1117–1123

179. Sleator EK, Ullmann RK. Can the physician diagnose hyperactivity in the office? *Pediatrics*. 1981;67(1):13–17

180. American Academy of Pediatrics. Fetal alcohol spectrum disorders program: toolkit. Available at: https://www.aap.org/en-us/advocacy-and-policy/aap-health-initiatives/fetal-alcohol-spectrum-disorders-toolkit/Pages/default.aspx. Accessed September 8, 2019

181. Hagan JF Jr, Balachova T, Bertrand J, et al; Neurobehavioral Disorder Associated With Prenatal Alcohol Exposure Workgroup; American Academy of Pediatrics. Neurobehavioral disorder associated with prenatal alcohol exposure. *Pediatrics*. 2016;138(4):e20151553

182. Gardner W, Murphy M, Childs G, et al. The PSC-17: a brief pediatric symptom checklist including psychosocial problem subscales: a report from PROS and ASPN. *Ambul Child Health*. 1999;5:225–236

183. National Institutes of Health. *Screening to Brief Intervention (S2BI)*. Bethesda, MD: National Institute on Drug Abuse. Available at: https://www.drugabuse.gov/ast/s2bi/#/. Accessed September 8, 2019

184. Levy SJ, Williams JF; Committee on Substance Use and Prevention. Substance use screening, brief intervention, and referral to treatment. *Pediatrics*. 2016;138(1):e20161211

185. University of Washington Harborview Center for Sexual Assault and Traumatic Stress. Standardized measures. Available at: https://depts.washington.edu/hcsats/PDF/TF-%20CBT/pages/assessment.html. Accessed September 8, 2019

186. Gordon M, Barkley RA, Lovett B. Tests and observational measures. In: Barkley RA, ed. *Attention-Deficit Hyperactivity Disorder Third Edition: A Handbook for Diagnosis and Treatment*. 3rd ed. New York, NY: Guilford Press; 2005:369–388

187. Edwards MC, Gardner ES, Chelonis JJ, Schulz EG, Flake RA, Diaz PF. Estimates of the validity and utility of the Conners' Continuous Performance Test in the assessment of inattentive and/or hyperactive-impulsive behaviors in children. *J Abnorm Child Psychol*. 2007;35(3):393–404

188. Li J, Olsen J, Vestergaard M, Obel C. Attention-deficit/hyperactivity disorder in the offspring following prenatal maternal bereavement: a nationwide follow-up study in Denmark. *Eur Child Adolesc Psychiatry*. 2010;19(10):747–753

189. Angold A, Erkanli A, Egger HL, Costello EJ. Stimulant treatment for children: a community perspective. *J Am Acad Child Adolesc Psychiatry*. 2000;39(8):975–984; discussion 984–994

190. Konofal E, Lecendreux M, Cortese S. Sleep and ADHD. *Sleep Med*. 2010;11(7):652–658

191. Gozal D, Kheirandish-Gozal L. Neurocognitive and behavioral morbidity in children with sleep disorders. *Curr Opin Pulm Med*. 2007;13(6):505–509

192. Capdevila OS, Kheirandish-Gozal L, Dayyat E, Gozal D. Pediatric obstructive sleep apnea: complications, management, and long-term

outcomes. *Proc Am Thorac Soc*. 2008; 5(2):274–282

193. Cortese S, Konofal E, Lecendreux M, et al. Restless legs syndrome and attention-deficit/hyperactivity disorder: a review of the literature. *Sleep*. 2005;28(8):1007–1013

194. Weiss MD, Wasdell MB, Bomben MM, Rea KJ, Freeman RD. Sleep hygiene and melatonin treatment for children and adolescents with ADHD and initial insomnia. *J Am Acad Child Adolesc Psychiatry*. 2006;45(5):512–519

195. Stein MA, Sarampote CS, Waldman ID, et al. A dose-response study of OROS methylphenidate in children and adolescents with attention-deficit/hyperactivity disorder. *Pediatrics*. 2003;112(5). Available at: www.pediatrics.org/cgi/content/full/112/5/e404

196. Corkum P, Panton R, Ironside S, Macpherson M, Williams T. Acute impact of immediate release methylphenidate administered three times a day on sleep in children with attention-deficit/hyperactivity disorder. *J Pediatr Psychol*. 2008;33(4): 368–379

197. O'Brien LM, Ivanenko A, Crabtree VM, et al. The effect of stimulants on sleep characteristics in children with attention deficit/hyperactivity disorder. *Sleep Med*. 2003;4(4): 309–316

198. Owens J, Sangal RB, Sutton VK, Bakken R, Allen AJ, Kelsey D. Subjective and objective measures of sleep in children with attention-deficit/hyperactivity disorder. *Sleep Med*. 2009;10(4):446–456

199. Owens JA. A clinical overview of sleep and attention-deficit/hyperactivity disorder in children and adolescents. *J Can Acad Child Adolesc Psychiatry*. 2009;18(2):92–102

200. Mick E, Biederman J, Jetton J, Faraone SV. Sleep disturbances associated with attention deficit hyperactivity disorder: the impact of psychiatric comorbidity and pharmacotherapy. *J Child Adolesc Psychopharmacol*. 2000;10(3):223–231

201. van der Heijden KB, Smits MG, van Someren EJ, Boudewijn Gunning W. Prediction of melatonin efficacy by pretreatment dim light melatonin onset in children with idiopathic chronic sleep onset insomnia. *J Sleep Res*. 2005;14(2):187–194

202. Cortese S, Faraone SV, Konofal E, Lecendreux M. Sleep in children with attention-deficit/hyperactivity disorder: meta-analysis of subjective and objective studies. *J Am Acad Child Adolesc Psychiatry*. 2009;48(9):894–908

203. Golan N, Shahar E, Ravid S, Pillar G. Sleep disorders and daytime sleepiness in children with attention-deficit/hyperactive disorder. *Sleep*. 2004;27(2):261–266

204. Lecendreux M, Konofal E, Bouvard M, Falissard B, Mouren-Siméoni MC. Sleep and alertness in children with ADHD. *J Child Psychol Psychiatry*. 2000;41(6): 803–812

205. Owens JA, Dalzell V. Use of the 'BEARS' sleep screening tool in a pediatric residents' continuity clinic: a pilot study. *Sleep Med*. 2005;6(1):63–69

206. Chervin RD, Hedger K, Dillon JE, Pituch KJ. Pediatric sleep questionnaire (PSQ): validity and reliability of scales for sleep-disordered breathing, snoring, sleepiness, and behavioral problems. *Sleep Med*. 2000;1(1):21–32

207. Owens JA, Spirito A, McGuinn M. The Children's Sleep Habits Questionnaire (CSHQ): psychometric properties of a survey instrument for school-aged children. *Sleep*. 2000;23(8):1043–1051

208. Aurora RN, Zak RS, Karippot A, et al; American Academy of Sleep Medicine. Practice parameters for the respiratory indications for polysomnography in children. *Sleep (Basel)*. 2011;34(3):379–388

209. Aurora RN, Lamm CI, Zak RS, et al. Practice parameters for the non-respiratory indications for polysomnography and multiple sleep latency testing for children. *Sleep (Basel)*. 2012;35(11):1467–1473

210. Gruber R, Wiebe S, Montecalvo L, Brunetti B, Amsel R, Carrier J. Impact of sleep restriction on neurobehavioral functioning of children with attention deficit hyperactivity disorder. *Sleep (Basel)*. 2011;34(3):315–323

211. Bunford N, Evans SW, Wymbs F. ADHD and emotion dysregulation among children and adolescents. *Clin Child Fam Psychol Rev*. 2015;18(3):185–217

212. Langberg JM, Vaughn AJ, Brinkman WB, Froehlich T, Epstein JN. Clinical utility of the Vanderbilt ADHD Rating Scale for ruling out comorbid learning disorders. *Pediatrics*. 2010;126(5). Available at: www.pediatrics.org/cgi/content/full/126/5/e1033

213. Kressly SJ. Extending the medical home to meet your patients' mental health needs: is telehealth the answer? *Pediatrics*. 2019;143(3): e20183765

214. Dudek E, Henschen E, Finkle E, Vyas S, Fiszbein D, Shukla A. Improving continuity in a patient centered medical home. *Pediatrics*. 2018;142(1): 366

215. Dessie AS, Hirway P, Gjelsvik A. Children with developmental, behavioral, or emotional problems are less likely to have a medical home. *Pediatrics*. 2018;141(1):23

216. Foy JM. The medical home and integrated behavioral health. *Pediatrics*. 2015;135(5):930–931

217. Ader J, Stille CJ, Keller D, Miller BF, Barr MS, Perrin JM. The medical home and integrated behavioral health: advancing the policy agenda. *Pediatrics*. 2015;135(5):909–917

218. American Academy of Pediatrics. Collaboration in practice: implementing team-based care. *Pediatrics*. 2016;138(2):e20161486

219. Kressley SJ. Team-based care for children: who should be included and who should lead? *AAP News*. July 24, 2017. Available at: https://www.aappublications.org/news/2017/07/24/TeamBased072417. Accessed September 8, 2019

220. Katkin JP, Kressly SJ, Edwards AR, et al; Task Force on Pediatric Practice Change. Guiding principles for team-based pediatric care. *Pediatrics*. 2017; 140(2):e20171489

221. Godoy L, Hodgkinson S, Robertson HA, et al. Increasing mental health engagement from primary care: the potential role of family navigation. *Pediatrics*. 2019;143(4):e20182418

222. Wolraich ML, Hagan JF Jr. *ADHD: What Every Parent Needs to Know*. 3rd ed.

Itasca, IL: American Academy of Pediatrics; 2019. Available at: https://shop.aap.org/adhd-paperback/. Accessed September 8, 2019

223. American Academy of Pediatrics. *Understanding ADHD*. Itasca, IL: American Academy of Pediatrics; 2017. Available at: https://shop.aap.org/understanding-adhd-brochure-50pk-brochure/. Accessed September 8, 2019

224. HealthyChildren.org. ADHD. 2018. Available at: https://www.healthychildren.org/English/health-issues/conditions/adhd/Pages/default.aspx. Accessed September 8, 2019

225. American Academy of Pediatrics. *ADHD Provider Toolkit*. 3rd ed. In production

226. Reiff MI. *ADHD: What Every Parent Needs to Know*. 2nd ed. Elk Grove Village, IL: American Academy of Pediatrics; 2011

227. Charach A, Fernandez R. Enhancing ADHD medication adherence: challenges and opportunities. *Curr Psychiatry Rep*. 2013;15(7):371

228. Greenhill LL, Abikoff HB, Arnold LE, et al. Medication treatment strategies in the MTA Study: relevance to clinicians and researchers. *J Am Acad Child Adolesc Psychiatry*. 1996;35(10):1304–1313

229. Cortese S, Adamo N, Del Giovane C, et al. Comparative efficacy and tolerability of medications for attention-deficit hyperactivity disorder in children, adolescents, and adults: a systematic review and network meta-analysis. *Lancet Psychiatry*. 2018;5(9):727–738

230. Pozzi M, Carnovale C, Peeters GGAM, et al. Adverse drug events related to mood and emotion in paediatric patients treated for ADHD: a meta-analysis. *J Affect Disord*. 2018;238:161–178

231. Robin AL, Foster SL. *Negotiating Parent Adolescent Conflict: A Behavioral-Family Systems Approach*. New York, NY: Guilford Press; 1989

232. Barkley RA, Edwards G, Laneri M, Fletcher K, Metevia L. The efficacy of problem-solving communication training alone, behavior management training alone, and their combination for parent-adolescent conflict in teenagers with ADHD and ODD. *J Consult Clin Psychol*. 2001;69(6):926–941

233. Bloch MH, Qawasmi A. Omega-3 fatty acid supplementation for the treatment of children with attention-deficit/hyperactivity disorder symptomatology: systematic review and meta-analysis. *J Am Acad Child Adolesc Psychiatry*. 2011;50(10):991–1000

234. Understood.org. Get personalized recommendations for you and your child. Available at: https://www.understood.org/en/learning-attention-issues/treatments-approaches/working-with-clinicians. Accessed September 8, 2019

235. ImpactADHD. Free resources for parents. Available at: https://impactadhd.com/resources/free-impactadhd-resources-for-parents/. Accessed September 8, 2019

236. ImpactADHD. ImpactADHD. Available at: https://www.youtube.com/user/ImpactADHD. Accessed September 8, 2019

237. Halfon N, Forrest CB, Lerner RM, Faustman EM. *Handbook of Life Course Health Development*. Cham, Switzerland: Springer; 2018

238. Evans SW, Owens JS, Mautone JA, DuPaul GJ, Power TJ. Toward a comprehensive, Life Course Model of care for youth with ADHD. In: Weist M, Lever N, Bradshaw C, Owens J, eds. *Handbook of School Mental Health*. 2nd ed. New York, NY: Springer; 2014:413–426

239. Pfiffner LJ, Hinshaw SP, Owens E, et al. A two-site randomized clinical trial of integrated psychosocial treatment for ADHD-inattentive type. *J Consult Clin Psychol*. 2014;82(6):1115–1127

240. Charach A, Volpe T, Boydell KM, Gearing RE. A theoretical approach to medication adherence for children and youth with psychiatric disorders. *Harv Rev Psychiatry*. 2008;16(2):126–135

241. Foy JM, ed. *Mental Health Care of Children and Adolescents: A Guide for Primary Care Clinicians*. Itasca, IL: American Academy of Pediatrics; 2018

242. Chan E. Complementary and alternative medicine in developmental-behavioral pediatrics. In: Wolraich ML, Drotar DD, Dworkin PH, Perrin EC, eds. *Developmental-Behavioral Pediatrics: Evidence and Practice*. Philadelphia, PA: Mosby Elsevier; 2008:259–280

243. Chan E. The role of complementary and alternative medicine in attention-deficit hyperactivity disorder. *J Dev Behav Pediatr*. 2002;23(suppl 1):S37–S45

244. James S, Stevenson SW, Silove N, Williams K. Chelation for autism spectrum disorder (ASD). *Cochrane Database Syst Rev*. 2015;(5):CD010766

245. Foy JM, ed. Office and network systems to support mental health care. In: *Mental Health Care of Children and Adolescents: A Guide for Primary Care Clinicians*. Itasca, IL: American Academy of Pediatrics; 2018:73–126

246. kidsdata.org. *Children With Special Health Care Needs, by Condition (California & U.S. Only)*. Palo Alto, CA: Lucille Packard Foundation for Children's Health; 2010. Available at: https://www.kidsdata.org/topic/486/special-needs-condition/table#fmt=640&loc=1,2&tf=74&ch=152,1039,854,154,845,1040,1041,858,157,158,1042,1043,160,161,861,1044,1045,1046,165,166. Accessed September 8, 2019

247. Danielson ML, Visser SN, Gleason MM, Peacock G, Claussen AH, Blumberg SJ. A national profile of attention-deficit hyperactivity disorder diagnosis and treatment among US children aged 2 to 5 years. *J Dev Behav Pediatr*. 2017;38(7):455–464

248. American Academy of Pediatrics. Mental health initiatives: residency curriculum. Available at: https://www.aap.org/en-us/advocacy-and-policy/aap-health-initiatives/Mental-Health/Pages/Residency-Curriculum.aspx. Accessed September 8, 2019

249. American Academy of Child & Adolescent Psychiatry. *Workforce Issues*. Washington, DC: American Academy of Child & Adolescent Psychiatry; 2016. Available at: https://www.aacap.org/aacap/Resources_for_Primary_Care/Workforce_Issues.aspx. Accessed September 8, 2019

250. Thomas CR, Holzer CE III. The continuing shortage of child and adolescent psychiatrists. *J Am Acad Child Adolesc Psychiatry*. 2006;45(9): 1023–1031

251. Rohlfing J, Navarro R, Maniya OZ, Hughes BD, Rogalsky DK. Medical student debt and major life choices other than specialty. *Med Educ Online*. 2014;19:25603

252. Centers for Disease Control and Prevention. *ADHD: Behavioral Health Services – Where They Are and Who Provides Them*. Atlanta, GA: Centers for Disease Control and Prevention; 2018. Available at: https://www.cdc.gov/ncbddd/adhd/stateprofiles-providers/index.html. Accessed September 8, 2019

253. Massachusetts Child Psychiatry Access Program. MCPAP: connecting primary care with child psychiatry. Available at: https://www.mcpap.com. Accessed September 8, 2019

254. Project Training and Education for the Advancement of Children's Health. Project TEACH (Training and Education for the Advancement of Children's Health). 2018. Available at: https://projectteachny.org/. Accessed September 8, 2019

255. Project Extension for Community Healthcare Outcomes. About ECHO. Available at: https://echo.unm.edu/about-echo/. Accessed September 8, 2019

256. Health Resources and Services Administration, Maternal and Child Health Bureau. Pediatric mental health care access program. Available at: https://mchb.hrsa.gov/training/projects.asp?program=34. Accessed July 2, 2019

257. National Network of Child Psychiatry Access Programs. Integrating mental and behavioral health care for every child. Available at: https://nncpap.org/. Accessed July 2, 2019

258. Horwitz SM, Storfer-Isser A, Kerker BD, et al. Barriers to the identification and management of psychosocial problems: changes from 2004 to 2013. *Acad Pediatr*. 2015;15(6):613–620

259. American Academy of Child and Adolescent Psychiatry Committee on Health Care Access and Economics Task Force on Mental Health. Improving mental health services in primary care: reducing administrative and financial barriers to access and collaboration [published correction appears in *Pediatrics. 2009;123(6):1611]. Pediatrics*. 2009;123(4):1248–1251

260. Centers for Medicare and Medicaid Services. *Accountable Care Organizations (ACOs)*. Baltimore, MD: Centers for Medicare and Medicaid Services; 2018. Available at: https://www.cms.gov/Medicare/Medicare-Fee-for-Service-Payment/ACO/. Accessed September 8, 2019

261. Fallu A, Dabouz F, Furtado M, Anand L, Katzman MA. A randomized, double-blind, cross-over, phase IV trial of oros-methylphenidate (CONCERTA(®)) and generic novo-methylphenidate ER-C (NOVO-generic). *Ther Adv Psychopharmacol*. 2016;6(4):237–251

262. Hagan JF, Shaw JS, Duncan PM, eds. *Bright Futures Guidelines for Health Supervision of Infants, Children, and Adolescents*. 4th ed. Elk Grove Village, IL: American Academy of Pediatrics; 2017

263. Foy JM, Kelleher KJ, Laraque D; American Academy of Pediatrics Task Force on Mental Health. Enhancing pediatric mental health care: strategies for preparing a primary care practice.*Pediatrics*. 2010;125(suppl 3): S87–S108

264. Allan C, Chacko A. Adverse events in behavioral parent training for children with ADHD: an under-appreciated phenomenon. *ADHD Rep*. 2018;26(1):4–9

265. US Department of Health and Human Services. Health information privacy. Available at: https://www.hhs.gov/hipaa/index.html. Accessed September 8, 2019

266. US Department of Education. *Family Educational Rights and Privacy Act (FERPA)*. Washington, DC: Department of Education; 2018. Available at: https://www2.ed.gov/policy/gen/guid/fpco/ferpa/index.html. Accessed September 8, 2019

267. Epstein JN, Langberg JM, Lichtenstein PK, Kolb R, Altaye M, Simon JO. Use of an Internet portal to improve community-based pediatric ADHD care: a cluster randomized trial. *Pediatrics*. 2011;128(5). Available at: www.pediatrics.org/cgi/content/full/128/5/e1201

268. Centers for Medicare and Medicaid Services. *Electronic Health Records*. Baltimore, MD: Centers for Medicare and Medicaid Services; 2012. Available at: https://www.cms.gov/Medicare/E-Health/EHealthRecords/index.html. Accessed September 8, 2019

269. Ohno-Machado L. Electronic health record systems: risks and benefits. *J Am Med Inform Assoc*. 2014;21(e1):e1

270. Koppel R, Lehmann CU. Implications of an emerging EHR monoculture for hospitals and healthcare systems. *J Am Med Inform Assoc*. 2015;22(2):465–471

271. Babbott S, Manwell LB, Brown R, et al. Electronic medical records and physician stress in primary care: results from the MEMO Study. *J Am Med Inform Assoc*. 2014;21(e1):e100–e106

272. Burke BL Jr, Hall RW; Section on Telehealth Care. Telemedicine: pediatric applications. *Pediatrics*. 2015;136(1). Available at: www.pediatrics.org/cgi/content/full/136/1/e293

273. Marcin JP, Rimsza ME, Moskowitz WB; Committee on Pediatric Workforce. The use of telemedicine to address access and physician workforce shortages. *Pediatrics*. 2015;136(1): 202–209

274. Sibley MH, Comer JS, Gonzalez J. Delivering parent-teen therapy for ADHD through videoconferencing: a preliminary investigation. *J Psychopathol Behav Assess*. 2017; 39(3):467–485

275. Comer JS, Furr JM, Miguel EM, et al. Remotely delivering real-time parent training to the home: an initial randomized trial of Internet-delivered parent-child interaction therapy (I-PCIT). *J Consult Clin Psychol*. 2017;85(9): 909–917

276. American Academy of Child and Adolescent Psychiatry; American Academy of Pediatrics. HIPAA privacy rule and provider to provider communication. Available at: https://www.aap.org/en-us/advocacy-and-policy/aap-health-initiatives/Mental-Health/Pages/HIPAA-Privacy-Rule-and-Provider-to-Provider-Communication.aspx. Accessed September 8, 2019

277. Kolko DJ, Campo J, Kilbourne AM, Hart J, Sakolsky D, Wisniewski S. Collaborative care outcomes for

pediatric behavioral health problems: a cluster randomized trial. *Pediatrics*. 2014;133(4). Available at: www.pediatrics.org/cgi/content/full/133/4/e981

278. Pordes E, Gordon J, Sanders LM, Cohen E. Models of care delivery for children with medical complexity. *Pediatrics*. 2018;141(suppl 3): S212–S223

279. Silverstein M, Hironaka LK, Walter HJ, et al. Collaborative care for children with ADHD symptoms: a randomized comparative effectiveness trial. *Pediatrics*. 2015;135(4). Available at: www.pediatrics.org/cgi/content/full/135/4/e858

280. Liddle M, Birkett K, Bonjour A, Risma K. A collaborative approach to improving health care for children with developmental disabilities. *Pediatrics*. 2018;142(6):e20181136

ERRATA

An error occurred in the AAP Clinical Practice Guideline by Wolraich et al, titled "Clinical Practice Guideline for the Diagnosis, Evaluation, and Treatment of Attention-Deficit/Hyperactivity Disorder in Children and Adolescents" published in the October 2019 issue of *Pediatrics* (2019;144[4]:e20192528; doi:10.1542/peds.2019-2528).

In the supplemental "Barriers" material, on page 30, paragraph 3 reads as follows:
"The specialist shortage is exacerbated by the geographically skewed distribution of extant child psychiatrists and developmental behavioral pediatricians who are concentrated in academic medical centers and urban environments. Almost three quarters (74%) of US counties have no child and adolescent psychiatrists; almost half (44%) do not even have any pediatricians.[252] As a result, many PCCs lack an adequate pool of pediatric behavioral and mental health specialists who can accept referrals to treat complicated pediatric ADHD patients and an adequate pool of behavioral therapists to provide evidence-based behavioral interventions. The result is that patients must often travel untenable distances and endure long waits to obtain these specialty services."

This should have read as follows:
"The specialist shortage is exacerbated by the geographically skewed distribution of extant child psychiatrists, developmental-behavioral pediatricians and child neurologists with neurodevelopmental disabilities training, who are concentrated in academic medical centers and urban environments. Almost three quarters (74%) of US counties have no child and adolescent psychiatrists; almost half (44%) do not even have any pediatricians.[252] As a result, many PCCs lack an adequate pool of pediatric behavioral, child neurology and mental health specialists who can accept referrals to treat complicated pediatric ADHD patients and an adequate pool of behavioral therapists to provide evidence-based behavioral interventions. The result is that patients must often travel untenable distances and endure long waits to obtain these specialty services."

The above correction has been made to the online article.

Attention-Deficit/Hyperactivity Disorder Clinical Practice Guideline Quick Reference Tools

- Action Statement Summary
  - — Clinical Practice Guideline for the Diagnosis, Evaluation, and Treatment of Attention-Deficit/Hyperactivity Disorder in Children and Adolescents
- *ICD-10-CM* Coding Quick Reference for ADHD
- Bonus Features
  - — ADHD Coding Fact Sheet for Primary Care Physicians
  - — Continuum Model for ADHD
- AAP Patient Education Handouts
  - — *ADHD—What Is Attention-Deficit/Hyperactivity Disorder?*
  - — *What Are the Symptoms of Attention-Deficit/Hyperactivity Disorder?*
  - — *How Is Attention-Deficit/Hyperactivity Disorder Diagnosed?*
  - — *What Causes Attention-Deficit/Hyperactivity Disorder and How Is It Treated?*

Action Statement Summary

Clinical Practice Guideline for the Diagnosis, Evaluation, and Treatment of Attention-Deficit/Hyperactivity Disorder in Children and Adolescents

Key Action Statement 1

The pediatrician or other PCC should initiate an evaluation for ADHD for any child or adolescent age 4 years to the 18th birthday who presents with academic or behavioral problems and symptoms of inattention, hyperactivity, or impulsivity. (Grade B: strong recommendation.)

Key Action Statement 2

To make a diagnosis of ADHD, the PCC should determine that *DSM-5* criteria have been met, including documentation of symptoms and impairment in more than 1 major setting (ie, social, academic, or occupational), with information obtained primarily from reports from parents or guardians, teachers, other school personnel, and mental health clinicians who are involved in the child or adolescent's care. The PCC should also rule out any alternative cause. (Grade B: strong recommendation.)

Key Action Statement 3

In the evaluation of a child or adolescent for ADHD, the PCC should include a process to at least screen for comorbid conditions, including emotional or behavioral conditions (eg, anxiety, depression, oppositional defiant disorder, conduct disorders, substance use), developmental conditions (eg, learning and language disorders, autism spectrum disorders), and physical conditions (eg, tics, sleep apnea). (Grade B: strong recommendation.)

Key Action Statement 4

ADHD is a chronic condition; therefore, the PCC should manage children and adolescents with ADHD in the same manner that they would children and youth with special health care needs, following the principles of the chronic care model and the medical home. (Grade B: strong recommendation.)

Key Action Statement 5a

For preschool-aged children (age 4 years to the sixth birthday) with ADHD, the PCC should prescribe evidence-based behavioral PTBM and/or behavioral classroom interventions as the first line of treatment, if available (grade A: strong recommendation). Methylphenidate may be considered if these behavioral interventions do not provide significant improvement and there is moderate-to-severe continued disturbance in the 4- through 5-year-old child's functioning. In areas in which evidence-based behavioral treatments are not available, the clinician needs to weigh the risks of starting medication before the age of 6 years against the harm of delaying treatment. (Grade B: strong recommendation.)

Key Action Statement 5b

For elementary and middle school–aged children (age 6 years to the 12th birthday) with ADHD, the PCC should prescribe US Food and Drug Administration (FDA)–approved medications for ADHD, along with PTBM and/or behavioral classroom intervention (preferably both PTBM and behavioral classroom interventions). Educational interventions and individualized instructional supports, including school environment, class placement, instructional placement, and behavioral supports, are a necessary part of any treatment plan and often include an Individualized Education Program (IEP) or a rehabilitation plan (504 plan). (Grade A: strong recommendation for medications; grade A: strong recommendation for PTBM training and behavioral treatments for ADHD implemented with the family and school.)

Key Action Statement 5c

For adolescents (age 12 years to the 18th birthday) with ADHD, the PCC should prescribe FDA-approved medications for ADHD with the adolescent's assent (grade A: strong recommendation). The PCC is encouraged to prescribe evidence-based training interventions and/or behavioral interventions as treatment of ADHD, if available. Educational interventions and individualized instructional supports, including school environment, class placement, instructional placement, and behavioral supports, are a necessary part of any treatment plan and often include an IEP or a rehabilitation plan (504 plan). (Grade A: strong recommendation.)

Key Action Statement 6

The PCC should titrate doses of medication for ADHD to achieve maximum benefit with tolerable side effects. (Grade B: strong recommendation.)

Key Action Statement 7

The PCC, if trained or experienced in diagnosing comorbid conditions, may initiate treatment of such conditions or make a referral to an appropriate subspecialist for treatment. After detecting possible comorbid conditions, if the PCC is not trained or experienced in making the diagnosis or initiating treatment, the patient should be referred to an appropriate subspecialist to make the diagnosis and initiate treatment. (Grade C: recommendation.)

Coding Quick Reference for ADHD	
ICD-10-CM	
F90.0	Attention-deficit hyperactivity disorder, predominantly inattentive type
F90.1	Attention-deficit hyperactivity disorder, predominantly hyperactive type

ADHD Coding Fact Sheet for Primary Care Physicians

Current Procedural Terminology (*CPT*®) (Procedure) Codes

Initial assessment usually involves a lot of time in determining the differential diagnosis, a diagnostic plan, and potential treatment options. Therefore, most pediatricians will report either an office or an outpatient evaluation and management (E/M) code using time or a consultation code for the initial assessment. Remember there are new guidelines (https://services.aap.org/en/practice-management/2021-office-based-em-changes) for office or other outpatient E/M service reporting *only*. Code-level section based on time or medical decision-making (MDM).

Physician E/M Services

***99202** Office or other outpatient visit, *new*[a] patient; straightforward MDM, 15–29 min.
***99203** low MDM, 30–44 min.
***99204** moderate MDM, 45–59 min.
***99205** high MDM, 60–74 min.
***99211** Office or other outpatient visit, *established* patient; not requiring the presence of a physician or other qualified health care professional.
***99212** straightforward MDM, 10–19 min.
***99213** low MDM, 20–29 min.
***99214** moderate MDM, 30–39 min.
***99215** high MDM, 40–54 min.
***•+99417** Prolonged office or other outpatient E/M service(s) beyond the minimum required time of the primary procedure which has been selected using total time, requiring total time with or without direct patient contact beyond the usual service, on the date of the primary service, each 15 minutes of total time (use only in conjunction with codes **99205**, **99215**)
***99241** Office or other outpatient *consultation*,[b–d] new or established patient; self-limited or minor problem, 15 min.
***99242** low severity problem, 30 min.
***99243** moderate severity problem, 45 min.
***99244** moderate to high severity problem, 60 min.
***99245** moderate to high severity problem, 80 min.
***+99354** Prolonged physician services in office or other outpatient setting, with direct patient contact; first hour (*use in conjunction with time-based codes* **99241–99245**, **99301–99350**, **90837**)
***+99355** each additional 30 min. (*use in conjunction with* **99354**)

- Used when a physician provides prolonged services beyond the usual service (ie, beyond the typical time).
- Time spent does not have to be continuous.

[a] A new patient is one who has not received any professional services (face-to-face services) rendered by physicians and other qualified health care professionals who may report E/M services using 1 or more specific *CPT* codes from the physician/qualified health care professional, or another physician/qualified health care professional of the exact same specialty and subspecialty who belongs to the same group practice, within the past 3 years.

[b] Use of these codes (**99241–99245**) requires the following actions:
1. Written or verbal request for consultation is documented in the medical record.
2. Consultant's opinion and any services ordered or performed are documented in the medical record.
3. Consultant's opinion and any services that are performed are prepared in a written report, which is sent to the requesting physician or other appropriate source.

[c] Patients/parents may not initiate a consultation.

[d] For more information on consultation code changes for 2010, see www.aap.org/en-us/professional-resources/practice-transformation/getting-paid/Coding-at-the-AAP/Pages/ADHD-Coding-Fact-Sheet.aspx.

• New *CPT* code
+ Codes are *add-on codes*, meaning they are reported separately in addition to the appropriate code for the service provided.
* Indicates a *CPT*-approved telemedicine service.

Reporting E/M Services Using "Time"

In this example we will look at office-based E/M service reporting only. Time rules will now vary between these services and consultations.

- Now based on total time including face-to-face and non-face-to-face time on date of encounter
- Does not have to be continuous on that day
- Are set by defined ranges
- No longer limited to time spent in counseling or care coordination
- Time may not include clinical staff time or time spent on a previous or subsequent day
- May only add Prolonged Services (https://services.aap.org/link/efbedcca82284a2c8dfc2820f0c41d38.aspx) (**+99417**) when choosing your code based on time and only when **99205** and **99215** have been exceeded
  - — **Example:** A physician sees an established patient in the office to discuss the current attention-deficit/hyperactivity disorder (ADHD) medication the patient was placed on. The total face-to-face time was 30 minutes. Prior to the visit the physician also reviews notes from the teacher and school counselor to assist with the assessment. This took an additional 10 minutes. After the encounter the physician wrote a summary and sent it off to the school counselor as requested. This was an additional 7 minutes. Total time spent is 47 minutes. Based on time, the physician may report a **99215** because the total time spent (cumulative direct and non-direct) is used to get to the level in lieu of MDM.

ADHD Follow-up During a Routine Preventive Medicine Service

- A good time to follow up with a patient regarding his or her ADHD could be during a preventive medicine service.
- If the follow-up requires little additional work on behalf of the physician, it should be reported under the preventive medicine service, rather than as a separate service.
- If the follow-up work requires an additional E/M service in addition to the preventive medicine service, it should be reported as a separate service.
- Chronic conditions should be reported only if they are separately addressed.
- When reporting a preventive medicine service in addition to an office-based E/M service and the services are significant and separately identifiable, modifier **25** will be required on the office-based E/M service.
  - — **Example:** A 12-year-old established patient presents for his routine preventive medicine service and, while he and Mom are there, Mom asks about changing his ADHD medication because of some side effects he is experiencing. The physician completes the routine preventive medicine check and then addresses the mom's concerns in a separate service. The additional E/M service takes 15 minutes face-to-face. Due to an issue at the pharmacy, the physician spends an additional 7 minutes on the phone. Total time is 22 minutes for this patient.
    - ~ Code **99394** and **99213-25** account for both E/M services and link each to the appropriate *International Classification of Diseases, 10th Revision, Clinical Modification* (*ICD-10-CM*) code.
    - ~ Modifier **25** is required on the problem-oriented office visit code (eg, **99213**) when it is significant and separately identifiable from another service.

- Prolonged service of less than 15 minutes beyond the first hour or less than 15 minutes beyond the final 30 minutes is not reported separately.
- If reporting E/M service according to time and not key factors (history, examination, and medical decision-making), the physician must reach the typical time in the highest code in the code set being reported (eg, **99205**, **99215**, **99245**) before face-to-face prolonged services can be reported.
- Refer to *CPT* for clinical staff prolonged services.

Physician Non–face-to-face Services

99339 Care Plan Oversight—Individual physician supervision of a patient (patient not present) in home, domiciliary or rest home (e.g., assisted living facility) requiring complex and multidisciplinary care modalities involving regular physician development and/or revision of care plans, review of subsequent reports of patient status, review of related laboratory and other studies, communication (including telephone calls) for purposes of assessment or care decisions with health care professional(s), family member(s), surrogate decision maker(s) (e.g., legal guardian) and/or key caregiver(s) involved in patient's care, integration of new information into the medical treatment plan and/or adjustment of medical therapy, within a calendar month; 15–29 minutes

99340 30 minutes or more

99358 Prolonged physician services without direct patient contact; first hour

+99359 each additional 30 min. (+ *use in conjunction with* **99358**)
Do not report **99358–99359** on the same day as **99202–99215**

99367 Medical team conference by physician with interdisciplinary team of health care professionals, patient and/or family not present, 30 minutes or more

Telephone Care

99441 Telephone evaluation and management to patient, parent or guardian not originating from a related E/M service within the previous 7 days nor leading to an E/M service or procedure within the next 24 hours or soonest available appointment; 5–10 minutes of medical discussion

99442 11–20 minutes of medical discussion

99443 21–30 minutes of medical discussion

Digital Online E/M Services

Are patient-initiated services with physicians or other advanced practitioners (NP/PA).

Require evaluation, assessment, and management of the patient.

The patient must be established, but the condition can be new.

The digital communication must take place over a secure platform which allows digital communication.

Online digital E/M services are reported once for the *cumulative time* devoted to the service, which includes
- review of the initial inquiry,
- review of patient records or data pertinent to assessment of the patient's problem,
- interaction with clinical staff focused on the patient's problem, development of management plans, including generation of prescriptions or ordering of tests, and subsequent communication with the patient through online, telephone, email, or other digitally supported communication during a seven-day period.

The seven-day period begins with the personal review of the patient-generated inquiry.

Online digital E/M services require permanent documentation storage

99421 Online digital evaluation and management service, for an established patient, for up to 7 days, cumulative time during the 7 days; 5-10 minutes

99422 11–20 minutes

99423 21 or more minutes

Chronic Care Management Services

Codes are selected according to the amount of time spent by clinical staff (**99490**)/physician (**99491**) providing care coordination activities. *CPT* clearly defines which activities are care coordination activities. To report chronic care management codes, you must
1. Provide 24/7 access to physicians or other qualified health care professionals or clinical staff.
2. Use a standardized methodology to identify patients who require chronic complex care coordination services.
3. Have an internal care coordination process/function whereby a patient identified as meeting the requirements for these services starts receiving them in a timely manner.
4. Use a form and format in the medical record that is standardized within the practice.
5. An electronic and/or printed plan of care must be documented and shared with the patient and/or caregiver.
6. Be able to engage and educate patients and caregivers, as well as coordinate care among all service professionals, as appropriate for each patient (also applies to code **99490** under NPP services).

99491 Chronic care management services, provided personally by a physician or other qualified health care professional, at least 30 minutes of physician or other qualified health care professional time, per calendar month, with the following required elements:
- multiple (two or more) chronic conditions expected to last at least 12 months, or until the death of the patient;
- chronic conditions place the patient at significant risk of death, acute exacerbation/decompensation, or functional decline;
- comprehensive care plan established, implemented, revised, or monitored.

Principal Care Management Services

Service focuses on the medical and/or psychological needs manifested by a single, complex chronic condition expected to last at least 3 months and includes establishing, implementing, revising, or monitoring a care plan specific to that single disease. Do not report for services less than 30 minutes. Refer to *CPT* for other excluded services with the same calendar month.

Principal care management services, for a single high-risk disease, with the following required elements:
1. one complex chronic condition expected to last at least 3 months, and that places the patient at significant risk of hospitalization, acute exacerbation/decompensation, functional decline, or death,
2. the condition requires development, monitoring, or revision of disease-specific care plan,
3. the condition requires frequent adjustments in the medication regimen and/or the management of the condition is unusually complex due to comorbidities,
4. ongoing communication and care coordination between relevant practitioners furnishing care

• New *CPT* code
+ Codes are *add-on codes*, meaning they are reported separately in addition to the appropriate code for the service provided.
* Indicates a *CPT*-approved telemedicine service.

•**99424** first 30 minutes provided personally by a physician or other qualified health care professional, per calendar month.

+•**99425** each additional 30 minutes provided personally by a physician or other qualified health care professional, per calendar month (List separately in addition to code **99424**)

Psychiatry

+90785 Interactive complexity (Use in conjunction with codes for diagnostic psychiatric evaluation [**90791**, **90792**], psychotherapy [**90832**, **90833**, **90834**, **90836**, **90837**, **90838**], or group psychotherapy [**90853**])

Psychiatric Diagnostic or Evaluative Interview Procedures

90791 Psychiatric diagnostic interview examination evaluation

90792 Psychiatric diagnostic evaluation with medical services

Psychotherapy

***90832** Psychotherapy, 30 min with patient;

***+90833** with medical E/M (Use in conjunction with **99202–99255**, **99304–99337**, **99341–99350**)

***90834** Psychotherapy, 45 min with patient;

***+90836** with medical E/M services (Use in conjunction with **99202–99255**, **99304–99337**, **99341–99350**)

***90837** Psychotherapy, 60 min with patient;

***+90838** with medical E/M services (Use in conjunction with **99202–99255**, **99304–99337**, **99341–99350**)

+90785 Interactive complexity (Use in conjunction with codes for diagnostic psychiatric evaluation [**90791**, **90792**], psychotherapy [**90832**, **90834**, **90837**], psychotherapy when performed with an evaluation and management service [**90833**, **90836**, **90838**, **99202–99255**, **99304–99337**, **99341–99350**], and group psychotherapy [**90853**])

- Refers to specific communication factors that complicate the delivery of a psychiatric procedure. Common factors include more difficult communication with discordant or emotional family members and engagement of young and verbally undeveloped or impaired patients. Typical encounters include
  - — Patients who have other individuals legally responsible for their care
  - — Patients who request others to be present or involved in their care such as translators, interpreters, or additional family members
  - — Patients who require the involvement of other third parties such as child welfare agencies, schools, or probation officers

***90846** Family psychotherapy (without patient present), 50 min

***90847** Family psychotherapy (conjoint psychotherapy) (with patient present), 50 min

Other Psychiatric Services/Procedures

90863 Pharmacologic management, including prescription and review of medication, when performed with psychotherapy services (Use in conjunction with **90832**, **90834**, **90837**)

- For pharmacologic management with psychotherapy services performed by a physician or other qualified health care professional who may report E/M codes, use the appropriate E/M codes (**99202–99255**, **99281–99285**, **99304–99337**, **99341–99350**) and the appropriate psychotherapy with E/M service (**90833**, **90836**, **90838**).

90887 Interpretation or explanation of results of psychiatric, other medical exams, or other accumulated data to family or other responsible persons, or advising them how to assist patient

90889 Preparation of reports on patient's psychiatric status, history, treatment, or progress (other than for legal or consultative purposes) for other physicians, agencies, or insurance carriers

97127 Therapeutic interventions that focus on cognitive function (eg, attention, memory, reasoning, executive function, problem solving, and/or pragmatic functioning) and compensatory strategies to manage the performance of an activity (eg, managing time or schedules, initiating, organizing and sequencing tasks), direct (one-on-one) patient contact

Developmental/Psychological Testing

96110 Developmental screening, with scoring and documentation, per standardized instrument (Do not use for ADHD screens or assessments)

96112 Developmental test administration (including assessment of fine and/or gross motor, language, cognitive level, social, memory and/or executive functions by standardized developmental instruments when performed), by physician or other qualified health care professional, with interpretation and report; first hour

+96113 each additional 30 minutes (Report with **96112**)

***96116** Neurobehavioral status examination (clinical assessment of thinking, reasoning and judgment [eg, acquired knowledge, attention, language, memory, planning and problem solving, and visual spatial abilities]), by physician or other qualified health care professional, both face-to-face time with the patient and time interpreting test results and preparing the report; first hour

***96121** each additional hour (Report with **96116**)

96127 Brief emotional/behavioral assessment (eg, depression inventory, attention-deficit/hyperactivity disorder [ADHD] scale), with scoring and documentation, per standardized instrument

96130 Psychological testing evaluation services by physician or other qualified health care professional, including integration of patient data, interpretation of standardized test results and clinical data, clinical decision making, treatment planning and report, and interactive feedback to the patient, family member(s) or caregiver(s), when performed; first hour

+96131 each additional hour (code with **96130**)

96136 Psychological or neuropsychological test administration and scoring by physician or other qualified health care professional, two or more tests, any method; first 30 minutes

+96137 each additional 30 minutes

Nonphysician Provider (NPP) Services

99366 Medical team conference with interdisciplinary team of health care professionals, face-to-face with patient and/or family, 30 minutes or more, participation by a nonphysician qualified health care professional

99368 Medical team conference with interdisciplinary team of health care professionals, patient and/or family not present, 30 minutes or more, participation by a nonphysician qualified health care professional

96146 Psychological or neuropsychological test administration, with single automated, standardized instrument via electronic platform, with automated result only

---

• New *CPT* code
+ Codes are *add-on codes*, meaning they are reported separately in addition to the appropriate code for the service provided.
* Indicates a *CPT*-approved telemedicine service.

Health and Behavior (Re-) Assessment and Intervention

The following codes are reported to describe services offered to patients who present with primary *physical illnesses, diagnoses,* or *symptoms* and may benefit from assessments and interventions that focus on the psychological and/or psychosocial factors related to the patient's health status.

•96156 Health behavior assessment, or re-assessment (ie, health-focused clinical interview, behavioral observations, clinical decision making)

•96158 Health behavior intervention, individual, face-to-face; initial 30 minutes

•+96159 each additional 15 minutes (code with **96158**)

•96164 Health behavior intervention, group (2 or more patients), face-to-face; initial 30 minutes

•+96165 each additional 15 minutes (code with **96164**)

•96167 Health behavior intervention, family (with the patient present), face-to-face; initial 30 minutes

•+96168 each additional 15 minutes (code with **96167**)

•96170 Health behavior intervention, family (without the patient present), face-to-face; initial 30 minutes

•+96171 each additional 15 minutes (code with **96170**)

Non–face-to-face Services: NPP

98966 Telephone assessment and management service provided by a qualified nonphysician health care professional to an established patient, parent or guardian not originating from a related assessment and management service provided within the previous seven days nor leading to an assessment and management service or procedure within the next 24 hours or soonest available appointment; 5–10 minutes of medical discussion

98967 11–20 minutes of medical discussion

98968 21–30 minutes of medical discussion

98969 Online assessment and management service provided by a qualified nonphysician health care professional to an established patient or guardian not originating from a related assessment and management service provided within the previous seven days nor using the internet or similar electronic communications network

NPP Online Digital E/M Service

Reported only once per 7 days.

Report these codes for qualified health care professionals such as speech pathologists, registered dieticians, or physical therapists.

Do not report for physician's or advanced practitioners (NP/PA).

For additional information see codes **99421–99423** in this resource or refer to the *CPT* manual.

98970 Qualified nonphysician health care professional online digital evaluation and management service, for an established patient, for up to 7 days, cumulative time during the 7 days; 5–10 minutes

98971 11–20 minutes

98972 21 or more minutes

Clinical Staff Services

99490 *Chronic care management services,* at least 20 minutes of clinical staff time directed by a physician or other qualified health care professional, per calendar month, with the following required elements:

- multiple (two or more) chronic conditions expected to last at least 12 months, or until the death of the patient;
- chronic conditions place the patient at significant risk of death, acute exacerbation/decompensation, or functional decline;
- comprehensive care plan established, implemented, revised, or monitored.

+•99439 each additional 20 minutes of clinical staff time directed by a physician or other qualified health care professional, per calendar month (List separately in addition to code **99490**)

Chronic care management services are provided when medical needs or psychosocial needs (or both types of needs) of the patient require establishing, implementing, revising, or monitoring the care plan. If 20 minutes is not met within a calendar month, you do not report chronic care management. Refer to code **99491** in this resource and *CPT* for more information.

Clinical Staff

99484 Care management services for *behavioral health conditions*, at least 20 minutes of clinical staff time, directed by a physician or other qualified health care professional, per calendar month, with the following required elements:

- initial assessment or follow-up monitoring, including the use of applicable validated rating scales;
- behavioral health care planning in relation to behavioral/ psychiatric health problems, including revision for patients who are not progressing or whose status changes;
- facilitating and coordinating treatment such as psychotherapy, pharmacotherapy, counseling and/or psychiatric consultation; and
- continuity of care with a designated member of the care team.

E/M services, including care management services (**99439**, **99487**, **99489**, **99490**, **99495**, **99496**), and psychiatric services (**90785–90899**) may be reported separately by the same physician or other qualified health care professional on the same day or during the same calendar month, but time and activities used to meet criteria for another reported service do not count toward meeting criteria for **99484**.

99492 Initial psychiatric collaborative care management, first 70 minutes in the first calendar month of behavioral health care manager activities, in consultation with a psychiatric consultant, and directed by the treating physician or other qualified health care professional, with the following required elements:

- outreach to and engagement in treatment of a patient directed by the treating physician or other qualified health care professional;
- initial assessment of the patient, including administration of validated rating scales, with the development of an individualized treatment plan;
- review by the psychiatric consultant with modifications of the plan if recommended;
- entering patient in a registry and tracking patient follow-up and progress using the registry, with appropriate documentation, and participation in weekly caseload consultation with the psychiatric consultant; and

• New *CPT* code
+ Codes are *add-on codes,* meaning they are reported separately in addition to the appropriate code for the service provided.
* Indicates a *CPT*-approved telemedicine service.

- provision of brief interventions using evidence-based techniques such as behavioral activation, motivational interviewing, and other focused treatment strategies.

99493 Subsequent psychiatric collaborative care management, first 60 minutes in a subsequent month of behavioral health care manager activities, in consultation with a psychiatric consultant, and directed by the treating physician or other qualified health care professional, with the following required elements:
- tracking patient follow-up and progress using the registry, with appropriate documentation;
- participation in weekly caseload consultation with the psychiatric consultant;
- ongoing collaboration with and coordination of the patient's mental health care with the treating physician or other qualified health care professional and any other treating mental health providers;
- additional review of progress and recommendations for changes in treatment, as indicated, including medications, based on recommendations provided by the psychiatric consultant;
- provision of brief interventions using evidence-based techniques such as behavioral activation, motivational interviewing, and other focused treatment strategies;
- monitoring of patient outcomes using validated rating scales; and
- relapse prevention planning with patients as they achieve remission of symptoms and/or other treatment goals and are prepared for discharge from active treatment.

+99494 Initial or subsequent psychiatric collaborative care management, each additional 30 minutes in a calendar month of behavioral health care manager activities, in consultation with a psychiatric consultant, and directed by the treating physician or other qualified health care professional (Use **99494** in conjunction with **99492**, **99493**)

Miscellaneous Services

99071 Educational supplies, such as books, tapes, or pamphlets, provided by the physician for the patient's education at cost to the physician

ICD-10-CM Codes

- Use as many diagnosis codes that apply to document the patient's complexity and report the patient's symptoms or adverse environmental circumstances (or both).
- Once a definitive diagnosis is established, report any appropriate definitive diagnosis codes as the primary codes, plus any other symptoms that the patient is exhibiting as secondary diagnoses that are not part of the usual disease course or are considered incidental.

Depressive Disorders

F32.A Depression, unspecified (NOS)
F34.1 Dysthymic disorder (depressive personality disorder, dysthymia neurotic depression)
F39 Mood (affective) disorder, unspecified
F30.8 Other manic episode

Anxiety Disorders

F06.4 Anxiety disorder due to known physiological conditions
F40.10 Social phobia, unspecified
F40.11 Social phobia, generalized
F40.8 Phobic anxiety disorders, other (phobic anxiety disorder of childhood)
F40.9 Phobic anxiety disorder, unspecified
F41.1 Generalized anxiety disorder
F41.9 Anxiety disorder, unspecified

Feeding and Eating Disorders/Elimination Disorders

F50.89 Eating disorders, other
F50.9 Eating disorder, unspecified
F98.0 Enuresis not due to a substance or known physiological condition
F98.1 Encopresis not due to a substance or known physiological condition
F98.3 Pica (infancy or childhood)

Impulse Disorders

F63.9 Impulse disorder, unspecified

Trauma- and Stressor-Related Disorders

F43.20 Adjustment disorder, unspecified
F43.21 Adjustment disorder with depressed mood
F43.22 Adjustment disorder with anxiety
F43.23 Adjustment disorder with mixed anxiety and depressed mood
F43.24 Adjustment disorder with disturbance of conduct

Neurodevelopmental/Other Developmental Disorders

F70 Mild intellectual disabilities
F71 Moderate intellectual disabilities
F72 Severe intellectual disabilities
F73 Profound intellectual disabilities
F79 Unspecified intellectual disabilities
F80.0 Phonological (speech) disorder (speech-sound disorder)
F80.1 Expressive language disorder
F80.2 Mixed receptive-expressive language disorder
F80.4 Speech and language developmental delay due to hearing loss (code also hearing loss)
F80.81 Stuttering
F80.82 Social pragmatic communication disorder
F80.89 Other developmental disorders of speech and language
F80.9 Developmental disorder of speech and language, unspecified
F81.0 Specific reading disorder
F81.2 Mathematics disorder
F81.89 Other developmental disorders of scholastic skills
F82 Developmental coordination disorder
F84.0 Autistic disorder (Autism spectrum disorder)
F88 Specified delays in development; other
F89 Unspecified delay in development
F81.9 Developmental disorder of scholastic skills, unspecified

Behavioral/Emotional Disorders

F90.0 Attention-deficit hyperactivity disorder, predominantly inattentive type
F90.1 Attention-deficit hyperactivity disorder, predominantly hyperactive type
F90.8 Attention-deficit hyperactivity disorder, other type
F90.9 Attention-deficit hyperactivity disorder, unspecified type

• New *CPT* code
+ Codes are *add-on codes*, meaning they are reported separately in addition to the appropriate code for the service provided.
* Indicates a *CPT*-approved telemedicine service.

F91.1 Conduct disorder, childhood-onset type
F91.2 Conduct disorder, adolescent-onset type
F91.3 Oppositional defiant disorder
F91.9 Conduct disorder, unspecified
F93.0 Separation anxiety disorder
F93.8 Other childhood emotional disorders (relationship problems)
F93.9 Childhood emotional disorder, unspecified
F94.9 Childhood disorder of social functioning, unspecified
F95.0 Transient tic disorder
F95.1 Chronic motor or vocal tic disorder
F95.2 Tourette's disorder
F95.9 Tic disorder, unspecified
F98.8 Other specified behavioral and emotional disorders with onset usually occurring in childhood and adolescence (nail-biting, nose-picking, thumb-sucking)

Other

F07.81 Postconcussional syndrome
F07.89 Personality and behavioral disorders due to known physiological condition, other
F07.9 Personality and behavioral disorder due to known physiological condition, unspecified
F45.41 Pain disorder exclusively related to psychological factors
F48.8 Nonpsychotic mental disorders, other (neurasthenia)
F48.9 Nonpsychotic mental disorders, unspecified
F51.01 Primary insomnia
F51.02 Adjustment insomnia
F51.03 Paradoxical insomnia
F51.04 Psychophysiologic insomnia
F51.05 Insomnia due to other mental disorder (Code also associated mental disorder)
F51.09 Insomnia, other (not due to a substance or known physiological condition)
F51.3 Sleepwalking [somnambulism]
F51.4 Sleep terrors [night terrors]
F51.8 Other sleep disorders
F93.8 Childhood emotional disorders, other
R46.89 Other symptoms and signs involving appearance and behavior

Substance-Related and Addictive Disorders

If a provider documents multiple patterns of use, only 1 should be reported. Use the following hierarchy: use–abuse–dependence (eg, if use and dependence are documented, only code for dependence).

When a minus symbol (-) is included in codes **F10–F17**, a last character is required. Be sure to include the last character from the following list:

0 anxiety disorder

2 sleep disorder

8 other disorder

9 unspecified disorder

Alcohol

F10.10 Alcohol abuse, uncomplicated (alcohol use disorder, mild)
F10.14 Alcohol abuse with alcohol-induced mood disorder
F10.159 Alcohol abuse with alcohol-induced psychotic disorder, unspecified
F10.18- Alcohol abuse with alcohol-induced
F10.19 Alcohol abuse with unspecified alcohol-induced disorder
F10.20 Alcohol dependence, uncomplicated
F10.21 Alcohol dependence, in remission
F10.24 Alcohol dependence with alcohol-induced mood disorder
F10.259 Alcohol dependence with alcohol-induced psychotic disorder, unspecified
F10.28- Alcohol dependence with alcohol-induced
F10.29 Alcohol dependence with unspecified alcohol-induced disorder
F10.94 Alcohol use, unspecified with alcohol-induced mood disorder
F10.959 Alcohol use, unspecified with alcohol-induced psychotic disorder, unspecified
F10.98- Alcohol use, unspecified with alcohol-induced
F10.99 Alcohol use, unspecified with unspecified alcohol-induced disorder

Cannabis

F12.10 Cannabis abuse, uncomplicated (cannabis use disorder, mild)
F12.18- Cannabis abuse with cannabis-induced
F12.19 Cannabis abuse with unspecified cannabis-induced disorder
F12.20 Cannabis dependence, uncomplicated
F12.21 Cannabis dependence, in remission
F12.28- Cannabis dependence with cannabis-induced
F12.29 Cannabis dependence with unspecified cannabis-induced disorder
F12.90 Cannabis use, unspecified, uncomplicated
F12.98- Cannabis use, unspecified with
F12.99 Cannabis use, unspecified with unspecified cannabis-induced disorder

Sedatives

F13.10 Sedative, hypnotic or anxiolytic abuse, uncomplicated (sedative, hypnotic, or anxiolytic use disorder, mild)
F13.129 Sedative, hypnotic or anxiolytic abuse with intoxication, unspecified
F13.14 Sedative, hypnotic or anxiolytic abuse with sedative, hypnotic or anxiolytic-induced mood disorder
F13.18- Sedative, hypnotic or anxiolytic abuse with sedative, hypnotic or anxiolytic-induced
F13.21 Sedative, hypnotic or anxiolytic dependence, in remission
F13.90 Sedative, hypnotic or anxiolytic use, unspecified, uncomplicated
F13.94 Sedative, hypnotic or anxiolytic use, unspecified with sedative, hypnotic or anxiolytic-induced mood disorder
F13.98- Sedative, hypnotic or anxiolytic use, unspecified with sedative, hypnotic or anxiolytic-induced
F13.99 Sedative, hypnotic or anxiolytic use, unspecified with unspecified sedative, hypnotic or anxiolytic-induced disorder

Stimulants (eg, caffeine, amphetamines)

F15.10 Other stimulant (amphetamine-related disorders or caffeine) abuse, uncomplicated (amphetamine, other or unspecified type substance use disorder, mild)
F15.14 Other stimulant (amphetamine-related disorders or caffeine) abuse with stimulant-induced mood disorder
F15.18- Other stimulant (amphetamine-related disorders or caffeine) abuse with stimulant-induced

• New *CPT* code
+ Codes are *add-on codes*, meaning they are reported separately in addition to the appropriate code for the service provided.
* Indicates a *CPT*-approved telemedicine service.

F15.19 Other stimulant (amphetamine-related disorders or caffeine) abuse with unspecified stimulant-induced disorder
F15.20 Other stimulant (amphetamine-related disorders or caffeine) dependence, uncomplicated
F15.21 Other stimulant (amphetamine-related disorders or caffeine) dependence, in remission
F15.24 Other stimulant (amphetamine-related disorders or caffeine) dependence with stimulant-induced mood disorder
F15.28- Other stimulant (amphetamine-related disorders or caffeine) dependence with stimulant-induced
F15.29 Other stimulant (amphetamine-related disorders or caffeine) dependence with unspecified stimulant-induced disorder
F15.90 Other stimulant (amphetamine-related disorders or caffeine) use, unspecified, uncomplicated
F15.94 Other stimulant (amphetamine-related disorders or caffeine) use, unspecified with stimulant-induced mood disorder
F15.98- Other stimulant (amphetamine-related disorders or caffeine) use, unspecified with stimulant-induced
F15.99 Other stimulant (amphetamine-related disorders or caffeine) use, unspecified with unspecified stimulant-induced disorder

Nicotine (eg, cigarettes)

F17.200 Nicotine dependence, unspecified, uncomplicated (tobacco use disorder, mild, moderate or severe)
F17.201 Nicotine dependence, unspecified, in remission
F17.203 Nicotine dependence, unspecified, with withdrawal
F17.20- Nicotine dependence, unspecified, with
F17.210 Nicotine dependence, cigarettes, uncomplicated
F17.211 Nicotine dependence, cigarettes, in remission
F17.213 Nicotine dependence, cigarettes, with withdrawal
F17.218- Nicotine dependence, cigarettes, with

Symptoms, Signs, and Ill-defined Conditions

Use these codes in absence of a definitive mental diagnosis or when the sign or symptom is not part of the disease course or is considered incidental.

G47.9 Sleep disorder, unspecified
H90.0 Conductive hearing loss, bilateral
H90.11 Conductive hearing loss, unilateral, right ear, with unrestricted hearing on the contralateral side
H90.12 Conductive hearing loss, unilateral, left ear, with unrestricted hearing on the contralateral side
H90.A1- Conductive hearing loss, unilateral, with restricted hearing on the contralateral side
H90.A2- Sensorineural hearing loss, unilateral, with restricted hearing on the contralateral side
H90.A3- Mixed conductive and sensorineural hearing loss, unilateral, with restricted hearing on the contralateral side
(Codes under category **H90** require a 6th digit: 1–right ear, 2–left ear)
K11.7 Disturbance of salivary secretions
K59.00 Constipation, unspecified
N39.44 Nocturnal enuresis
R10.0 Acute abdomen pain
R11.11 Vomiting without nausea
R11.2 Nausea with vomiting, unspecified
R19.7 Diarrhea, unspecified
R21 Rash, NOS
R25.0 Abnormal head movements
R25.1 Tremor, unspecified
R25.3 Twitching, NOS
R25.8 Other abnormal involuntary movements
R25.9 Unspecified abnormal involuntary movements
R27.8 Other lack of coordination (excludes ataxia)
R27.9 Unspecified lack of coordination
R41.83 Borderline intellectual functioning
R42 Dizziness
R48.0 Alexia/dyslexia, NOS
R51.9 Headache
R62.0 Delayed milestone in childhood
R62.52 Short stature (child)
R63.3 Feeding difficulties
R63.4 Abnormal weight loss
R63.5 Abnormal weight gain
R68.2 Dry mouth, unspecified
T56.0X1A Toxic effect of lead and its compounds, accidental (unintentional), initial encounter

Z Codes

Z codes represent reasons for encounters. Categories **Z00–Z99** are provided for occasions when circumstances other than a disease, an injury, or an external cause classifiable to categories **A00–Y89** are recorded as *diagnoses* or *problems.* This can arise in 2 main ways.

1. When a person who may or may not be sick encounters the health services for some specific purpose, such as to receive limited care or service for a current condition, to donate an organ or tissue, to receive prophylactic vaccination (immunization), or to discuss a problem that is, in itself, not a disease or an injury
2. When some circumstance or problem is present that influences the person's health status but is not, in itself, a current illness or injury

Z55.0 Illiteracy and low-level literacy
Z55.2 Failed school examinations
Z55.3 Underachievement in school
Z55.4 Educational maladjustment and discord with teachers and classmates
Z55.8 Other problems related to education and literacy
Z55.9 Problems related to education and literacy, unspecified
(**Z55** codes exclude those conditions reported with **F80–F89**)
Z60.4 Social exclusion and rejection
Z60.8 Other problems related to social environment
Z60.9 Problem related to social environment, unspecified
Z62.0 Inadequate parental supervision and control
Z62.21 Foster care status (child welfare)
Z62.6 Inappropriate (excessive) parental pressure
Z62.810 Personal history of physical and sexual abuse in childhood
Z62.811 Personal history of psychological abuse in childhood
Z62.820 Parent-biological child conflict
Z62.821 Parent-adopted child conflict
Z62.822 Parent-foster child conflict
Z63.72 Alcoholism and drug addiction in family
Z63.8 Other specified problems related to primary support group
Z65.3 Problems related to legal circumstances
Z71.89 Counseling, other specified
Z71.9 Counseling, unspecified
Z72.0 Tobacco use
Z77.011 Contact with and (suspected) exposure to lead
Z79.899 Other long term (current) drug therapy

• New *CPT* code
+ Codes are *add-on codes,* meaning they are reported separately in addition to the appropriate code for the service provided.
* Indicates a *CPT*-approved telemedicine service.

Z81.0 Family history of intellectual disabilities (conditions classifiable to **F70–F79**)
Z81.8 Family history of other mental and behavioral disorders
Z83.2 Family history of diseases of the blood and blood-forming organs (anemia) (conditions classifiable to **D50–D89**)
Z86.2 Personal history of diseases of the blood and blood-forming organs
Z86.39 Personal history of other endocrine, nutritional, and metabolic disease
Z86.59 Personal history of other mental and behavioral disorders
Z86.69 Personal history of other diseases of the nervous system and sense organs
Z87.09 Personal history of other diseases of the respiratory system
Z87.19 Personal history of other diseases of the digestive system
Z87.798 Personal history of other (corrected) congenital malformations
Z87.820 Personal history of traumatic brain injury
Z91.128 Patient's intentional underdosing of medication regimen for other reason (report drug code)
Z91.138 Patient's unintentional underdosing of medication regimen for other reason (report drug code)
Z91.14 Patient's other noncompliance with medication regimen
Z91.19 Patient's noncompliance with other medical treatment and regimen
Z91.411 Personal history of adult psychological abuse

• New *CPT* code
+ Codes are *add-on codes*, meaning they are reported separately in addition to the appropriate code for the service provided.
* Indicates a *CPT*-approved telemedicine service.

Continuum Model for Attention-Deficit/Hyperactivity Disorder

Code selection at any level above **99211** *may be based on the complexity of MDM or the total time spent by the physician or other qualified health care professional on the date of the encounter. (Code* **99211** *is not included due to lack of indication for follow-up by clinical staff.)*

	MDM (2 of 3 elements required)		
***CPT* Code With Total Physician Time and Vignette**	**Number and Complexity of Problems Addressed**	**Amount and/or Complexity of Data Reviewed and Analyzed**	**Risk of Complications and/or Morbidity or Mortality of Patient Management**
99211 Nurse visit to check growth or blood pressure prior to renewing prescription for psychoactive drugs	*Time and MDM do not apply. Must indicate continuation of physician's plan of care, medical necessity, assessment, and/or education provided.* CC: Check growth or blood pressure. Documentation: Height, weight, and blood pressure. Existing medications and desired/undesired effects. Assessment: Doing well. Obtained physician approval for prescription refill. Keep appointment with physician in 1 month.		
99212 (Time: 10–19 min) 4-year-old whose parents are concerned about ADHD symptoms (ADHD is not diagnosed; parents are reassured.)	**Minimal:** 1 self-limited problem	**Limited:** Assessment requiring an independent historian	**Minimal:** Parent education
99213 (Time: 20–29 min) Initial follow-up after initiation of medication, patient responding well	**Low:** 1 stable chronic illness	**Limited:** Assessment requiring an independent historian	**Moderate:** Prescription drug management, delayed prescribing
99214 (Time: 30–39 min) Follow-up recent weight loss in patient with established ADHD otherwise stable on stimulant medication	**Moderate:** 1 chronic illness with side effects of treatment	**Limited:** Assessment requiring an independent historian	**Moderate:** Prescription drug management
99215 (Time: 40–54 min) Initial evaluation of patient with ADHD and new onset of suicidal ideation. Patient and mother refuse hospitalization due to cost. *Tip:* Add **99417** if time on the date of service is ≥55 minutes. Add **99058** if service(s) are provided on an emergency basis in the office, which disrupts other scheduled office services.	**High:** 1 acute or chronic illness or injury that poses a threat to life or bodily function	**Moderate:** Assessment requiring an independent historian; discussion with behavioral health specialist; psychiatric testing	**High:** Decision regarding hospitalization

Abbreviations: ADHD, attention-deficit/hyperactivity disorder; CC, chief complaint; *CPT*, *Current Procedural Terminology*; MDM, medical decision-making.

ADHD—What is Attention Deficit/ Hyperactivity Disorder?

Almost all children can experience times of decreased attention and/or increased activity. However, for some children, decreased attention and/or increased activity is more than an occasional problem. Read on for information from the American Academy of Pediatrics about attention deficit/hyperactivity disorder (ADHD).

What is ADHD?

ADHD is a condition of the brain that makes it difficult for children to manage their attention, activity, and impulses. It is one of the most common chronic conditions of childhood. It affects 6% to 12% of school-aged children. ADHD is diagnosed about 3 times more often in boys than in girls (who more frequently have the inattentive type that goes unnoticed). The condition affects children in specific ways.

Children with attention-deficit/hyperactivity disorder (ADHD) have neurobehavioral problems that can interfere with their daily lives. An impulsive nature may put them into physical danger. Children with ADHD may speed about in constant motion, make noise nonstop, refuse to wait their turn, or crash into things. At other times, they may drift as if in a daydream, be unable to pay attention, or be unable to or finish what they start because they are paying attention to another thought or something they see. Those who have trouble paying attention may have trouble learning. Keep in mind that not all children with ADHD have all the symptoms. Each child is unique. For example, some may only have problems paying attention, while others may have problems with both attention and activity.

Recognition is important as early as possible to help minimize or prevent serious, lifelong problems, such as difficulty in school, at home, or at work and/or difficulty in making and keeping friends. Children with ADHD may have trouble getting along with siblings and other children. They may be labeled "bad kids."

If your child has ADHD, effective treatment is available. Your child's doctor can offer a long-term treatment plan to help your child lead a happy and healthy life. As a parent, you have a very important role in this treatment.

Visit HealthyChildren.org for more information.

Resources

American Academy of Pediatrics

www.AAP.org and www.HealthyChildren.org

Here is a list of ADHD support groups and resources. Also, your child's doctor may know about specific resources in your community.

ADDA (Attention Deficit Disorder Association)

www.add.org

CHADD (Children and Adults with Attention-Deficit/ Hyperactivity Disorder)—The National Resource Center on ADHD

800/233-4050

www.chadd.org

Center for Parent Information and Resources

www.parentcenterhub.org

National Institute of Mental Health

866/615-6464 www.nimh.nih.gov

Tourette Association of America

888/4-TOURET (486-8738)

www.tourette.org

From Your Doctor

American Academy of Pediatrics
DEDICATED TO THE HEALTH OF ALL CHILDREN®

healthychildren.org
Powered by pediatricians. Trusted by parents.
from the American Academy of Pediatrics

The American Academy of Pediatrics (AAP) is an organization of 67,000 primary care pediatricians, pediatric medical subspecialists, and pediatric surgical specialists dedicated to the health, safety, and well-being of infants, children, adolescents, and young adults.

Adapted from the American Academy of Pediatrics patient education booklet, *Understanding ADHD: Information for Parents About Attention-Deficit/Hyperactivity Disorder*. Any websites, brand names, products, or manufacturers are mentioned for informational and identification purposes only and do not imply an endorsement by the American Academy of Pediatrics (AAP). The AAP is not responsible for the content of external resources. Information was current at the time of publication. The information contained in this publication should not be used as a substitute for the medical care and advice of your pediatrician. There may be variations in treatment that your pediatrician may recommend based on individual facts and circumstances.

ADHD—What are the Symptoms of Attention Deficit/Hyperactivity Disorder?

Are you concerned your child may have attention deficit/hyperactivity disorder (ADHD)? Read on for information from the American Academy of Pediatrics about the symptoms and types of ADHD.

What are the symptoms of ADHD?

Children with ADHD have symptoms that fall into 3 groups: inattention, hyperactivity, and impulsivity. See Table 1.

Table 1. Symptoms of ADHD

Symptom	How a Child With This Symptom May Behave
Inattention	Often has a hard time paying attention; daydreams
	Often does not seem to listen
	Is easily distracted from work or play
	Often does not seem to notice details; makes careless mistakes
	Frequently does not follow through on instructions or finish tasks
	Is disorganized
	Frequently loses a lot of important things
	Often forgets things
	Frequently avoids doing things that require ongoing mental efforts
Hyperactivity	Is in constant motion, as if "driven by a motor"
	Has trouble staying seated
	Frequently squirms and fidgets
	Talks a lot
	Often runs, jumps, and climbs when this is not permitted
	Has trouble playing quietly
Impulsivity	Frequently acts and speaks without thinking
	May run into the street without looking for traffic first
	Frequently has trouble taking turns
	Cannot wait for things
	Often calls out an answer before the question is complete
	Frequently interrupts others

Are there different types of ADHD?

Children with ADHD may have one or more of the symptoms listed in Table 1. The symptoms are usually classified as the following types of ADHD:

- Inattentive only (formerly known as attention-deficit disorder [ADD])—Children with this form of ADHD are not overly active. Because they do not disrupt the classroom or other activities, their symptoms may not be noticed. Among girls with ADHD, this form is more common.
- Hyperactive-impulsive—Children with this type of ADHD have increased activity and impulsivity with typical attention spans. This is the least common type and often occurs in younger children.
- Combined inattentive–hyperactive-impulsive—Children with this type of ADHD have all 3 symptoms. It is the type most people think of when they think of ADHD.

How can I tell if my child has ADHD?

Remember, it is common for all children to show some of these symptoms from time to time. Your child may be reacting to stress at school or at home. He may be bored or going through a difficult stage of life. It does not mean he has ADHD.

Sometimes a teacher is the first to notice inattention, hyperactivity, and/or impulsivity and will inform the parents.

Visit HealthyChildren.org for more information.

From Your Doctor

American Academy of Pediatrics
DEDICATED TO THE HEALTH OF ALL CHILDREN®

healthychildren.org
Powered by pediatricians. Trusted by parents.
from the American Academy of Pediatrics

The American Academy of Pediatrics (AAP) is an organization of 67,000 primary care pediatricians, pediatric medical subspecialists, and pediatric surgical specialists dedicated to the health, safety, and well-being of infants, children, adolescents, and young adults.

Adapted from the American Academy of Pediatrics patient education booklet, *Understanding ADHD: Information for Parents About Attention-Deficit/Hyperactivity Disorder.* The information contained in this publication should not be used as a substitute for the medical care and advice of your pediatrician. There may be variations in treatment that your pediatrician may recommend based on individual facts and circumstances.

ADHD—How is Attention Deficit/ Hyperactivity Disorder Diagnosed?

There is no single test for attention deficit/hyperactivity disorder (ADHD). Diagnosis requires several steps and involves gathering information from multiple sources. You, your child, your child's school, and other caregivers should be involved in observing your child. Read on for information from the American Academy of Pediatrics about diagnosing ADHD.

How is ADHD diagnosed?

Your child's or teen's doctor will determine whether your child or teen has ADHD by using standard guidelines developed by the American Academy of Pediatrics specifically for children, teens, and young adults 4 to 18 years of age.

It is difficult to diagnose ADHD in children younger than 4 years. This is because younger children change very rapidly. It is also more difficult to diagnose ADHD once a child becomes a teen.

Children with ADHD show signs of inattention, hyperactivity, and/or impulsivity in specific ways. Your child's doctor will consider how your child's actions compare with that of other children his age, using the information reported about your child by you, his teacher, and any other caregivers who spend time with your child, such as coaches, grandparents, or child care workers.

Here are guidelines used to confirm a diagnosis of ADHD.

- Some symptoms occur in 2 or more settings such as home, school, and social situations and cause some impairment.
- In a child or teen 4 to 17 years of age, 6 or more symptoms must be identified.
- In a teen or young adult 17 years and older, 5 or more symptoms must be identified.
- Symptoms significantly impair your child's ability to function in some daily activities, such as doing schoolwork, maintaining relationships with parents and siblings, building relationships with friends, or having the ability to function in groups such as sports teams.

Your child's doctor will conduct a physical and neurological examination. A full medical history will be needed to put your child's action into context and screen for other conditions that may affect behavior. Your child's doctor will also talk with your child about how he acts and feels.

Your child's doctor may refer your child to a pediatric subspecialist or mental health professionals if there are concerns of

- Intellectual disability (previously called mental retardation)
- Developmental disorders, such as in speech, coordination, or learning
- Chronic illness being treated with a medication that may interfere with learning
- Trouble seeing and/or hearing
- History of abuse
- Major anxiety or major depression
- Severe aggression
- Possible seizure disorder
- Possible sleep disorder

How can parents help with the diagnosis?

As a parent, you will provide crucial information about your child's actions and how they affect life at home, in school, and in other social settings. Your child's doctor will want to know what symptoms your child is showing, how long the symptoms have occurred, and how these affect him and your family. You will likely be asked to fill in checklists or rating scales about your child's actions.

In addition, sharing your family history can offer important clues about your child's behavior.

How will my child's school be involved?

For an accurate diagnosis, your child's doctor will need to get information about your child directly from his classroom teacher or another school professional. Children at least 4 years and older spend many of their waking hours at preschool or school. Teachers provide valuable insights. Your child's teacher may write a report or discuss the following topics with your child's doctor:

- Your child's actions in the classroom
- Your child's learning patterns
- How long the symptoms have been a problem
- How the symptoms are affecting your child's progress at school
- Ways the classroom program is being adapted to help your child
- Whether other conditions may be affecting the symptoms
- If there are evaluations and help the school can provide

In addition, your child's doctor may want to see report cards, standardized tests, and samples of your child's schoolwork.

How will others who care for my child be involved?

Other caregivers may also provide important information about your child's actions. Former teachers, religious and scout leaders, grandparents, or coaches may have valuable input. If your child is homeschooled, it is especially important to assess his actions in settings outside the home.

Your child may not behave the same way at home as he does in other settings. Direct information about the way your child acts in more than one setting is a requirement to make a diagnosis. It is important to consider other possible causes of your child's symptoms in these settings.

In some cases, other mental health care professionals, such as child psychologists or psychiatrists, may also need to be involved in gathering information for the diagnosis.

Are there other tests for ADHD?

You may have heard theories about other tests for ADHD. There are no other proven diagnostic tests at this time.

Many theories have been presented, but studies have shown that the following evaluations add little value in diagnosing the disorder:

- Screening for thyroid problems
- Computerized continuous performance tests
- Brain imaging studies, such as computed tomography (CT) and magnetic resonance imaging (MRI)
- Electroencephalography (EEG) or brain-wave testing

While these evaluations are not helpful in diagnosing ADHD, your child's doctor may see other signs or symptoms in your child that warrant additional tests.

What are coexisting conditions?

As part of the diagnosis, your child's doctor will look for other conditions that cause the same types of symptoms as ADHD. Your child may simply have a different condition or ADHD combined with another condition (a coexisting condition). Most children with a diagnosis of ADHD have at least one additional condition.

Common coexisting conditions include

- **Learning disabilities**—Learning disabilities are conditions that make it difficult for a child to master specific skills, such as reading or math. ADHD is not a learning disability per se. However, ADHD can make it hard for a child to learn and do well in school. Diagnosing learning disabilities requires conducting evaluations, such as intelligence quotient (IQ) and academic achievement tests, and it requires educational interventions. The school will usually be able to assess whether your child has a learning disability and what his educational needs are.
- **Oppositional defiant disorder or conduct disorder**—Up to 35% of children with ADHD may have inappropriate actions because of an oppositional defiant or conduct disorder.
  - Children with oppositional defiant disorder tend to lose their temper easily and to annoy people on purpose, and they can be defiant and hostile toward authority figures.
  - Children with conduct disorder may break rules, destroy property, be suspended or expelled from school, violate the rights of other people, or show cruelty to other children or animals.
  - Children with coexisting conduct disorder are at higher risk of having trouble with the law or having substance use problems than children who have only ADHD. Studies show that this type of coexisting condition is more common among children with the combined type of ADHD.
- **Anxiety disorders**—About 25% of children with ADHD also have anxiety disorders. Children with anxiety disorders have extreme feelings of fear, worry, or panic that make it difficult to function. These disorders can produce physical symptoms such as racing pulse, sweating, diarrhea, and nausea. Counseling and/or different medication may be needed to treat these coexisting conditions.
- **Mood disorders, including depression**—About 18% of children with ADHD also have mood disorders, usually depression and less commonly bipolar disorder (formerly called manic depressive disorder). There may be a family history of these conditions. Coexisting mood disorders may put children and teens at higher risk for self-harm or suicide, especially during the teen years. These disorders are more common among children with inattentive or combined type of ADHD. Children with mood disorders or depression often require additional interventions or a different type of medication than those typically used to treat ADHD.
- **Language disorders**—Children with ADHD may have difficulty with how they use language. This is referred to as a pragmatic language disorder. It may not show up with standard tests of language. A speech-language clinician can detect it by observing how a child uses language in his day-to-day activities.

Visit HealthyChildren.org for more information.

From Your Doctor

American Academy of Pediatrics
DEDICATED TO THE HEALTH OF ALL CHILDREN®

healthychildren.org
Powered by pediatricians. Trusted by parents.
from the American Academy of Pediatrics

The American Academy of Pediatrics (AAP) is an organization of 67,000 primary care pediatricians, pediatric medical subspecialists, and pediatric surgical specialists dedicated to the health, safety, and well-being of infants, children, adolescents, and young adults.

Adapted from the American Academy of Pediatrics patient education booklet, *Understanding ADHD: Information for Parents About Attention-Deficit/Hyperactivity Disorder*. Information applies to all sexes and genders; however, for easier reading, pronouns such as he are used in this publication. The information contained in this publication should not be used as a substitute for the medical care and advice of your pediatrician. There may be variations in treatment that your pediatrician may recommend based on individual facts and circumstances.

ADHD—What Causes Attention Deficit/ Hyperactivity Disorder and How Is It Treated?

Understanding attention deficit/hyperactivity disorder (ADHD) helps you understand how it affects your child. Read on for information from the American Academy of Pediatrics about the causes and treatments for ADHD.

What causes ADHD?

ADHD is one of the most studied conditions of childhood, and it may be caused by a number of things.

Research to date has shown

- ADHD is a neurobiological condition whose symptoms can also depend on the child's environment.
- A lower level of activity in the parts of the brain that control attention and activity level may be associated with ADHD.
- ADHD often runs in families.
- In very rare cases, toxins in the environment may lead to ADHD-like symptoms. For instance, lead in the body can affect child development.
- Significant head injuries may cause ADHD-like symptoms in some children.
- Preterm birth increases the risk of developing ADHD.
- Prenatal substance exposures, such as to alcohol or nicotine from smoking, increase the risk of developing ADHD-like symptoms.

There is no scientific evidence that ADHD is caused by

- Eating too much sugar
- Food additives or food colorings
- Allergies
- Immunizations

How is ADHD treated?

Once the diagnosis is confirmed, the outlook for most children who receive treatment of ADHD is encouraging. There is no specific cure for ADHD, but many treatment options are available to manage the condition. Some children and adults learn to compensate for the symptoms as they mature so that they no longer require treatment.

Each child's treatment must be tailored to meet his individual needs. In most cases, treatment of ADHD should include A long-term management plan with

- Target outcomes for behavior
  - Follow-up activities
  - Monitoring
  - Education about ADHD
- Teamwork among doctors, parents, teachers, caregivers, other health care professionals, and the child
- Behavioral parent training
- Behavioral school programs
- Medication

Treatment of ADHD is based on the same principles that are used to treat other chronic conditions, such as asthma or diabetes. Long-term planning for many children is needed. Families must manage chronic conditions continually. In the case of ADHD, schools and other caregivers must also be involved in managing the condition.

Educating the people involved with your child is a key part of treatment of ADHD. As a parent, you will need to learn about the condition. Read about it and talk with people who understand it. This will help you manage the ways ADHD affects your child and your family day to day. It will also help your child learn to help himself.

What are target outcomes?

At the beginning of treatment, your child's doctor should help your family set up to 3 target outcomes (goals) for your child. These target outcomes will guide the treatment plan. Your child's target outcomes should be chosen to help him function as well as possible at home, at school, and in your community. You and your child should identify what is preventing him from succeeding.

Here are examples of target outcomes.

- Improved relationships with parents, siblings, teachers, and friends—for example, fewer arguments with siblings or being invited more often to friends' houses or parties
- Better schoolwork practices—for example, completing all classwork or homework assignments
- More independence in self-care or homework—for example, getting ready for school in the morning without supervision
- Improved self-esteem, such as feeling that he can get his work done
- Fewer disruptive actions—for example, decreasing the number of times he refuses to obey rules
- Safer behavior in the community—for example, being careful when crossing streets

The target outcomes should be

- Realistic
- Something your child will be able to do
- Behaviors that you can observe and count (with rating scales when possible)

Your child's treatment plan will be set up to help achieve these goals.

Visit HealthyChildren.org for more information.

American Academy of Pediatrics
DEDICATED TO THE HEALTH OF ALL CHILDREN®

healthychildren.org
Powered by pediatricians. Trusted by parents.
from the American Academy of Pediatrics

The American Academy of Pediatrics (AAP) is an organization of 67,000 primary care pediatricians, pediatric medical subspecialists, and pediatric surgical specialists dedicated to the health, safety, and well-being of infants, children, adolescents, and young adults.

Adapted from the American Academy of Pediatrics patient education booklet, *Understanding ADHD: Information for Parents About Attention-Deficit/Hyperactivity Disorder.* The information contained in this publication should not be used as a substitute for the medical care and advice of your pediatrician. There may be variations in treatment that your pediatrician may recommend based on individual facts and circumstances.

Brief Resolved Unexplained Events (Formerly Apparent Life-Threatening Events) and Evaluation of Lower-Risk Infants

- *Clinical Practice Guideline*
  - *PPI: AAP Partnership for Policy Implementation*
    See Appendix 1 for more information.

- *Executive Summary*
  - *PPI: AAP Partnership for Policy Implementation*
    See Appendix 1 for more information.

CLINICAL PRACTICE GUIDELINE Guidance for the Clinician in Rendering Pediatric Care

American Academy of Pediatrics

DEDICATED TO THE HEALTH OF ALL CHILDREN™

Brief Resolved Unexplained Events (Formerly Apparent Life-Threatening Events) and Evaluation of Lower-Risk Infants

Joel S. Tieder, MD, MPH, FAAP, Joshua L. Bonkowsky, MD, PhD, FAAP, Ruth A. Etzel, MD, PhD, FAAP, Wayne H. Franklin, MD, MPH, MMM, FAAP, David A. Gremse, MD, FAAP, Bruce Herman, MD, FAAP, Eliot S. Katz, MD, FAAP, Leonard R. Krilov, MD, FAAP, J. Lawrence Merritt II, MD, FAAP, Chuck Norlin, MD, FAAP, Jack Percelay, MD, MPH, FAAP, Robert E. Sapién, MD, MMM, FAAP, Richard N. Shiffman, MD, MCIS, FAAP, Michael B.H. Smith, MB, FRCPCH, FAAP, for the SUBCOMMITTEE ON APPARENT LIFE THREATENING EVENTS

abstract

This is the first clinical practice guideline from the American Academy of Pediatrics that specifically applies to patients who have experienced an apparent life-threatening event (ALTE). This clinical practice guideline has 3 objectives. First, it recommends the replacement of the term ALTE with a new term, brief resolved unexplained event (BRUE). Second, it provides an approach to patient evaluation that is based on the risk that the infant will have a repeat event or has a serious underlying disorder. Finally, it provides management recommendations, or key action statements, for lower-risk infants. The term BRUE is defined as an event occurring in an infant younger than 1 year when the observer reports a sudden, brief, and now resolved episode of ≥1 of the following: (1) cyanosis or pallor; (2) absent, decreased, or irregular breathing; (3) marked change in tone (hyper- or hypotonia); and (4) altered level of responsiveness. A BRUE is diagnosed only when there is no explanation for a qualifying event after conducting an appropriate history and physical examination. By using this definition and framework, infants younger than 1 year who present with a BRUE are categorized either as (1) a lower-risk patient on the basis of history and physical examination for whom evidence-based recommendations for evaluation and management are offered or (2) a higher-risk patient whose history and physical examination suggest the need for further investigation and treatment but for whom recommendations are not offered. This clinical practice guideline is intended to foster a patient- and family-centered approach to care, reduce unnecessary and costly medical interventions, improve patient outcomes, support implementation, and provide direction for future research. Each key action statement indicates a level of evidence, the benefit-harm relationship, and the strength of recommendation.

DOI: 10.1542/peds.2016-0590

PEDIATRICS (ISSN Numbers: Print, 0031-4005; Online, 1098-4275).

To cite: Tieder JS, Bonkowsky JL, Etzel RA, et al. Brief Resolved Unexplained Events (Formerly Apparent Life-Threatening Events) and Evaluation of Lower-Risk Infants. *Pediatrics*. 2016;137(5):e20160590

INTRODUCTION

This clinical practice guideline applies to infants younger than 1 year and is intended for pediatric clinicians. This guideline has 3 primary objectives. First, it recommends the replacement of the term apparent life-threatening event (ALTE) with a new term, brief resolved unexplained event (BRUE). Second, it provides an approach to patient evaluation that is based on the risk that the infant will have a recurring event or has a serious underlying disorder. Third, it provides evidence-based management recommendations, or key action statements, for lower-risk patients whose history and physical examination are normal. It does not offer recommendations for higher-risk patients whose history and physical examination suggest the need for further investigation and treatment (because of insufficient evidence or the availability of clinical practice guidelines specific to their presentation). This clinical practice guideline also provides implementation support and suggests directions for future research.

The term ALTE originated from a 1986 National Institutes of Health Consensus Conference on Infantile Apnea and was intended to replace the term "near-miss sudden infant death syndrome" (SIDS).[1] An ALTE was defined as "an episode that is frightening to the observer and that is characterized by some combination of apnea (central or occasionally obstructive), color change (usually cyanotic or pallid but occasionally erythematous or plethoric), marked change in muscle tone (usually marked limpness), choking, or gagging. In some cases, the observer fears that the infant has died."[2] Although the definition of ALTE eventually enabled researchers to establish that these events are separate entities from SIDS, the clinical application of this classification, which describes a constellation of observed, subjective, and nonspecific symptoms, has raised significant challenges for clinicians and parents in the evaluation and care of these infants.[3] Although a broad range of disorders can present as an ALTE (eg, child abuse, congenital abnormalities, epilepsy, inborn errors of metabolism, and infections), for a majority of infants who appear well after the event, the risk of a serious underlying disorder or a recurrent event is extremely low.[2]

CHANGE IN TERMINOLOGY AND DIAGNOSIS

The imprecise nature of the original ALTE definition is difficult to apply to clinical care and research.[3] As a result, the clinician is often faced with several dilemmas. First, under the ALTE definition, the infant is often, but not necessarily, asymptomatic on presentation. The evaluation and management of symptomatic infants (eg, those with fever or respiratory distress) need to be distinguished from that of asymptomatic infants. Second, the reported symptoms under the ALTE definition, although often concerning to the caregiver, are not intrinsically life-threatening and frequently are a benign manifestation of normal infant physiology or a self-limited condition. A definition needs enough precision to allow the clinician to base clinical decisions on events that are characterized as abnormal after conducting a thorough history and physical examination. For example, a constellation of symptoms suggesting hemodynamic instability or central apnea needs to be distinguished from more common and less concerning events readily characterized as periodic breathing of the newborn, breath-holding spells, dysphagia, or gastroesophageal reflux (GER). Furthermore, events defined as ALTEs are rarely a manifestation of a more serious illness that, if left undiagnosed, could lead to morbidity or death. Yet, the perceived potential for recurring events or a serious underlying disorder often provokes concern in caregivers and clinicians.[2,4,5] This concern can compel testing or admission to the hospital for observation, which can increase parental anxiety and subject the patient to further risk and does not necessarily lead to a treatable diagnosis or prevention of future events. A more precise definition could prevent the overuse of medical interventions by helping clinicians distinguish infants with lower risk. Finally, the use of ALTE as a diagnosis may reinforce the caregivers' perceptions that the event was indeed "life-threatening," even when it most often was not. For these reasons, a replacement of the term ALTE with a more specific term could improve clinical care and management.

In this clinical practice guideline, a more precise definition is introduced for this group of clinical events: brief resolved unexplained event (BRUE). The term BRUE is intended to better reflect the transient nature and lack of clear cause and removes the "life-threatening" label. The authors of this guideline recommend that the term ALTE no longer be used by clinicians to describe an event or as a diagnosis. Rather, the term BRUE should be used to describe events occurring in infants younger than 1 year of age that are characterized by the observer as "brief" (lasting <1 minute but typically <20–30 seconds) and "resolved" (meaning the patient returned to baseline state of health after the event) and with a reassuring history, physical examination, and vital signs at the time of clinical evaluation by trained medical providers (Table 1). For example, the presence of respiratory symptoms or fever would preclude classification of an event as a BRUE. BRUEs are also "unexplained," meaning that a clinician is unable to explain the cause of the event after

an appropriate history and physical examination. Similarly, an event characterized as choking or gagging associated with spitting up is not included in the BRUE definition, because clinicians will want to pursue the cause of vomiting, which may be related to GER, infection, or central nervous system (CNS) disease. However, until BRUE-specific codes are available, for billing and coding purposes, it is reasonable to apply the ALTE International Classification of Diseases, 9th Revision, and International Classification of Diseases, 10th revision, codes to patients determined to have experienced a BRUE (see section entitled "Dissemination and Implementation").

TABLE 1 BRUE Definition and Factors for Inclusion and Exclusion

	Includes	Excludes
Brief	Duration <1 min; typically 20–30 s	Duration ≥1 min
Resolved	Patient returned to his or her baseline state of health after the event	At the time of medical evaluation:
	Normal vital signs	Fever or recent fever
	Normal appearance	Tachypnea, bradypnea, apnea
		Tachycardia or bradycardia
		Hypotension, hypertension, or hemodynamic instability
		Mental status changes, somnolence, lethargy
		Hypotonia or hypertonia
		Vomiting
		Bruising, petechiae, or other signs of injury/trauma
		Abnormal weight, growth, or head circumference
		Noisy breathing (stridor, sturgor, wheezing)
		Repeat event(s)
Unexplained	Not explained by an identifiable medical condition	Event consistent with GER, swallow dysfunction, nasal congestion, etc
		History or physical examination concerning for child abuse, congenital airway abnormality, etc
Event Characterization		
Cyanosis or pallor	Central cyanosis: blue or purple coloration of face, gums, trunk	Acrocyanosis or perioral cyanosis
	Central pallor: pale coloration of face or trunk	Rubor
Absent, decreased, or irregular breathing	Central apnea	Periodic breathing of the newborn
	Obstructive apnea	Breath-holding spell
	Mixed obstructive apnea	
Marked change in tone (hyper- or hypotonia)	Hypertonia	Hypertonia associated with crying, choking, or gagging due to GER or feeding problems
	Hypotonia	Tone changes associated with breath-holding spell
		Tonic eye deviation or nystagmus
		Tonic-clonic seizure activity
		Infantile spasms
Altered responsiveness	Loss of consciousness	Loss of consciousness associated with breath-holding spell
	Mental status change	
	Lethargy	
	Somnolence	
	Postictal phase	

BRUE DEFINITION

Clinicians should use the term BRUE to describe an event occurring in an infant <1 year of age when the observer reports a sudden, brief, and now resolved episode of ≥1 of the following:

- **cyanosis or pallor**
- **absent, decreased, or irregular breathing**
- **marked change in tone (hyper- or hypotonia)**
- **altered level of responsiveness**

Moreover, clinicians should diagnose a BRUE only when there is no explanation for a qualifying event after conducting an appropriate history and physical examination (Tables 2 and 3).

Differences between the terms ALTE and BRUE should be noted. First, the BRUE definition has a strict age limit. Second, an event is only a BRUE if there is no other likely explanation. Clinical symptoms such as fever, nasal congestion, and increased work of breathing may indicate temporary airway obstruction from viral infection. Events characterized as choking after vomiting may indicate a gastrointestinal cause, such as GER. Third, a BRUE diagnosis is based on the clinician's characterization of features of the event and not on a caregiver's perception that the event was life-threatening. Although such perceptions are understandable and important to address, such risk can only be assessed after the event has been objectively characterized by a clinician. Fourth, the clinician should determine whether the infant had episodic cyanosis or pallor, rather than just determining whether "color change" occurred. Episodes of rubor or redness are not consistent with BRUE, because they are common in healthy infants. Fifth, BRUE expands the respiratory criteria beyond "apnea" to include absent breathing, diminished breathing, and other breathing irregularities. Sixth, instead of the less specific criterion of "change in muscle tone," the clinician should determine whether there was marked change in tone, including

hypertonia or hypotonia. Seventh, because choking and gagging usually indicate common diagnoses such as GER or respiratory infection, their presence suggests an event was not a BRUE. Finally, the use of "altered level of responsiveness" is a new criterion, because it can be an important component of an episodic but serious cardiac, respiratory, metabolic, or neurologic event.

For infants who have experienced a BRUE, a careful history and physical examination are necessary to characterize the event, assess the risk of recurrence, and determine the presence of an underlying disorder (Tables 2 and 3). The recommendations provided in this guideline focus on infants with a lower risk of a subsequent event or serious underlying disorder (see section entitled "Risk Assessment: Lower- Versus Higher-Risk BRUE"). In the absence of identifiable risk factors, infants are at lower risk and laboratory studies, imaging studies, and other diagnostic procedures are unlikely to be useful or necessary. However, if the clinical history or physical examination reveals abnormalities, the patient may be at higher risk and further evaluation should focus on the specific areas of concern. For example,

- possible child abuse may be considered when the event history is reported inconsistently or is incompatible with the child's developmental age, or when, on physical examination, there is unexplained bruising or a torn labial or lingual frenulum;
- a cardiac arrhythmia may be considered if there is a family history of sudden, unexplained death in first-degree relatives; and
- infection may be considered if there is fever or persistent respiratory symptoms.

TABLE 2 Historical Features To Be Considered in the Evaluation of a Potential BRUE

Features To Be Considered
Considerations for possible child abuse:
Multiple or changing versions of the history/circumstances
History/circumstances inconsistent with child's developmental stage
History of unexplained bruising
Incongruence between caregiver expectations and child's developmental stage, including assigning negative attributes to the child
History of the event
General description
Who reported the event?
Witness of the event? Parent(s), other children, other adults? Reliability of historian(s)?
State immediately before the event
Where did it occur (home/elsewhere, room, crib/floor, etc)?
Awake or asleep?
Position: supine, prone, upright, sitting, moving?
Feeding? Anything in the mouth? Availability of item to choke on? Vomiting or spitting up?
Objects nearby that could smother or choke?
State during the event
Choking or gagging noise?
Active/moving or quiet/flaccid?
Conscious? Able to see you or respond to voice?
Muscle tone increased or decreased?
Repetitive movements?
Appeared distressed or alarmed?
Breathing: yes/no, struggling to breathe?
Skin color: normal, pale, red, or blue?
Bleeding from nose or mouth?
Color of lips: normal, pale, or blue?
End of event
Approximate duration of the event?
How did it stop: with no intervention, picking up, positioning, rubbing or clapping back, mouth-to-mouth, chest compressions, etc?
End abruptly or gradually?
Treatment provided by parent/caregiver (eg, glucose-containing drink or food)?
911 called by caregiver?
State after event
Back to normal immediately/gradually/still not there?
Before back to normal, was quiet, dazed, fussy, irritable, crying?
Recent history
Illness in preceding day(s)?
If yes, detail signs/symptoms (fussiness, decreased activity, fever, congestion, rhinorrhea, cough, vomiting, diarrhea, decreased intake, poor sleep)
Injuries, falls, previous unexplained bruising?
Past medical history
Pre-/perinatal history
Gestational age
Newborn screen normal (for IEMs, congenital heart disease)?
Previous episodes/BRUE?
Reflux? If yes, obtain details, including management
Breathing problems? Noisy ever? Snoring?
Growth patterns normal?
Development normal? Assess a few major milestones across categories, any concerns about development or behavior?
Illnesses, injuries, emergencies?
Previous hospitalization, surgery?
Recent immunization?
Use of over-the-counter medications?
Family history
Sudden unexplained death (including unexplained car accident or drowning) in first- or second-degree family members before age 35, and particularly as an infant?
Apparent life-threatening event in sibling?
Long QT syndrome?
Arrhythmia?

TABLE 2 Continued

Features To Be Considered
Inborn error of metabolism or genetic disease?
Developmental delay?
Environmental history
Housing: general, water damage, or mold problems?
Exposure to tobacco smoke, toxic substances, drugs?
Social history
Family structure, individuals living in home?
Housing: general, mold?
Recent changes, stressors, or strife?
Exposure to smoke, toxic substances, drugs?
Recent exposure to infectious illness, particularly upper respiratory illness, paroxysmal cough, pertussis?
Support system(s)/access to needed resources?
Current level of concern/anxiety; how family manages adverse situations?
Potential impact of event/admission on work/family?
Previous child protective services or law enforcement involvement (eg, domestic violence, animal abuse), alerts/reports for this child or others in the family (when available)?
Exposure of child to adults with history of mental illness or substance abuse?

The key action statements in this clinical practice guideline do not apply to higher-risk patients but rather apply only to infants who meet the lower-risk criteria by having an otherwise normal history and physical examination.

RISK ASSESSMENT: LOWER- VERSUS HIGHER-RISK BRUE

Patients who have experienced a BRUE may have a recurrent event or an undiagnosed serious condition (eg, child abuse, pertussis, etc) that confers a risk of adverse outcomes. Although this risk has been difficult to quantify historically and no studies have fully evaluated patient-centered outcomes (eg, family experience survey), the systematic review of the ALTE literature identified a subset of BRUE patients who are unlikely to have a recurrent event or undiagnosed serious conditions, are at lower risk of adverse outcomes, and can likely be managed safely without extensive diagnostic evaluation or hospitalization.[3] In the systematic review of ALTE studies in which it was possible to identify BRUE patients, the following characteristics most consistently conferred higher risk: infants <2 months of age, those with a history of prematurity, and those with more than 1 event. There was generally an increased risk from prematurity in infants born at <32 weeks' gestation, and the risk attenuated once infants born at <32 weeks' gestation reached 45 weeks' postconceptional age. Two ALTE studies evaluated the duration of the event.[6,7] Although duration did not appear to be predictive of hospital admission, it was difficult to discern a BRUE population from the heterogeneous ALTE populations. Nonetheless, most events were less than one minute. By consensus, the subcommittee established <1 minute as the upper limit of a "brief event," understanding that objective, verifiable measurements were rarely, if ever, available. Cariopulmonary resuscitation (CPR) was identified as a risk factor in the older ALTE studies and confirmed in a recent study,[6] but it was unclear how the need for CPR was determined. Therefore, the committee agreed by consensus that the need for CPR should be determined by trained medical providers.

PATIENT FACTORS THAT DETERMINE A LOWER RISK

To be designated lower risk, the following criteria should be met (see Fig 1):

- Age >60 days
- Prematurity: gestational age ≥32 weeks and postconceptional age ≥45 weeks
- First BRUE (no previous BRUE ever and not occurring in clusters)
- Duration of event <1 minute
- No CPR required by trained medical provider
- No concerning historical features (see Table 2)
- No concerning physical examination findings (see Table 3)

Infants who have experienced a BRUE who do not qualify as lower-risk patients are, by definition, at higher risk. Unfortunately, the outcomes data from ALTE studies in the heterogeneous higher-risk population are unclear and preclude the derivation of evidence-based recommendations regarding management. Thus, pending further research, this guideline does not provide recommendations for the management of the higher-risk infant. Nonetheless, it is important for clinicians and researchers to recognize that some studies suggest that higher-risk BRUE patients may be more likely to have a serious underlying cause, recurrent event, or an adverse outcome. For example, infants younger than 2 months who experience a BRUE may be more likely to have a congenital or infectious cause and be at higher risk of an adverse outcome. Infants who have experienced multiple events or a concerning social assessment for child abuse may warrant increased observation to better document the events or contextual factors. A list of differential diagnoses for BRUE patients is provided in Supplemental Table 6.

METHODS

In July 2013, the American Academy of Pediatrics (AAP) convened a multidisciplinary subcommittee composed of primary care clinicians

TABLE 3 Physical Examination Features To Be Considered in the Evaluation of a Potential BRUE

Physical Examination
General appearance
Craniofacial abnormalities (mandible, maxilla, nasal)
Age-appropriate responsiveness to environment
Growth variables
Length, weight, occipitofrontal circumference
Vital signs
Temperature, pulse, respiratory rate, blood pressure, oxygen saturation
Skin
Color, perfusion, evidence of injury (eg, bruising or erythema)
Head
Shape, fontanelles, bruising or other injury
Eyes
General, extraocular movement, pupillary response
Conjunctival hemorrhage
Retinal examination, if indicated by other findings
Ears
Tympanic membranes
Nose and mouth
Congestion/coryza
Blood in nares or oropharynx
Evidence of trauma or obstruction
Torn frenulum
Neck
Mobility
Chest
Auscultation, palpation for rib tenderness, crepitus, irregularities
Heart
Rhythm, rate, auscultation
Abdomen
Organomegaly, masses, distention
Tenderness
Genitalia
Any abnormalities
Extremities
Muscle tone, injuries, limb deformities consistent with fracture
Neurologic
Alertness, responsiveness
Response to sound and visual stimuli
General tone
Pupillary constriction in response to light
Presence of symmetrical reflexes
Symmetry of movement/tone/strength

and experts in the fields of general pediatrics, hospital medicine, emergency medicine, infectious diseases, child abuse, sleep medicine, pulmonary medicine, cardiology, neurology, biochemical genetics, gastroenterology, environmental health, and quality improvement. The subcommittee also included a parent representative, a guideline methodologist/informatician, and an epidemiologist skilled in systematic reviews. All panel members declared potential conflicts on the basis of the AAP policy on Conflict of Interest and Voluntary Disclosure. Subcommittee members repeated this process annually and upon publication of the guideline. All potential conflicts of interest are listed at the end of this document. The project was funded by the AAP.

The subcommittee performed a comprehensive review of the literature related to ALTEs from 1970 through 2014. Articles from 1970 through 2011 were identified and evaluated by using "Management of Apparent Life Threatening Events in Infants: A Systematic Review," authored by the Society of Hospital Medicine's ALTE Expert Panel (which included 4 members of the subcommittee).[3] The subcommittee partnered with the Society of Hospital Medicine Expert Panel and a librarian to update the original systematic review with articles published through December 31, 2014, with the use of the same methodology as the original systematic review. PubMed, Cumulative Index to Nursing and Allied Health Literature, and Cochrane Library databases were searched for studies involving children younger than 24 months by using the stepwise approach specified in the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) statement.[8] Search terms included "ALTE(s)," "apparent life threatening event(s)," "life threatening event(s)," "near miss SIDS" or "near miss sudden infant death syndrome," "aborted crib death" or "aborted sudden infant death syndrome," and "aborted SIDS" or "aborted cot death" or "infant death, sudden." The Medical Subject Heading "infantile apparent life-threatening event," introduced in 2011, was also searched but did not identify additional articles.

In updating the systematic review published in 2012, pairs of 2 subcommittee members used validated methodology to independently score the newly identified abstracts from English-language articles (n = 120) for relevance to the clinical questions (Supplemental Fig 3).[9,10] Two independent reviewers then critically appraised the full text of the identified articles (n = 23) using a structured data collection form based on published guidelines for evaluating medical literature.[11,12] They recorded each study's relevance to the clinical question, research design, setting, time period covered, sample size, patient eligibility criteria, data source, variables collected, key results, study

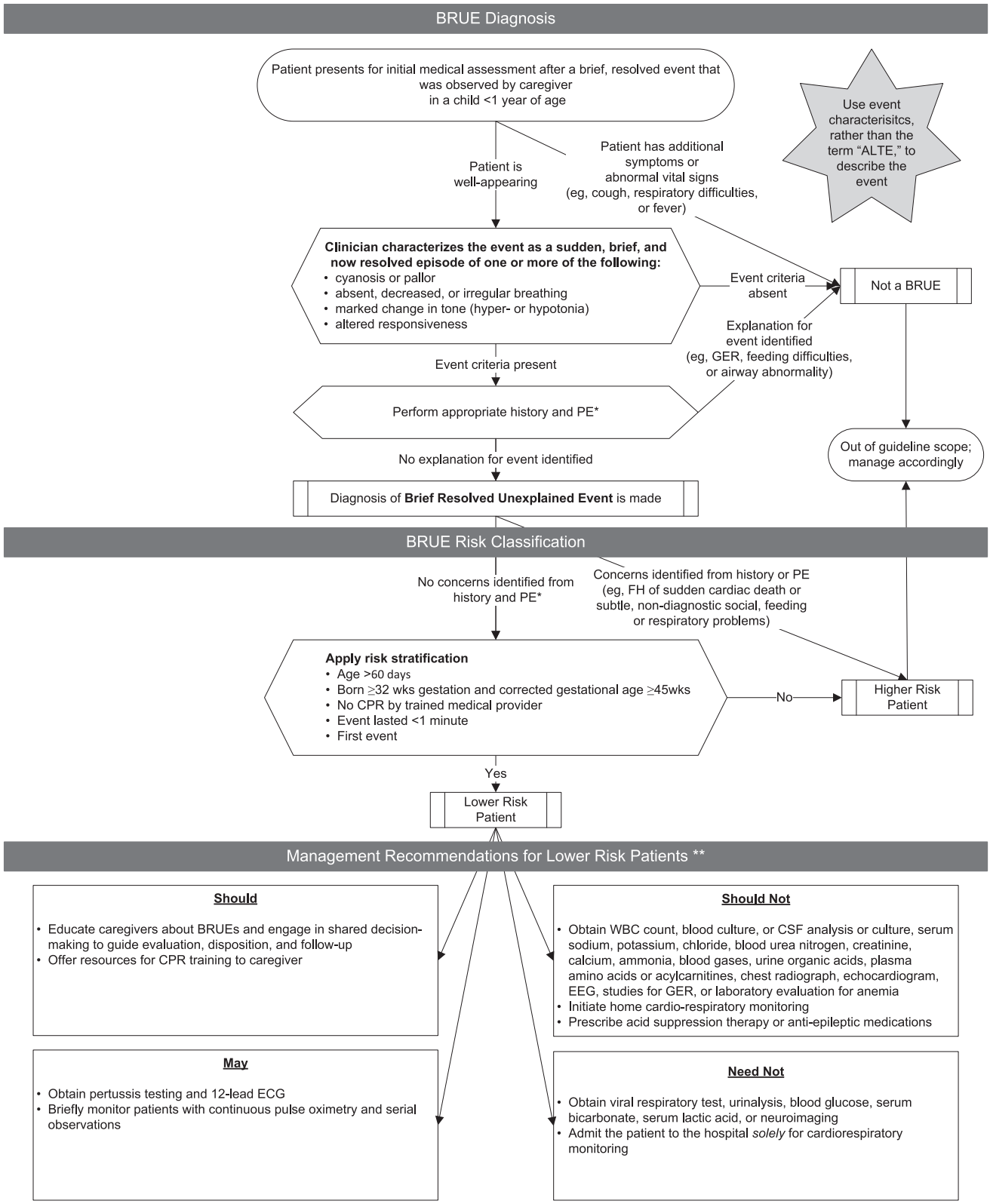


FIGURE 1

Diagnosis, risk classification, and recommended management of a BRUE. *See Tables 3 and 4 for the determination of an appropriate and negative FH and PE. **See Fig 2 for the AAP method for rating of evidence and recommendations. CSF, cerebrospinal fluid; FH, family history; PE, physical examination; WBC, white blood cell.

Figure 1, shown here, has been updated per the erratum at http://pediatrics.aappublications.org/content/138/2/e20161487.

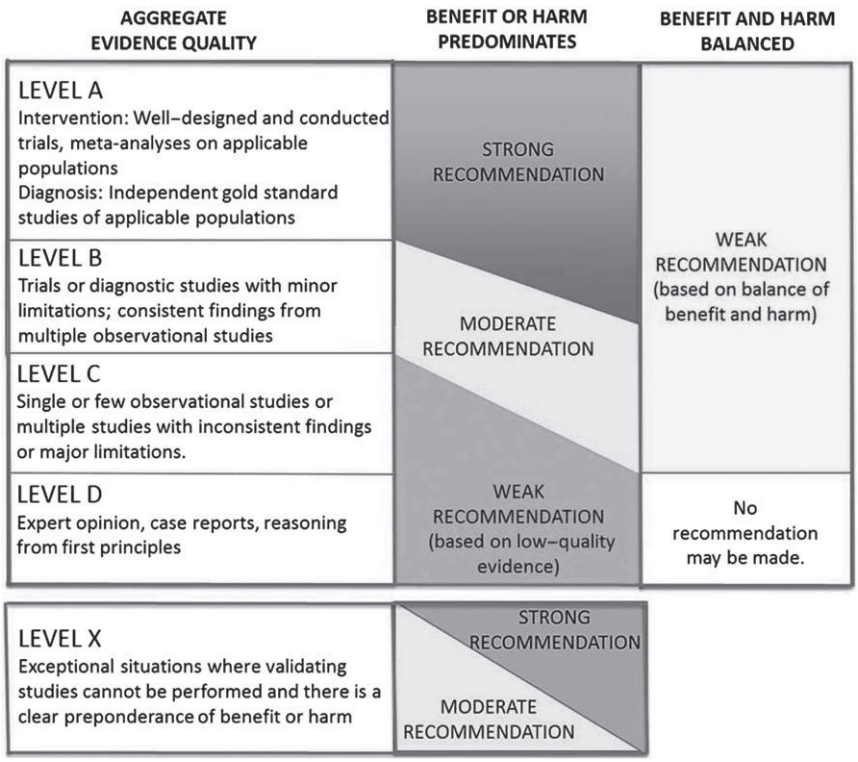


FIGURE 2
AAP rating of evidence and recommendations.

limitations, potential sources of bias, and stated conclusions. If at least 1 reviewer judged an article to be relevant on the basis of the full text, subsequently at least 2 reviewers critically appraised the article and determined by consensus what evidence, if any, should be cited in the systematic review. Selected articles used in the earlier review were also reevaluated for their quality. The final recommendations were based on articles identified in the updated (n = 18) and original (n = 37) systematic review (Supplemental Table 7).[6,7,13–28] The resulting systematic review was used to develop the guideline recommendations by following the policy statement from the AAP Steering Committee on Quality Improvement and Management, "Classifying Recommendations for Clinical Practice Guidelines."[29] Decisions and the strength of recommendations were based on a systematic grading of the quality of evidence from the updated literature review by 2 independent reviewers and incorporation of the previous systematic review. Expert consensus was used when definitive data were not available. If committee members disagreed with the rest of the consensus, they were encouraged to voice their concern until full agreement was reached. If full agreement could not be reached, each committee member reserved the right to state concern or disagreement in the publication (which did not occur). Because the recommendations of this guideline were based on the ALTE literature, we relied on the studies and outcomes that could be attributable to the new definition of lower- or higher-risk BRUE patients.

Key action statements (summarized in Table 5) were generated by using BRIDGE-Wiz (Building Recommendations in a Developers Guideline Editor), an interactive software tool that leads guideline development teams through a series of questions that are intended to create clear, transparent, and actionable key action statements.[30] BRIDGE-Wiz integrates the quality of available evidence and a benefit-harm assessment into the final determination of the strength of each recommendation. Evidence-based guideline recommendations from the AAP may be graded as strong,

TABLE 4 Guideline Definitions for Key Action Statements

Statement	Definition	Implication
Strong recommendation	A particular action is favored because anticipated benefits clearly exceed harms (or vice versa) and quality of evidence is excellent or unobtainable.	Clinicians should follow a strong recommendation unless a clear and compelling rationale for an alternative approach is present.
Moderate recommendation	A particular action is favored because anticipated benefits clearly exceed harms (or vice versa) and the quality of evidence is good but not excellent (or is unobtainable).	Clinicians would be prudent to follow a moderate recommendation but should remain alert to new information and sensitive to patient preferences.
Weak recommendation (based on low-quality evidence)	A particular action is favored because anticipated benefits clearly exceed harms (or vice versa), but the quality of evidence is weak.	Clinicians would be prudent follow a weak recommendation but should remain alert to new information and very sensitive to patient preferences.
Weak recommendation (based on balance of benefits and harms)	Weak recommendation is provided when the aggregate database shows evidence of both benefit and harm that appear to be similar in magnitude for any available courses of action.	Clinicians should consider the options in their decision-making, but patient preference may have a substantial role.

TABLE 5 Summary of Key Action Statements for Lower-Risk BRUEs

When managing an infant aged >60 d and <1 y and who, on the basis of a thorough history and physical examination, meets criteria for having experienced a lower-risk BRUE, clinicians:	Evidence Quality; Strength of Recommendation
1. Cardiopulmonary evaluation	
1A. Need not admit infants to the hospital solely for cardiorespiratory monitoring.	B; Weak
1B. May briefly monitor patients with continuous pulse oximetry and serial observations.	D; Weak
1C. Should not obtain a chest radiograph.	B; Moderate
1D. Should not obtain a measurement of venous or arterial blood gas.	B; Moderate
1E. Should not obtain an overnight polysomnograph.	B; Moderate
1F. May obtain a 12-lead electrocardiogram.	C; Weak
1G. Should not obtain an echocardiogram.	C; Moderate
1H. Should not initiate home cardiorespiratory monitoring.	B; Moderate
2. Child abuse evaluation	
2A. Need not obtain neuroimaging (CT, MRI, or ultrasonography) to detect child abuse.	C; Weak
2B. Should obtain an assessment of social risk factors to detect child abuse.	C; Moderate
3. Neurologic evaluation	
3A. Should not obtain neuroimaging (CT, MRI, or ultrasonography) to detect neurologic disorders.	C; Moderate
3B. Should not obtain an EEG to detect neurologic disorders.	C; Moderate
3C. Should not prescribe antiepileptic medications for potential neurologic disorders.	C; Moderate
4. Infectious disease evaluation	
4A. Should not obtain a WBC count, blood culture, or cerebrospinal fluid analysis or culture to detect an occult bacterial infection.	B; Strong
4B. Need not obtain a urinalysis (bag or catheter).	C; Weak
4C. Should not obtain chest radiograph to assess for pulmonary infection.	B; Moderate
4D. Need not obtain respiratory viral testing if rapid testing is available.	C; Weak
4E. May obtain testing for pertussis.	B; Weak
5. Gastrointestinal evaluation	
5A. Should not obtain investigations for GER (eg, upper gastrointestinal tract series, pH probe, endoscopy, barium contrast study, nuclear scintigraphy, and ultrasonography).	C; Moderate
5B. Should not prescribe acid suppression therapy.	C; Moderate
6. IEM evaluation	
6A. Need not obtain measurement of serum lactic acid or serum bicarbonate.	C; Weak
6B. Should not obtain a measurement of serum sodium, potassium, chloride, blood urea nitrogen, creatinine, calcium, or ammonia.	C; Moderate
6C. Should not obtain a measurement of venous or arterial blood gases.	C; Moderate
6D. Need not obtain a measurement of blood glucose.	C; Weak
6E. Should not obtain a measurement of urine organic acids, plasma amino acids, or plasma acylcarnitines.	C; Moderate
7. Anemia evaluation	
7A. Should not obtain laboratory evaluation for anemia.	C; Moderate
8. Patient- and family-centered care	
8A. Should offer resources for CPR training to caregiver.	C; Moderate
8B. Should educate caregivers about BRUEs.	C; Moderate
8C. Should use shared decision-making.	C; Moderate

CPR, cardiopulmonary resuscitation; CT, computed tomography; GER, gastroesophageal reflux; WBC, white blood cell.

moderate, weak based on low-quality evidence, or weak based on balance between benefits and harms. Strong and moderate recommendations are associated with "should" and "should not" recommendation statements, whereas weak recommendation may be recognized by use of "may" or "need not" (Fig 2, Table 4).

A strong recommendation means that the committee's review of the evidence indicates that the benefits of the recommended approach clearly exceed the harms of that approach (or, in the case of a strong negative recommendation, that the harms clearly exceed the benefits) and that the quality of the evidence supporting this approach is excellent. Clinicians are advised to follow such guidance unless a clear and compelling rationale for acting in a contrary manner is present. A moderate recommendation means that the committee believes that the benefits exceed the harms (or, in the case of a negative recommendation, that the harms exceed the benefits), but the quality of the evidence on which this recommendation is based is not as strong. Clinicians are also encouraged to follow such guidance but also should be alert to new information and sensitive to patient preferences.

A weak recommendation means either that the evidence quality that exists is suspect or that well-designed, well-conducted studies have shown little clear advantage to one approach versus another. Weak recommendations offer clinicians flexibility in their decision-making regarding appropriate practice, although they may set boundaries on alternatives. Family and patient preference should have a substantial role in influencing clinical

1A. Clinicians Need Not Admit Infants Presenting With a Lower-Risk BRUE to the Hospital Solely for Cardiorespiratory Monitoring (Grade B, Weak Recommendation)

Aggregate Evidence Quality	Grade B
Benefits	Reduce unnecessary testing and caregiver/infant anxiety Avoid consequences of false-positive result, health care–associated infections, and other patient safety risks
Risks, harm, cost	May rarely miss a recurrent event or diagnostic opportunity for rare underlying condition
Benefit-harm assessment	The benefits of reducing unnecessary testing, nosocomial infections, and false-positive results, as well as alleviating caregiver and infant anxiety, outweigh the rare missed diagnostic opportunity for an underlying condition
Intentional vagueness	None
Role of patient preferences	Caregiver anxiety and access to quality follow-up care may be important considerations in determining whether a hospitalization for cardiovascular monitoring is indicated
Exclusions	None
Strength	Weak recommendation (because of equilibrium between benefits and harms)
Key references	31, 32

1B. Clinicians May Briefly Monitor Infants Presenting With a Lower-Risk BRUE With Continuous Pulse Oximetry and Serial Observations (Grade D, Weak Recommendation)

Aggregate Evidence Quality	Grade D
Benefits	Identification of hypoxemia
Risks, harm, cost	Increased costs due to monitoring over time and the use of hospital resources False-positive results may lead to subsequent testing and hospitalization False reassurance from negative test results
Benefit-harm assessment	The potential benefit of detecting hypoxemia outweighs the harm of cost and false results
Intentional vagueness	Duration of time to monitor patients with continuous pulse oximetry and the number and frequency of serial observations may vary
Role of patient preferences	Level of caregiver concern may influence the duration of oximetry monitoring
Exclusions	None
Strength	Weak recommendation (based on low quality of evidence)
Key references	33, 36

decision-making, particularly when recommendations are expressed as weak. Key action statements based on that evidence and expert consensus are provided. A summary is provided in Table 5.

The practice guideline underwent a comprehensive review by stakeholders before formal approval by the AAP, including AAP councils, committees, and sections; selected outside organizations; and individuals identified by the subcommittee as experts in the field. All comments were reviewed by the subcommittee and incorporated into the final guideline when appropriate.

This guideline is intended for use primarily by clinicians providing care for infants who have experienced a BRUE and their families. This guideline may be of interest to parents and payers, but it is not intended to be used for reimbursement or to determine insurance coverage. This guideline is not intended as the sole source of guidance in the evaluation and management of BRUEs but rather is intended to assist clinicians by providing a framework for clinical decision-making.

KEY ACTION STATEMENTS FOR LOWER-RISK BRUE

1. Cardiopulmonary

1A. Clinicians Need Not Admit Infants Presenting With a Lower-Risk BRUE to the Hospital Solely for Cardiorespiratory Monitoring (Grade B, Weak Recommendation)

Infants presenting with an ALTE often have been admitted for observation and testing. Observational data indicate that 12% to 14% of infants presenting with a diagnosis of ALTE had a subsequent event or condition that required hospitalization.[7,31] Thus, research has sought to identify risk factors that could be used to identify infants likely to benefit from hospitalization. A long-term follow-up study in infants hospitalized with an ALTE showed that no infants subsequently had SIDS but 11% were victims of child abuse and 4.9% had adverse neurologic outcomes (see 3. Neurology).[32] The ALTE literature supports that infants presenting with a lower-risk BRUE do not have an increased rate of cardiovascular or other events during admission and hospitalization may not be required, but close follow-up is recommended. Careful outpatient follow-up is advised (repeat clinical history and physical examination within 24 hours after the initial evaluation) to identify infants with ongoing medical concerns that would indicate further evaluation and treatment.

Al-Kindy et al[33] used documented monitoring in 54% of infants admitted for an ALTE (338 of 625) and identified 46 of 338 (13.6%) with "extreme" cardiovascular events (central apnea >30 seconds, oxygen saturation <80% for 10 seconds, decrease in heart rate <50–60/ minutes for 10 seconds on the basis

of postconceptional age). However, no adverse outcomes were noted for any of their cohort (although whether there is a protective effect of observation alone is not known). Some of the infants with extreme events developed symptoms of upper respiratory infection 1 to 2 days after the ALTE presentation. The risk factors for "extreme" events were prematurity, postconceptional age <43 weeks, and (presence of) upper respiratory infection symptoms. Importantly, infants with a postconceptional age >48 weeks were not documented as having an extreme event in this cohort. A previous longitudinal study also identified "extreme" events that occurred with comparable frequency in otherwise normal term infants and that were not statistically increased in term infants with a history of ALTE.[34]

Preterm infants have been shown to have more serious events, although an ALTE does not further increase that risk compared with asymptomatic preterm infants without ALTE.[34] Claudius and Keens[31] performed an observational prospective study in 59 infants presenting with ALTE who had been born at >30 weeks' gestation and had no significant medical illness. They evaluated factors in the clinical history and physical examination that, according to the authors, would warrant hospital admission on the basis of adverse outcomes (including recurrent cardiorespiratory events, infection, child abuse, or any life-threatening condition). Among these otherwise well infants, those with multiple ALTEs or age <1 month experienced adverse outcomes necessitating hospitalization. Prematurity was also a risk factor predictive of subsequent adverse events after an ALTE. Paroxysmal decreases in oxygen saturation in infants immediately before and during viral illnesses have been well documented.[33,35] However, the significance of these brief hypoxemic events has not been established.

1B. Clinicians May Briefly Monitor Infants Presenting With a Lower-Risk BRUE With Continuous Pulse Oximetry and Serial Observations (Grade D, Weak Recommendation)

A normal physical examination, including vital signs and oximetry, is needed for a patient who has experienced a BRUE to be considered lower-risk. An evaluation at a single point in time may not be as accurate as a longer interval of observation. Unfortunately, there are few data to suggest the optimal duration of this period, the value of repeat examinations, and the effect of false-positive evaluations on family-centered care. Several studies have documented intermittent episodes of hypoxemia after admission for ALTE.[7,31,33] Pulse oximetry identified more infants with concerning paroxysmal events than cardiorespiratory monitoring alone.[33] However, occasional oxygen desaturations are commonly observed in normal infants, especially during sleep.[36] Furthermore, normative oximetry data are dependent on the specific machine, averaging interval, altitude, behavioral state, and postconceptional age. Similarly, there may be considerable variability in the vital signs and the clinical appearance of an infant. Pending further research into this important issue, clinicians may choose to monitor and provide serial examinations of infants in the lower-risk group for a brief period of time, ranging from 1 to 4 hours, to establish that the vital signs, physical examination, and symptomatology remain stable.

1C. Clinicians Should Not Obtain a Chest Radiograph in Infants Presenting With a Lower-Risk BRUE (Grade B, Moderate Recommendation)

Infectious processes can precipitate apnea. In 1 ALTE study, more than 80% of these infections involved the respiratory tract.[37] Most, but not all, infants with significant lower respiratory tract infections will be symptomatic at the time of ALTE presentation. However, 2 studies have documented pneumonia in infants presenting with ALTE and an otherwise noncontributory history and physical examination.[4,37] These rare exceptions have generally been in infants younger than 2 months and would have placed them in the higher-risk category for a BRUE in this guideline. Similarly, Davies and Gupta[38] reported that 9 of 65 patients (ages unknown) who had ALTEs had abnormalities on chest radiography (not fully specified) despite no suspected respiratory disorder on clinical history or physical examination. Some of the radiographs were performed up to 24 hours after presentation. Davies and Gupta further reported that 33% of infants with ALTEs that were ultimately associated with a respiratory disease had a normal initial respiratory examination.[38] Kant et al[18] reported that 2 of 176 infants discharged after admission for ALTE died within 2 weeks, both of pneumonia. One infant had a normal chest radiograph initially; the other, with a history of prematurity, had a "possible" infiltrate. Thus, most experience has shown that a chest radiograph in otherwise well-appearing infants rarely alters clinical management.[7] Careful follow-up within 24 hours is important in infants with a nonfocal clinical history and physical examination to identify those who will ultimately have a lower respiratory tract infection diagnosed.

1D. Clinicians Should Not Obtain Measurement of Venous or Arterial Blood Gases in Infants Presenting With a Lower-Risk BRUE (Grade B, Moderate Recommendation)

Blood gas measurements have not been shown to add significant clinical information in otherwise well-appearing infants presenting with an ALTE.[4] Although not part of

1C. Clinicians Should Not Obtain Chest Radiograph in Infants Presenting With a Lower-Risk BRUE (Grade B, Moderate Recommendation)

Aggregate Evidence Quality	Grade B
Benefits	Reduce costs, unnecessary testing, radiation exposure, and caregiver/infant anxiety Avoid consequences of false-positive results
Risks, harm, cost	May rarely miss diagnostic opportunity for early lower respiratory tract or cardiac disease
Benefit-harm assessment	The benefits of reducing unnecessary testing, radiation exposure, and false-positive results, as well as alleviating caregiver and infant anxiety, outweigh the rare missed diagnostic opportunity for lower respiratory tract or cardiac disease
Intentional vagueness	None
Role of patient preferences	Caregiver may express concern regarding a longstanding breathing pattern in his/her infant or a recent change in breathing that might influence the decision to obtain chest radiography
Exclusions	None
Strength	Moderate recommendation
Key references	4, 37

1D. Clinicians Should Not Obtain Measurement of Venous or Arterial Blood Gases in Infants Presenting With a Lower-Risk BRUE (Grade B, Moderate Recommendation)

Aggregate Evidence Quality	Grade B
Benefits	Reduce costs, unnecessary testing, pain, risk of thrombosis, and caregiver/infant anxiety Avoid consequences of false-positive results
Risks, harm, cost	May miss rare instances of hypercapnia and acid-base imbalances
Benefit-harm assessment	The benefits of reducing unnecessary testing and false-positive results, as well as alleviating caregiver and infant anxiety, outweigh the rare missed diagnostic opportunity for hypercapnia and acid-base imbalances
Intentional vagueness	None
Role of patient preferences	None
Exclusions	None
Strength	Moderate recommendation
Key reference	4

this guideline, future research may demonstrate that blood gases are helpful in select infants with a higher risk BRUE to support the diagnosis of pulmonary disease, control-of-breathing disorders, or inborn errors of metabolism (IEMs).

1E. Clinicians Should Not Obtain an Overnight Polysomnograph in Infants Presenting With a Lower-Risk BRUE (Grade B, Moderate Recommendation)

Polysomnography consists of 8 to 12 hours of documented monitoring, including EEG, electro-oculography, electromyography, nasal/oral airflow, electrocardiography, end-tidal carbon dioxide, chest/abdominal excursion, and oximetry. Polysomnography is considered by many to be the gold standard for identifying obstructive sleep apnea (OSA), central sleep apnea, and periodic breathing and may identify seizures. Some data have suggested using polysomnography in infants presenting with ALTEs as a means to predict the likelihood of recurrent significant cardiorespiratory events. A study in which polysomnography was performed in a cohort of infants with ALTEs (including recurrent episodes) reported that polysomnography may reveal respiratory pauses of >20 seconds or brief episodes of bradycardia that are predictive of ensuing events over the next several months.[40] However, without a control population, the clinical significance of these events is uncertain, because respiratory pauses are frequently observed in otherwise normal infants.[35] Similarly, Kahn and Blum[41] reported that 10 of 71 infants with a clinical history of "benign" ALTEs had an abnormal polysomnograph, including periodic breathing (7 of 10) or obstructive apnea (4 of 100), but specific data were not presented. These events were not found in a control group of 181 infants. The severity of the periodic breathing (frequency of arousals and extent of oxygen desaturation) could not be evaluated from these data. Daniëls et al[42] performed polysomnography in 422 infants with ALTEs and identified 11 infants with significant bradycardia, OSA, and/or oxygen desaturation. Home monitoring revealed episodes of bradycardia (<50 per minute) in 7 of 11 infants and concluded that polysomnography is a useful modality. However, the clinical history, physical examination, and laboratory findings were not presented. GER has also been associated with specific episodes of severe bradycardia in monitored infants.[43] Overall, most polysomnography studies have shown minimal or nonspecific findings in infants presenting with ALTEs.[44,45] Polysomnography studies generally have not been predictive of ALTE recurrence and do not identify those infants at risk of SIDS.[46] Thus, the routine use of polysomnography in infants presenting with a lower-risk BRUE is likely to have a low diagnostic yield and is unlikely to lead to changes in therapy.

OSA has been occasionally associated with ALTEs in many series, but not all.[39,47–49] The use of overnight polysomnography to evaluate for OSA should be guided by an assessment of risk on the basis of a

1E. Clinicians Should Not Obtain an Overnight Polysomnograph in Infants Presenting With a Lower-Risk BRUE (Grade B, Moderate Recommendation)

Aggregate Evidence Quality	Grade B
Benefits	Reduce costs, unnecessary testing, and caregiver/infant anxiety Avoid consequences of false-positive results
Risks, harm, cost	May miss rare instances of hypoxemia, hypercapnia, and/or bradycardia that would be detected by polysomnography
Benefit-harm assessment	The benefits of reducing unnecessary testing and false-positive results, as well as alleviating caregiver and infant anxiety, outweigh the rare missed diagnostic opportunity for hypoxemia, hypercapnia, and/or bradycardia
Intentional vagueness	None
Role of patient preferences	Caregivers may report concern regarding some aspects of their infant's sleep pattern that may influence the decision to perform polysomnography
Exclusions	None
Strength	Moderate recommendation
Key reference	39

1F. Clinicians May Obtain a 12-Lead Electrocardiogram for Infants Presenting With Lower-Risk BRUE (Grade C, Weak Recommendation)

Aggregate Evidence Quality	Grade C
Benefits	May identify BRUE patients with channelopathies (long QT syndrome, short QT syndrome, and Brugada syndrome), ventricular pre-excitation (Wolff-Parkinson-White syndrome), cardiomyopathy, or other heart disease
Risks, harm, cost	False-positive results may lead to further workup, expert consultation, anxiety, and cost False reassurance from negative results Cost and availability of electrocardiography testing and interpretation
Benefit-harm assessment	The benefit of identifying patients at risk of sudden cardiac death outweighs the risk of cost and false results
Intentional vagueness	None
Role of patient preferences	Caregiver may decide not to have testing performed
Exclusions	None
Strength	Weak recommendation (because of equilibrium between benefits and harms)
Key references	4, 16

comprehensive clinical history and physical examination.[50] Symptoms of OSA, which may be subtle or absent in infants, include snoring, noisy respirations, labored breathing, mouth breathing, and profuse sweating.[51] Occasionally, infants with OSA will present with failure to thrive, witnessed apnea, and/or developmental delay.[52] Snoring may be absent in younger infants with OSA, including those with micrognathia. In addition, snoring in otherwise normal infants is present at least 2 days per week in 11.8% and at least 3 days per week in 5.3% of infants.[53] Some infants with OSA may be asymptomatic and have a normal physical examination.[54] However, some studies have reported a high incidence of snoring in infants with (26%–44%) and without (22%–26%) OSA, making the distinction difficult.[55] Additional risk factors for infant OSA include prematurity, maternal smoking, bronchopulmonary dysplasia, obesity, and specific medical conditions including laryngomalacia, craniofacial abnormalities, neuromuscular weakness, Down syndrome, achondroplasia, Chiari malformations, and Prader-Willi syndrome.[34,56–58]

1F. Clinicians May Obtain a 12-Lead Electrocardiogram for Infants Presenting With Lower-Risk BRUE (Grade C, Weak Recommendation)

ALTE studies have examined screening electrocardiograms (ECGs). A study by Brand et al[4] found no positive findings on 24 ECGs performed on 72 patients (33%) without a contributory history or physical examination. Hoki et al[16] reported a 4% incidence of cardiac disease found in 485 ALTE patients; ECGs were performed in 208 of 480 patients (43%) with 3 of 5 abnormal heart rhythms identified by the ECG and the remaining 2 showing structural heart disease. Both studies had low positive-predictive values of ECGs (0% and 1%, respectively). Hoki et al had a negative predictive value of 100% (96%–100%), and given the low prevalence of disease, there is little need for further testing in patients with a negative ECG.

Some cardiac conditions that may present as a BRUE include channelopathies (long QT syndrome, short QT syndrome, Brugada syndrome, and catecholaminergic polymorphic ventricular tachycardia), ventricular pre-excitation (Wolff-Parkinson-White syndrome), and cardiomyopathy/myocarditis (hypertrophic cardiomyopathy, dilated cardiomyopathy). Resting ECGs are ineffective in identifying patients with catecholaminergic polymorphic ventricular tachycardia. Family history is important in identifying individuals with channelopathies.

Severe potential outcomes of any of these conditions, if left undiagnosed or untreated, include sudden death or neurologic injury.[59] However, many patients do not ever experience symptoms in their lifetime and adverse outcomes are uncommon. A genetic autopsy study in infants who died of SIDS in Norway showed an association between 9.5% and 13.0% of infants with abnormal

1G. Clinicians Should Not Obtain an Echocardiogram in Infants Presenting With Lower-Risk BRUE (Grade C, Moderate Recommendation)

Aggregate Evidence Quality	Grade C
Benefits	Reduce costs, unnecessary testing, caregiver/infant anxiety, and sedation risk
	Avoid consequences of false-positive results
Risks, harm, cost	May miss rare diagnosis of cardiac disease
Benefit-harm assessment	The benefits of reducing unnecessary testing and sedation risk, as well as alleviating caregiver and infant anxiety, outweigh the rare missed diagnostic opportunity for cardiac causes
Intentional vagueness	Abnormal cardiac physical examination reflects the clinical judgment of the clinician
Role of patient preferences	Some caregivers may prefer to have echocardiography performed
Exclusions	Patients with an abnormal cardiac physical examination
Strength	Moderate recommendation
Key references	4, 16

1H. Clinicians Should Not Initiate Home Cardiorespiratory Monitoring in Infants Presenting With a Lower-Risk BRUE (Grade B, Moderate Recommendation)

Aggregate Evidence Quality	Grade B
Benefits	Reduce costs, unnecessary testing, and caregiver/infant anxiety
	Avoid consequences of false-positive results
Risks, harm, cost	May rarely miss an infant with recurrent central apnea or cardiac arrhythmias
Benefit-harm assessment	The benefits of reducing unnecessary testing and false-positive results, as well as alleviating caregiver and infant anxiety, outweigh the rare missed diagnostic opportunity for recurrent apnea or cardiac arrhythmias
Intentional vagueness	None
Role of patient preferences	Caregivers will frequently request monitoring be instituted after an ALTE in their infant; a careful explanation of the limitations and disadvantages of this technology should be given
Exclusions	None
Strength	Moderate recommendation
Key reference	34

or novel gene findings at the long QT loci.[60] A syncopal episode, which could present as a BRUE, is strongly associated with subsequent sudden cardiac arrest in patients with long QT syndrome.[61] The incidence and risk in those with other channelopathies have not been adequately studied. The incidence of sudden cardiac arrest in patients with ventricular pre-excitation (Wolff-Parkinson-White syndrome) is 3% to 4% over the lifetime of the individual.[62]

1G. Clinicians Should Not Obtain an Echocardiogram in Infants Presenting With Lower-Risk BRUE (Grade C, Moderate Recommendation)

Cardiomyopathy (hypertrophic and dilated cardiomyopathy) and myocarditis could rarely present as a lower-risk BRUE and can be identified with echocardiography. The cost of an echocardiogram is high and accompanied by sedation risks.

In a study in ALTE patients, Hoki et al[16] did not recommend echocardiography as an initial cardiac test unless there are findings on examination or from an echocardiogram consistent with heart disease. The majority of abnormal echocardiogram findings in their study were not perceived to be life-threatening or related to a cause for the ALTE (eg, septal defects or mild valve abnormalities), and they would have been detected on echocardiogram or physical examination. Brand et al[4] reported 32 echocardiograms in 243 ALTE patients and found only 1 abnormal echocardiogram, which was suspected because of an abnormal history and physical examination (double aortic arch).

1H. Clinicians Should Not Initiate Home Cardiorespiratory Monitoring in Infants Presenting With a Lower-Risk BRUE (Grade B, Moderate Recommendation)

The use of ambulatory cardiorespiratory monitors in infants presenting with ALTEs has been proposed as a modality to identify subsequent events, reduce the risk of SIDS, and alert caregivers of the need for intervention. Monitors can identify respiratory pauses and bradycardia in many infants presenting with ALTE; however, these events are also occasionally observed in otherwise normal infants.[34,40] In addition, infant monitors are prone to artifact and have not been shown to improve outcomes or prevent SIDS or improve neurodevelopmental outcomes.[63] Indeed, caregiver anxiety may be exacerbated with the use of infant monitors and potential false alarms. The overwhelming majority of monitor-identified alarms, including many with reported clinical symptomatology, do not reveal abnormalities on cardiorespiratory recordings.[64–66] Finally, there are several studies showing a lack of correlation between ALTEs and SIDS.[24,32]

Kahn and Blum[41] monitored 50 infants considered at "high risk" of SIDS and reported that 80% had alarms at home. All infants with alarms had at least 1 episode of parental intervention motivated by the alarms, although the authors acknowledged that some cases of parental intervention may have been attributable to parental anxiety. Nevertheless, the stimulated infants did not die of SIDS or require rehospitalization and therefore it was concluded that monitoring

resulted in successful resuscitation, but this was not firmly established. Côté et al[40] reported "significant events" involving central apnea and bradycardia with long-term monitoring. However, these events were later shown to be frequently present in otherwise well infants.[34] There are insufficient data to support the use of commercial infant monitoring devices marketed directly to parents for the purposes of SIDS prevention.[63] These monitors may be prone to false alarms, produce anxiety, and disrupt sleep. Furthermore, these machines are frequently used without a medical support system and in the absence of specific training to respond to alarms. Although it is beyond the scope of this clinical practice guideline, future research may show that home monitoring (cardiorespiratory and/or oximetry) is appropriate for some infants with higher-risk BRUE.

2. Child Abuse

2A. Clinicians Need Not Obtain Neuroimaging (Computed Tomography, MRI, or Ultrasonography) To Detect Child Abuse in Infants Presenting With a Lower-Risk BRUE (Grade C, Weak Recommendation)

2B. Clinicians Should Obtain an Assessment of Social Risk Factors To Detect Child Abuse in Infants Presenting With a Lower-Risk BRUE (Grade C, Moderate Recommendation)

Child abuse is a common and serious cause of an ALTE. Previous research has suggested that this occurs in up to 10% of ALTE cohorts.[3,67] Abusive head trauma is the most common form of child maltreatment associated with an ALTE. Other forms of child abuse that can present as an ALTE, but would not be identified by radiologic evaluations, include caregiver-fabricated illness (formally known as Münchausen by proxy), smothering, and poisoning.

Children who have experienced child abuse, most notably abusive head trauma, may present with a

2A. Clinicians Need Not Obtain Neuroimaging (Computed Tomography, MRI, or Ultrasonography) To Detect Child Abuse in Infants Presenting With a Lower-Risk BRUE (Grade C, Weak Recommendation)

Aggregate Evidence Quality	Grade C
Benefits	Decrease cost
	Avoid sedation, radiation exposure, consequences of false-positive results
Risks, harm, cost	May miss cases of child abuse and potential subsequent harm
Benefit-harm assessment	The benefits of reducing unnecessary testing, sedation, radiation exposure, and false-positive results, as well as alleviating caregiver and infant anxiety, outweigh the rare missed diagnostic opportunity for child abuse
Intentional vagueness	None
Role of patient preferences	Caregiver concerns may lead to requests for CNS imaging
Exclusions	None
Strength	Weak recommendation (based on low quality of evidence)
Key references	3, 67

2B. Clinicians Should Obtain an Assessment of Social Risk Factors To Detect Child Abuse in Infants Presenting With a Lower-Risk BRUE (Grade C, Moderate Recommendation)

Aggregate Evidence Quality	Grade C
Benefits	Identification of child abuse
	May benefit the safety of other children in the home
	May identify other social risk factors and needs and help connect caregivers with appropriate resources (eg, financial distress)
Risks, harm, cost	Resource intensive and not always available, particularly for smaller centers
	Some social workers may have inadequate experience in child abuse assessment
	May decrease caregiver's trust in the medical team
Benefit-harm assessment	The benefits of identifying child abuse and identifying and addressing social needs outweigh the cost of attempting to locate the appropriate resources or decreasing the trust in the medical team
Intentional vagueness	None
Role of patient preferences	Caregivers may perceive social services involvement as unnecessary and intrusive
Exclusions	None
Strength	Moderate recommendation
Key reference	68

BRUE. Four studies reported a low incidence (0.54%–2.5%) of abusive head trauma in infants presenting to the emergency department with an ALTE.[22,37,67,69] If only those patients meeting lower-risk BRUE criteria were included, the incidence of abusive head trauma would have been <0.3%. Although missing abusive head trauma can result in significant morbidity and mortality, the yield of performing neuroimaging to screen for abusive head trauma is extremely low and has associated risks of sedation and radiation exposure.[32,70]

Unfortunately, the subtle presentation of child abuse may lead to a delayed diagnosis of abuse and result in significant morbidity and mortality.[70] A thorough history and physical examination is the best way to identify infants at risk of these

conditions.[67,71] Significant concerning features for child abuse (especially abusive head trauma) can include a developmentally inconsistent or discrepant history provided by the caregiver(s), a previous ALTE, a recent emergency service telephone call, vomiting, irritability, or bleeding from the nose or mouth.[67,71]

Clinicians and medical team members (eg, nurses and social workers) should obtain an assessment of social risk factors in infants with a BRUE, including negative attributions to and unrealistic expectations of the child, mental health problems, domestic violence/intimate partner violence, social service involvement, law enforcement involvement, and substance abuse.[68] In addition, clinicians and medical team members can help families identify and use resources that may expand and strengthen their network of social support.

In previously described ALTE cohorts, abnormal physical findings were associated with an increased risk of abusive head trauma. These findings include bruising, subconjunctival hemorrhage, bleeding from the nose or mouth, and a history of rapid head enlargement or head circumference >95th percentile.[67,70–74] It is important to perform a careful physical examination to identify subtle findings of child abuse, including a large or full/bulging anterior fontanel, scalp bruising or bogginess, oropharynx or frenula damage, or skin findings such as bruising or petechiae, especially on the trunk, face, or ears. A normal physical examination does not rule out the possibility of abusive head trauma. Although beyond the scope of this guideline, it is important for the clinician to note that according to the available evidence, brain neuroimaging is probably indicated in patients who qualify as higher-risk because of concerns about abuse resulting from abnormal history or physical findings.[67]

A social and environmental assessment should evaluate the risk of intentional poisoning, unintentional poisoning, and environmental exposure (eg, home environment), because these can be associated with the symptoms of ALTEs in infants.[75–78] In 1 study, 8.4% of children presenting to the emergency department after an ALTE were found to have a clinically significant, positive comprehensive toxicology screen.[76] Ethanol or other drugs have also been associated with ALTEs.[79] Pulmonary hemorrhage can be caused by environmental exposure to moldy, water-damaged homes; it would usually present with hemoptysis and thus probably would not qualify as a BRUE.[80]

3. Neurology

3A. Clinicians Should Not Obtain Neuroimaging (Computed Tomography, MRI, or Ultrasonography) To Detect Neurologic Disorders in Infants Presenting With a Lower-Risk BRUE (Grade C, Moderate Recommendation)

Epilepsy or an abnormality of brain structure can present as a lower-risk BRUE. CNS imaging is 1 method for evaluating whether underlying abnormalities of brain development or structure might have led to the BRUE. The long-term risk of a diagnosis of neurologic disorders ranges from 3% to 11% in historical cohorts of ALTE patients.[2,32] One retrospective study in 243 ALTE patients reported that CNS imaging contributed to a neurologic diagnosis in 3% to 7% of patients.[4] However, the study population included all ALTEs, including those with a significant past medical history, non–well-appearing infants, and those with tests ordered as part of the emergency department evaluation.

In a large study of ALTE patients, the utility of CNS imaging studies in potentially classifiable lower-risk BRUE patients was found to be low.[32] The cohort of 471 patients was followed both acutely and long-term for the development of epilepsy and other neurologic disorders, and the sensitivity and positive-predictive value of abnormal CNS imaging for subsequent development of epilepsy was 6.7% (95% confidence interval [CI]: 0.2%–32%) and 25% (95% CI: 0.6%–81%), respectively.

The available evidence suggests minimal utility of CNS imaging to evaluate for neurologic disorders, including epilepsy, in lower-risk patients. This situation is particularly true for pediatric epilepsy, in which even if a patient is determined ultimately to have seizures/epilepsy, there is no evidence of benefit from starting therapy after the first seizure compared with starting therapy after a second seizure in terms of achieving seizure remission.[81–83] However, our recommendations for BRUEs are not based on any prospective studies and only on a single retrospective study. Future work should track both short- and long-term neurologic outcomes when considering this issue.

3B. Clinicians Should Not Obtain an EEG To Detect Neurologic Disorders in Infants Presenting With a Lower-Risk BRUE (Grade C, Moderate Recommendation)

Epilepsy may first present as a lower-risk BRUE. The long-term risk of epilepsy ranges from 3% to 11% in historical cohorts of ALTE patients.[2,32] EEG is part of the typical evaluation for diagnosis of seizure disorders. However, the utility of obtaining an EEG routinely was found to be low in 1 study.[32] In a cohort of 471 ALTE patients followed both acutely and long-term for the development of epilepsy, the sensitivity and positive-predictive value of an abnormal EEG for subsequent development of epilepsy was 15% (95% CI: 2%–45%) and 33% (95% CI: 4.3%–48%), respectively. In contrast, another retrospective study in 243 ALTE patients reported that EEG contributed to a neurologic diagnosis in 6% of patients.[4] This study

3A. Clinicians Should Not Obtain Neuroimaging (Computed Tomography, MRI, or Ultrasonography) To Detect Neurologic Disorders in Infants Presenting With a Lower-Risk BRUE (Grade C, Moderate Recommendation)

Aggregate Evidence Quality	Grade C
Benefits	Reduce unnecessary testing, radiation exposure, sedation, caregiver/infant anxiety, and costs Avoid consequences of false-positive results
Risks, harm, cost	May rarely miss diagnostic opportunity for CNS causes of BRUEs May miss unexpected cases of abusive head trauma
Benefit-harm assessment	The benefits of reducing unnecessary testing, radiation exposure, sedation, and false-positive results, as well as alleviating caregiver and infant anxiety, outweigh the rare missed diagnostic opportunity for CNS cause
Intentional vagueness	None
Role of patient preferences	Caregivers may seek reassurance from neuroimaging and may not understand the risks from radiation and sedation
Exclusions	None
Strength	Moderate recommendation
Key references	2, 32, 81

3B. Clinicians Should Not Obtain an EEG To Detect Neurologic Disorders in Infants Presenting With a Lower-Risk BRUE (Grade C, Moderate Recommendation)

Aggregate Evidence Quality	Grade C
Benefits	Reduce unnecessary testing, sedation, caregiver/infant anxiety, and costs Avoid consequences of false-positive or nonspecific results
Risks, harm, cost	Could miss early diagnosis of seizure disorder
Benefit-harm assessment	The benefits of reducing unnecessary testing, sedation, and false-positive results, as well as alleviating caregiver and infant anxiety, outweigh the rare missed diagnostic opportunity for epilepsy
Intentional vagueness	None
Role of patient preferences	Caregivers may seek reassurance from an EEG, but they may not appreciate study limitations and the potential of false-positive results
Exclusions	None
Strength	Moderate recommendation
Key references	32, 84, 85

population differed significantly from that of Bonkowsky et al[32] in that all ALTE patients with a significant past medical history and non–well-appearing infants were included in the analysis and that tests ordered in the emergency department evaluation were also included in the measure of EEG yield.

A diagnosis of seizure is difficult to make from presenting symptoms of an ALTE.[30] Although EEG is recommended by the American Academy of Neurology after a first-time nonfebrile seizure, the yield and sensitivity of an EEG after a first-time ALTE in a lower-risk child are low.[86] Thus, the evidence available suggests no utility for routine EEG to evaluate for epilepsy in a lower-risk BRUE. However, our recommendations for BRUEs are based on no prospective studies and on only a single retrospective study. Future work should track both short- and long-term epilepsy when considering this issue.

Finally, even if a patient is determined ultimately to have seizures/epilepsy, the importance of an EEG for a first-time ALTE is low, because there is little evidence that shows a benefit from starting therapy after the first seizure compared with after a second seizure in terms of achieving seizure remission.[81–83,85]

3C. Clinicians Should Not Prescribe Antiepileptic Medications for Potential Neurologic Disorders in Infants Presenting With a Lower-Risk BRUE (Grade C, Moderate Recommendation)

Once epilepsy is diagnosed, treatment can consist of therapy with an antiepileptic medication. In a cohort of 471 ALTE patients followed both acutely and long-term for the development of epilepsy, most patients who developed epilepsy had a second event within 1 month of their initial presentation.[32,87] Even if a patient is determined ultimately to have seizures/epilepsy, there is no evidence of benefit from starting therapy after the first seizure compared with starting therapy after a second seizure in terms of achieving seizure remission.[81–83,85] Sudden unexpected death in epilepsy (SUDEP) has a frequency close to 1 in 1000 patient-years, but the risks of SUDEP are distinct from ALTEs/BRUEs and include adolescent age and presence of epilepsy for more than 5 years. These data do not support prescribing an antiepileptic medicine for a first-time possible seizure because of a concern for SUDEP. Thus, the evidence available for ALTEs suggests lack of benefit for starting an antiepileptic medication for a lower-risk BRUE. However, our recommendations for BRUEs are based on no prospective studies and on only a single retrospective study. Future work should track both short- and long-term epilepsy when considering this issue.

4. Infectious Diseases

4A. Clinicians Should Not Obtain a White Blood Cell Count, Blood Culture, or Cerebrospinal Fluid Analysis or Culture To Detect an Occult Bacterial Infection in Infants Presenting With a Lower-Risk BRUE (Grade B, Strong Recommendation)

Some studies reported that ALTEs are the presenting complaint of an invasive infection, including bacteremia and/or meningitis

3C. Clinicians Should Not Prescribe Antiepileptic Medications for Potential Neurologic Disorders in Infants Presenting With a Lower-Risk BRUE (Grade C, Moderate Recommendation)

Aggregate Evidence Quality	Grade C
Benefits	Reduce medication adverse effects and risks, avoid treatment with unproven efficacy, and reduce cost
Risks, harm, cost	Delay in treatment of epilepsy could lead to subsequent BRUE or seizure
Benefit-harm assessment	The benefits of reducing medication adverse effects, avoiding unnecessary treatment, and reducing cost outweigh the risk of delaying treatment of epilepsy
Intentional vagueness	None
Role of patient preferences	Caregivers may feel reassured by starting a medicine but may not understand the medication risks
Exclusions	None
Strength	Moderate recommendation
Key references	32, 85, 87

4A. Clinicians Should Not Obtain a White Blood Cell Count, Blood Culture, or Cerebrospinal Fluid Analysis or Culture To Detect an Occult Bacterial Infection in Infants Presenting With a Lower-Risk BRUE (Grade B, Strong Recommendation)

Aggregate Evidence Quality	Grade B
Benefits	Reduce unnecessary testing, pain, exposure, caregiver/infant anxiety, and costs Avoid unnecessary antibiotic use and hospitalization pending culture results Avoid consequences of false-positive results/contaminants
Risks, harm, cost	Could miss serious bacterial infection at presentation
Benefit-harm assessment	The benefits of reducing unnecessary testing, pain, exposure, costs, unnecessary antibiotic use, and false-positive results, as well as alleviating caregiver and infant anxiety, outweigh the rare missed diagnostic opportunity for a bacterial infection
Intentional vagueness	None
Role of patient preferences	Caregiver concerns over possible infectious etiology may lead to requests for antibiotic therapy
Exclusions	None
Strength	Strong recommendation
Key references	4, 37, 88

detected during the initial workup. However, on further review of such cases with serious bacterial infections, these infants did not qualify as lower-risk BRUEs, because they had risk factors (eg, age <2 months) and/or appeared ill and had abnormal findings on physical examination (eg, meningeal signs, nuchal rigidity, hypothermia, shock, respiratory failure) suggesting a possible severe bacterial infection. After eliminating those cases, it appears extremely unlikely that meningitis or sepsis will be the etiology of a lower-risk BRUE.[2–4,37,88,89] Furthermore, performing these tests for bacterial infection may then lead the clinician to empirically treat with antibiotics with the consequent risks of medication adverse effects, intravenous catheters, and development of resistant organisms. Furthermore, false-positive blood cultures (eg, coagulase negative staphylococci, *Bacillus* species, *Streptococcus viridans)* are likely to occur at times, leading to additional testing, longer hospitalization and antibiotic use, and increased parental anxiety until they are confirmed as contaminants.

Thus, the available evidence suggests that a complete blood cell count, blood culture, and lumbar puncture are not of benefit in infants with the absence of risk factors or findings from the patient's history, vital signs, and physical examination (ie, a lower-risk BRUE).

4B. Clinicians Need Not Obtain a Urinalysis (Bag or Catheter) in Infants Presenting With a Lower-Risk BRUE (Grade C, Weak Recommendation)

Case series of infants with ALTEs have suggested that a urinary tract infection (UTI) may be detected at the time of first ALTE presentation in up to 8% of cases.[3,4,37,88] Claudius et al[88] provided insight into 17 cases of certain (n = 13) or possible (n = 4) UTI. However, 14 of these cases would not meet the criteria for a lower-risk BRUE on the basis of age younger than 2 months or being ill-appearing and/or having fever at presentation.

Furthermore, these studies do not always specify the method of urine collection, urinalysis findings, and/or the specific organisms and colony-forming units per milliliter of the isolates associated with the reported UTIs that would confirm the diagnosis. AAP guidelines for the diagnosis and management of UTIs in children 2 to 24 months of age assert that the diagnosis of UTI requires "*both* urinalysis results that suggest infection (pyuria and/or bacteruria) *and* the presence of at least 50 000 colony-forming units/mL of a uropathogen cultured from a urine specimen obtained through catheterization or suprapubic aspirate."[90] Thus, it seems unlikely for a UTI to present as a lower-risk BRUE.

Pending more detailed studies that apply a rigorous definition of UTI to infants presenting with a lower-risk BRUE, a screening urinalysis need not be obtained routinely. If it is decided to evaluate the infant for a possible UTI, then a urinalysis can be obtained but should only be followed up with a culture if the urinalysis has

4B. Clinicians Need Not Obtain a Urinalysis (Bag or Catheter) in Infants Presenting With a Lower-Risk BRUE (Grade C, Weak Recommendation)

Aggregate Evidence Quality	Grade C
Benefits	Reduce unnecessary testing, pain, iatrogenic infection, caregiver/infant anxiety, and costs Avoid consequences of false-positive results Avoid delay from time it takes to obtain a bag urine
Risks, harm, cost	May delay diagnosis of infection
Benefit-harm assessment	The benefits of reducing unnecessary testing, iatrogenic infection, pain, costs, and false-positive results, as well as alleviating caregiver and infant anxiety, outweigh the rare missed diagnostic opportunity for a urinary tract infection
Intentional vagueness	None
Role of patient preferences	Caregiver concerns may lead to preference for testing
Exclusions	None
Strength	Weak recommendation (based on low quality of evidence)
Key references	4, 88

4C. Clinicians Should Not Obtain a Chest Radiograph To Assess for Pulmonary Infection in Infants Presenting With a Lower-Risk BRUE (Grade B, Moderate Recommendation)

Aggregate Evidence Quality	Grade B
Benefits	Reduce costs, unnecessary testing, radiation exposure, and caregiver/infant anxiety Avoid consequences of false-positive results
Risks, harm, cost	May miss early lower respiratory tract infection
Benefit-harm assessment	The benefits of reducing unnecessary testing, radiation exposure, and false-positive results, as well as alleviating caregiver and infant anxiety, outweigh the rare missed diagnostic opportunity for pulmonary infection
Intentional vagueness	None
Role of patient preferences	Caregiver concerns may lead to requests for a chest radiograph
Exclusions	None
Strength	Moderate recommendation
Key references	4, 18, 37

abnormalities suggestive of possible infection (eg, increased white blood cell count, positive nitrates, and/or leukocyte esterase).

4C. Clinicians Should Not Obtain a Chest Radiograph To Assess for Pulmonary Infection in Infants Presenting With a Lower-Risk BRUE (Grade B, Moderate Recommendation)

Chest radiography is unlikely to yield clinical benefit in a well-appearing infant presenting with a lower-risk BRUE. In the absence of abnormal respiratory findings (eg, cough, tachypnea, decreased oxygen saturation, auscultatory changes), lower respiratory tract infection is unlikely to be present.

Studies in children presenting with an ALTE have described occasional cases with abnormal findings on chest radiography in the absence of respiratory findings on history or physical examination.[4,37] However, the nature of the abnormalities and their role in the ALTE presentation in the absence of further details about the radiography results make it difficult to interpret the significance of these observations. For instance, descriptions of increased interstitial markings or small areas of atelectasis would not have the same implication as a focal consolidation or pleural effusion.

Kant et al,[18] in a follow-up of 176 children admitted for an ALTE, reported that 2 infants died within 2 weeks of discharge and both were found to have pneumonia on postmortem examination. This observation does not support the potential indication for an initial radiograph. In fact, one of the children had a normal radiograph during the initial evaluation. The finding of pneumonia on postmortem examination may reflect an agonal aspiration event. Brand et al[4] reported 14 cases of pneumonia identified at presentation in their analysis of 95 cases of ALTEs. However, in 13 of the patients, findings suggestive of lower respiratory infection, such as tachypnea, stridor, retractions, use of accessory muscles, or adventitious sounds on auscultation, were detected at presentation, leading to the request for chest radiography.

4D. Clinicians Need Not Obtain Respiratory Viral Testing If Rapid Testing Is Available in Infants Presenting With a Lower-Risk BRUE (Grade C, Weak Recommendation)

Respiratory viral infections (especially with respiratory syncytial virus [RSV]) have been reported as presenting with apnea or an ALTE, with anywhere from 9% to 82% of patients tested being positive for RSV.[2,4,37,88] However, this finding was observed predominantly in children younger than 2 months and/or those who were born prematurely. Recent data suggest that apnea or an ALTE presentation is not unique to RSV and may be seen with a spectrum of respiratory viral infections.[90] The data in ALTE cases do not address the potential role of other respiratory viruses in ALTEs or BRUEs.

In older children, respiratory viral infection would be expected to present with symptoms ranging from upper respiratory to lower respiratory tract infection rather than as an isolated BRUE. A history of respiratory symptoms and illness exposure; findings of congestion and/or cough, tachypnea, or lower respiratory tract abnormalities; and local epidemiology regarding currently circulating viruses are

4D. Clinicians Need Not Obtain Respiratory Viral Testing If Rapid Testing Is Available in Infants Presenting With a Lower-Risk BRUE (Grade C, Weak Recommendation)

Aggregate Evidence Quality	Grade C
Benefits	Reduce costs, unnecessary testing, and caregiver/infant discomfort
	Avoid false-negative result leading to missed diagnosis and false reassurance
Risks, harm, cost	Failure to diagnose a viral etiology
	Not providing expectant management for progression and appropriate infection control interventions for viral etiology
Benefit-harm assessment	The benefits of reducing unnecessary testing, pain, costs, false reassurance, and false-positive results, as well as alleviating caregiver and infant anxiety and challenges associated with providing test results in a timely fashion, outweigh the rare missed diagnostic opportunity for a viral infection
Intentional vagueness	"Rapid testing"; time to results may vary
Role of patient preferences	Caregiver may feel reassured by a specific viral diagnosis
Exclusions	None
Strength	Weak recommendation (based on low-quality evidence)
Key references	4, 37, 91

4E. Clinicians May Obtain Testing for Pertussis in Infants Presenting With a Lower-Risk BRUE (Grade B, Weak Recommendation)

Aggregate Evidence Quality	Grade B
Benefits	Identify a potentially treatable infection
	Monitor for progression of symptoms, additional apneic episodes
	Potentially prevent secondary spread and/or identify and treat additional cases
Risks, harm, cost	Cost of test
	Discomfort of nasopharyngeal swab
	False-negative results leading to missed diagnosis and false reassurance
	Rapid testing not always available
	False reassurance from negative results
Benefit-harm assessment	The benefits of identifying and treating pertussis and preventing apnea and secondary spread outweigh the cost, discomfort, and consequences of false test results and false reassurance; the benefits are greatest in at-risk populations (exposed, underimmunized, endemic, and during outbreaks)
Intentional vagueness	None
Role of patient preferences	Caregiver may feel reassured if a diagnosis is obtained and treatment can be implemented
Exclusions	None
Strength	Weak recommendation (based on balance of benefit and harm)
Key reference	93

considerations in deciding whether to order rapid testing for respiratory viruses. Because lower-risk BRUE patients do not have these symptoms, clinicians need not perform such testing.

In addition, until recently and in reports of ALTE patients to date, RSV testing was performed by using antigen detection tests. More recently, automated nucleic acid amplification-based tests have entered clinical practice. These assays are more sensitive than antigen detection tests and can detect multiple viruses from a single nasopharyngeal swab. The use of these tests in future research may allow better elucidation of the role of respiratory viruses in patients presenting with an ALTE in general and whether they play a role in BRUEs.

As a cautionary note, detection of a virus in a viral multiplex assay may not prove causality, because some agents, such as rhinovirus and adenovirus, may persist for periods beyond the acute infection (up to 30 days) and may or may not be related to the present episode.[92] In a lower-risk BRUE without respiratory symptoms testing for viral infection may not be indicated, but in the presence of congestion and/or cough, or recent exposure to a viral respiratory infection, such testing may provide useful information regarding the cause of the child's symptoms and for infection control management. Anticipatory guidance and arranging close follow-up at the initial presentation could be helpful if patients subsequently develop symptoms of a viral infection.

4E. Clinicians May Obtain Testing for Pertussis in Infants Presenting With a Lower-Risk BRUE (Grade B, Weak Recommendation)

Pertussis infection has been reported to cause ALTEs in infants, because it can cause gagging, gasping, and color change followed by respiratory pause. Such infants can be afebrile and may not develop cough or lower respiratory symptoms for several days afterward.

The decision to test a lower-risk BRUE patient for pertussis should consider potential exposures, vaccine history (including intrapartum immunization of the mother as well as the infant's vaccination history), awareness of pertussis activity in the community, and turnaround time for results. Polymerase chain reaction testing for pertussis on a nasopharyngeal specimen, if available, offers the advantage of rapid turnaround time to results.[94] Culture for the organism requires selective media and will take days to yield results but may still be useful in the face of identified risk of exposure. In patients in whom there is a high index of suspicion on the basis of

the aforementioned risk factors, clinicians may consider prolonging the observation period and starting empirical antibiotics while awaiting test results (more information is available from the Centers for Disease Control and Prevention).[95]

5. Gastroenterology

5A. Clinicians Should Not Obtain Investigations for GER (eg, Upper Gastrointestinal Series, pH Probe, Endoscopy, Barium Contrast Study, Nuclear Scintigraphy, and Ultrasonography) in Infants Presenting With a Lower-Risk BRUE (Grade C, Moderate Recommendation)

GER occurs in more than two-thirds of infants and is the topic of discussion with pediatricians at one-quarter of all routine 6-month infant visits.[96] GER can lead to airway obstruction, laryngospasm, or aspiration. Although ALTEs that can be attributed to GER symptoms (eg, choking after spitting up) qualify as an ALTE according to the National Institutes of Health definition, importantly, they do not qualify as a BRUE.

GER may still be a contributing factor to a lower-risk BRUE if the patient's GER symptoms were not witnessed or well described by caregivers. However, the available evidence suggests no utility of routine diagnostic testing to evaluate for GER in these patients. The brief period of observation that occurs during an upper gastrointestinal series is inadequate to rule out the occurrence of pathologic reflux at other times, and the high prevalence of nonpathologic reflux that often occurs during the study can encourage false-positive diagnoses. In addition, the observation of the reflux of a barium column into the esophagus during gastrointestinal contrast studies may not correlate with the severity of GER or the degree of esophageal mucosal inflammation in patients with reflux esophagitis. Routine performance of an upper gastrointestinal series to diagnose GER is not justified and should be reserved to screen for anatomic abnormalities associated with vomiting (which is a symptom that precludes the diagnosis of a lower-risk BRUE).[98] Gastroesophageal scintigraphy scans for reflux of ^{99m}Tc-labeled solids or liquids into the esophagus or lungs after the administration of the test material into the stomach. The lack of standardized techniques and age-specific normal values limits the usefulness of this test. Therefore, gastroesophageal scintigraphy is not recommended in the routine evaluation of pediatric patients with GER symptoms or a lower-risk BRUE.[97] Multiple intraluminal impedance (MII) is useful for detecting both acidic and nonacidic reflux, thereby providing a more detailed picture of esophageal events than pH monitoring. Combined pH/MII testing is evolving into the test of choice to detect temporal relationships between specific symptoms and the reflux of both acid and nonacid gastric contents. In particular, MII has been used in recent years to investigate how GER correlates with respiratory symptoms, such as apnea or cough. Performing esophageal pH +/- impedance monitoring is not indicated in the routine evaluation of infants presenting with a lower-risk BRUE, although it may be considered in patients with recurrent BRUEs and GER symptoms even if these occur independently.

5A. Clinicians Should Not Obtain Investigations for GER (eg, Upper Gastrointestinal Series, pH Probe, Endoscopy, Barium Contrast Study, Nuclear Scintigraphy, and Ultrasonography) in Infants Presenting With a Lower-Risk BRUE (Grade C, Moderate Recommendation)

Aggregate Evidence Quality	Grade C
Benefits	Reduce unnecessary testing, procedural complications (sedation, intestinal perforation, bleeding), pain, radiation exposure, caregiver/infant anxiety, and costs
	Avoid consequences of false-positive results
Risks, harm, cost	Delay diagnosis of rare but serious gastrointestinal abnormalities (eg, tracheoesophageal fistula)
	Long-term morbidity of repeated events (eg, chronic lung disease)
Benefit-harm assessment	The benefits of reducing unnecessary testing, complications, radiation, pain, costs, and false-positive results, as well as alleviating caregiver and infant anxiety, outweigh the rare missed diagnostic opportunity for a gastrointestinal abnormality or morbidity from repeat events
Intentional vagueness	None
Role of patient preferences	Caregiver may be reassured by diagnostic evaluation of GER
Exclusions	None
Strength	Moderate recommendation
Key references	96, 97

Problems with the coordination of feedings can lead to ALTEs and BRUEs. In a study in Austrian newborns, infants who experienced an ALTE had a more than twofold increase in feeding difficulties (multivariate relative risk: 2.5; 95% CI: 1.3–4.6).[99] In such patients, it is likely that poor suck-swallow-breathe coordination triggered choking or laryngospasm. A clinical speech therapy evaluation may help to evaluate any concerns for poor coordination swallowing with feeding.

5B. Clinicians Should Not Prescribe Acid Suppression Therapy for Infants Presenting With a Lower-Risk BRUE (Grade C, Moderate Recommendation)

The available evidence suggests no proven efficacy of acid suppression therapy for esophageal reflux in patients presenting with a lower-risk BRUE. Acid suppression therapy with H2-receptor antagonists or proton

5B. Clinicians Should Not Prescribe Acid Suppression Therapy for Infants Presenting With a Lower-Risk BRUE (Grade C, Moderate Recommendation)

Aggregate Evidence Quality	Grade C
Benefits	Reduce unnecessary medication use, adverse effects, and cost from treatment with unproven efficacy
Risks, harm, cost	Delay treatment of rare but undiagnosed gastrointestinal disease, which could lead to complications (eg, esophagitis)
Benefit-harm assessment	The benefits of reducing medication adverse effects, avoiding unnecessary treatment, and reducing cost outweigh the risk of delaying treatment of gastrointestinal disease
Intentional vagueness	None
Role of patient preferences	Caregiver concerns may lead to requests for treatment
Exclusions	None
Strength	Moderate recommendation
Key reference	98

pump inhibitors may be indicated in selected pediatric patients with GER disease (GERD), which is diagnosed in patients when reflux of gastric contents causes troublesome symptoms or complications.[98] Infants with spitting up or throat-clearing coughs that are not troublesome do not meet diagnostic criteria for GERD. Indeed, the inappropriate administration of acid suppression therapy may have harmful adverse effects because it exposes infants to an increased risk of pneumonia or gastroenteritis.[100]

GER leading to apnea is not always clinically apparent and can be the cause of a BRUE. Acid reflux into the esophagus has been shown to be temporally associated with oxygen desaturation and obstructive apnea, suggesting that esophageal reflux may be one of the underlying conditions in selected infants presenting with BRUEs.[101] Respiratory symptoms are more likely to be associated with GER when gross emesis occurs at the time of a BRUE, when episodes occur while the infant is awake and supine (sometimes referred to as "awake apnea"), and when a pattern of obstructive apnea is observed while the infant is making respiratory efforts without effective air movement.[102]

Wenzl et al[103] reported a temporal association between 30% of the nonpathologic, short episodes of central apnea and GER by analyzing combined data from simultaneous esophageal and cardiorespiratory monitoring. These findings cannot be extrapolated to pathologic infant apnea and may represent a normal protective cessation of breathing during regurgitation. Similarly, Mousa et al[104] analyzed data from 527 apneic events in 25 infants and observed that only 15.2% were temporally associated with GER. Furthermore, there was no difference in the linkage between apneic events and acid reflux (7.0%) and nonacid reflux (8.2%). They concluded that there is little evidence for an association between acid reflux or nonacid reflux and the frequency of apnea. Regression analysis revealed a significant association between apnea and reflux in 4 of 25 infants. Thus, in selected infants, a clear temporal relationship between apnea and ALTE can be shown. However, larger studies have not proven a causal relationship between pathologic apnea and GER.[105]

As outlined in the definition of a BRUE, when an apparent explanation for the event, such as GER, is evident at the time of initial evaluation, the patient should be managed as appropriate for the clinical situation. However, BRUEs can be caused by episodes of reflux-related laryngospasm (sometimes referred to as "silent reflux"), which may not be clinically apparent at the time of initial evaluation. Laryngospasm may also occur during feeding in the absence of GER. Measures that have been shown to be helpful in the nonpharmacologic management of GER in infants include avoiding overfeeding, frequent burping during feeding, upright positioning in the caregiver's arms after feeding, and avoidance of secondhand smoke.[106] Thickening feedings with commercially thickened formula for infants without milk-protein intolerance does not alter esophageal acid exposure detected by esophageal pH study but has been shown to decrease the frequency of regurgitation. Given the temporal association observed between GER and respiratory symptoms in selected infants, approaches that decrease the height of the reflux column, the volume of refluxate, and the frequency of reflux episodes may theoretically be beneficial.[98] Combined pH/MII testing has shown that, although the frequency of reflux events is unchanged with thickened formula, the height of the column of refluxate is decreased. Studies have shown that holding the infant on the caregiver's shoulders for 10 to 20 minutes to allow for adequate burping after a feeding before placing the infant in the "back to sleep position" can decrease the frequency of GER in infants. In contrast, placing an infant in a car seat or in other semisupine positions, such as in an infant carrier, exacerbates esophageal reflux and should be avoided.[98] The frequency of GER has been reported to be decreased in breastfed compared with formula-fed infants. Thus, the benefits of breastfeeding are preferred over the theoretical effect of thickened formula feeding, so exclusive breastfeeding should be encouraged whenever possible.

6. Inborn Errors of Metabolism

6A. Clinicians Need Not Obtain Measurement of Serum Lactic Acid or Serum Bicarbonate To Detect an IEM in Infants Presenting With a Lower-Risk BRUE (Grade C, Weak Recommendation)

6B. Clinicians Should Not Obtain a Measurement of Serum Sodium, Potassium, Chloride, Blood Urea Nitrogen, Creatinine, Calcium, or Ammonia To Detect an IEM on Infants Presenting With a Lower-Risk BRUE (Grade C, Moderate Recommendation)

6C. Clinicians Should Not Obtain a Measurement of Venous or Arterial Blood Gases To Detect an IEM in Infants Presenting With Lower-Risk BRUE (Grade C, Moderate Recommendation)

6D. Clinicians Need Not Obtain a Measurement of Blood Glucose To Detect an IEM in Infants Presenting With a Lower-Risk BRUE (Grade C, Weak Recommendation)

6E. Clinicians Should Not Obtain Measurements of Urine Organic Acids, Plasma Amino Acids, or Plasma Acylcarnitines To Detect an IEM in Infants Presenting With a Lower-Risk BRUE (Grade C, Moderate Recommendation)

6A. Clinicians Need Not Obtain Measurement of Serum Lactic Acid or Serum Bicarbonate To Detect an IEM in Infants Presenting With a Lower-Risk BRUE (Grade C, Weak Recommendation)

Aggregate Evidence Quality	Grade C
Benefits	Reduce unnecessary testing, caregiver/infant anxiety, and costs Avoid consequences of false-positive or nonspecific results
Risks, harm, cost	May miss detection of an IEM
Benefit-harm assessment	The benefits of reducing unnecessary testing, cost, and false-positive results, as well as alleviating caregiver and infant anxiety, outweigh the rare missed diagnostic opportunity for an IEM
Intentional vagueness	Detection of higher lactic acid or lower bicarbonate levels should be considered to have a lower likelihood of being a false-positive result and may warrant additional investigation
Role of patient preferences	Caregiver concerns may lead to requests for diagnostic testing
Exclusions	None
Strength	Weak recommendation (based on low-quality evidence)
Key reference	38

6B. Clinicians Should Not Obtain a Measurement of Serum Sodium, Potassium, Chloride, Blood Urea Nitrogen, Creatinine, Calcium, or Ammonia To Detect an IEM on Infants Presenting With a Lower-Risk BRUE (Grade C, Moderate Recommendation)

Aggregate Evidence Quality	Grade C
Benefits	Reduce costs, unnecessary testing, pain, and caregiver/infant anxiety Avoid consequences of false-positive results
Risks, harm, cost	May miss detection of an IEM
Benefit-harm assessment	The benefits of reducing unnecessary testing, cost, and false-positive results, as well as alleviating caregiver and infant anxiety, outweigh the rare missed diagnostic opportunity for an IEM
Intentional vagueness	None
Role of patient preferences	Caregiver concerns may lead to requests for diagnostic testing
Exclusions	None
Strength	Moderate recommendation
Key reference	4

IEMs are reported to cause an ALTE in 0% to 5% of cases.[2,27,38,99,107,108] On the basis of the information provided by the authors for these patients, it seems unlikely that events could have been classified as a lower-risk BRUE, either because the patient had a positive history or physical examination or a recurrent event. The most commonly reported disorders include fatty acid oxidation disorders or urea cycle disorders.[107,109] In cases of vague or resolved symptoms, a careful history can help determine whether the infant had not received previous treatment (eg, feeding after listlessness for suspected hypoglycemia). These rare circumstances could include milder or later-onset presentations of IEMs.

Infants may be classified as being at a higher risk of BRUE because of a family history of an IEM, developmental disabilities, SIDS, or a medical history of abnormal newborn screening results, unexplained infant death, age younger than 2 months, a prolonged event (>1 minute), or multiple events without an explanation. Confirmation that a newborn screen is complete and is negative is an important aspect of the medical history, but the clinician must consider that not all potential disorders are included in current newborn screening panels in the United States.

Lactic Acid

Measurement of lactic acid can result in high false-positive rates if the sample is not collected properly, making the decision to check a lactic acid problematic. In addition, lactic acid may be elevated because of metabolic abnormalities attributable to other conditions, such as sepsis, and are not specific for IEMs.

Only 2 studies evaluated the specific measurement of lactic acid.[27,38] Davies and Gupta[38] reported 65 infants with consistent laboratory evaluations and found that 54% of infants had a lactic acid >2 mmol/L but only 15% had levels >3 mmol/L. The latter percentage of infants are more likely to be clinically significant and less likely to reflect a false-positive result. Five of 7 infants with a lactic acid >3 mmol/L had a "specific, serious diagnosis," although the specifics of these diagnoses were not included and no IEM was

6C. Clinicians Should Not Obtain a Measurement of Venous or Arterial Blood Gases To Detect an IEM in Infants Presenting With Lower-Risk BRUE (Grade C, Moderate Recommendation)

Aggregate Evidence Quality	Grade C
Benefits	Reduce costs, unnecessary testing, pain, risk of thrombosis, and caregiver/infant anxiety Avoid consequences of false-positive results
Risks, harm, cost	May miss detection of an IEM
Benefit-harm assessment	The benefits of reducing unnecessary testing, cost, and false-positive results, as well as alleviating caregiver and infant anxiety, outweigh the rare missed diagnostic opportunity for an IEM
Intentional vagueness	None
Role of patient preferences	Caregiver concerns may lead to requests for diagnostic testing
Exclusions	None
Strength	Moderate recommendation
Key reference	4

6D. Clinicians Need Not Obtain a Measurement of Blood Glucose To Detect an IEM in Infants Presenting With a Lower-Risk BRUE (Grade C, Weak Recommendation)

Aggregate Evidence Quality	Grade C
Benefits	Reduce costs, unnecessary testing, pain, risk of thrombosis, and caregiver/infant anxiety Avoid consequences of false-positive results
Risks, harm, cost	May miss rare instances of hypoglycemia attributable to undiagnosed IEM
Benefit-harm assessment	The benefits of reducing unnecessary testing, cost, and false-positive results, as well as alleviating caregiver and infant anxiety, outweigh the rare missed diagnostic opportunity for an IEM
Intentional vagueness	Measurement of glucose is often performed immediately through a simple bedside test; no abnormalities have been reported in asymptomatic infants, although studies often do not distinguish between capillary or venous measurement
Role of patient preferences	Caregiver concerns may lead to requests for diagnostic testing
Exclusions	None
Strength	Weak recommendation (based on low-quality evidence)
Key reference	4

confirmed in this study. This study also reported a 20% positive yield of testing for a bicarbonate <20 mmol/L and commented that there was a trend for lower bicarbonate and higher lactic acid levels in those with a recurrent event or a definitive diagnosis. The second publication[27] found no elevations of lactate in 4 of 49 children who had an initial abnormal venous blood gas, of which all repeat blood gas measurements were normal.

Serum Bicarbonate

Abnormal serum bicarbonate levels have been studied in 11 infants, of whom 7 had a diagnosis of sepsis or seizures.[38] Brand et al[4] studied 215 infants who had bicarbonate measured and found only 9 abnormal results, and only 3 of these contributed to the final diagnosis. Although unknown, it is most likely that the event in those infants would not have been classified as a BRUE under the new classification, because those infants were most likely symptomatic on presentation.

Serum Glucose

Abnormal blood glucose levels were evaluated but not reported in 3 studies.[4,38,110] Although abnormalities of blood glucose can occur from various IEMs, such as medium-chain acyl–coenzyme A dehydrogenase deficiency or other fatty acid oxidation disorders, their prevalence has not been increased in SIDS and near-miss SIDS but could be considered as a cause of higher-risk BRUEs.[111] It is important to clarify through a careful medical history evaluation that the infant was not potentially hypoglycemic at discovery of the event and improved because of enteral treatment, because these disorders will not typically self-resolve without intervention (ie, feeding).

Serum Electrolytes and Calcium

ALTE studies evaluating the diagnostic value of electrolytes, including sodium, potassium, blood urea nitrogen, and creatinine, reported the rare occurrence of abnormalities, ranging from 0% to 4.3%.[4,38,110] Abnormal calcium levels have been reported in 0% to 1.5% of infants with ALTE, although these reports did not provide specific causes of hypocalcemia. Another study reported profound vitamin D deficiency with hypocalcemia in 5 of 25 infants with a diagnosis of an ALTE over a 2-year period in Saudi Arabia.[4,21,38,110] In lower-risk BRUE infants, clinicians should not obtain a calcium measurement unless the clinical history raises suspicion of hypocalcemia (eg, vitamin D deficiency or hypoparathyroidism).

Ammonia

Elevations of ammonia are typically associated with persistent symptoms and recurring events, and therefore testing would not be indicated in lower-risk BRUEs. Elevations of ammonia were reported in 11 infants (7 whom had an IEM) in a report of infants with recurrent ALTE and SIDS, limiting extrapolation to

lower-risk BRUEs.[109] Elevations of ammonia >100 mmol/L were found in 4% of 65 infants, but this publication did not document a confirmed IEM.[38] Weiss et al[27] reported no abnormal elevations of ammonia in 4 infants with abnormal venous blood gas.

Venous or Arterial Blood Gas

Blood gas abnormalities leading to a diagnosis have not been reported in previous ALTE studies. Brand et al[4] reported 53 of 60 with positive findings, with none contributing to the final diagnosis. Weiss et al[27] reported 4 abnormal findings of 49 completed, all of which were normal on repeat measurements (along with normal lactate and ammonia levels). Blood gas detection is a routine test performed in acutely symptomatic patients who are being evaluated for suspected IEMs and may be considered in higher-risk BRUEs.

Urine Organic Acids, Plasma Amino Acids, Plasma Acylcarnitines

The role of advanced screening for IEMs has been reported in only 1 publication. Davies and Gupta[38] reported abnormalities of urine organic acids in 2% of cases and abnormalities of plasma amino acids in 4% of cases. Other reports have described an "unspecified metabolic screen" that was abnormal in 4.5% of cases but did not provide further description of specifics within that "screen."[4] Other reports have frequently included the descriptions of ALTEs with urea cycle disorders, organic acidemias, lactic acidemias, and fatty acid oxidation disorders such as medium chain acyl–coenzyme A dehydrogenase deficiency but did not distinguish between SIDS and near-miss SIDS.[107,109,111] Specific testing of urine organic acids, plasma amino acids, or plasma acylcarnitines may have a role in patients with a higher-risk BRUE.

6E. Clinicians Should Not Obtain Measurements of Urine Organic Acids, Plasma Amino Acids, or Plasma Acylcarnitines To Detect an IEM in Infants Presenting With a Lower-Risk BRUE (Grade C, Moderate Recommendation)

Aggregate Evidence Quality	Grade C
Benefits	Reduce costs, unnecessary testing, pain, risk of thrombosis, and caregiver/infant anxiety Avoid consequences of false-positive results
Risks, harm, cost	May miss detection of an IEM
Benefit-harm assessment	The benefits of reducing unnecessary testing, cost, and false-positive results, as well as alleviating caregiver and infant anxiety, outweigh the rare missed diagnostic opportunity for an IEM
Intentional vagueness	Lower-risk BRUEs will have a very low likelihood of disease, but these tests may be indicated in rare cases in which there is no documentation of a newborn screen being performed
Role of patient preferences	Caregiver concerns may lead to requests for diagnostic testing
Exclusions	None
Strength	Moderate recommendation
Key references	4, 38

7A. Clinicians Should Not Obtain Laboratory Evaluation for Anemia in Infants Presenting With a Lower-Risk BRUE (Grade C, Moderate Recommendation)

Aggregate Evidence Quality	Grade C
Benefits	Reduce costs, unnecessary testing, pain, risk of thrombosis, and caregiver/infant anxiety Avoid consequences of false-positive results
Risks, harm, cost	May miss diagnosis of anemia
Benefit-harm assessment	The benefits of reducing unnecessary testing, cost, and false-positive results, as well as alleviating caregiver and infant anxiety, outweigh the missed diagnostic opportunity for anemia
Intentional vagueness	None
Role of patient preferences	Caregivers may be reassured by testing
Exclusions	None
Strength	Moderate recommendation
Key reference	22

7. Anemia

7A. Clinicians Should Not Obtain Laboratory Evaluation for Anemia in Infants Presenting With a Lower-Risk BRUE (Grade C, Moderate Recommendation)

Anemia has been associated with ALTEs in infants, but the significance and causal association with the event itself are unclear.[38,112,113] Normal hemoglobin concentrations have also been reported in many other ALTE populations.[69,112,114] Brand et al[4] reported an abnormal hemoglobin in 54 of 223 cases, but in only 2 of 159 was the hemoglobin concentration associated with the final diagnosis (which was abusive head injury in both). Parker and Pitetti[22] also reported that infants who presented with ALTEs and ultimately were determined to be victims of child abuse were more likely to have a lower mean hemoglobin (10.6 vs 12.7 g/dL; $P = .02$).

8. Patient- and Family-Centered Care

8A. Clinicians Should Offer Resources for CPR Training to Caregivers (Grade C, Moderate Recommendation)

The majority of cardiac arrests in children result from a respiratory deterioration. Bystander CPR has been reported to have been conducted in 37% to 48% of pediatric out-of-hospital cardiac arrests and

in 34% of respiratory arrests.[116] Bystander CPR results in significant improvement in 1-month survival rates in both cardiac and respiratory arrest.[117–119]

Although lower-risk BRUEs are neither a cardiac nor a respiratory arrest, the AAP policy statement on CPR recommends that pediatricians advocate for life-support training for caregivers and the general public.[115] A technical report that accompanies the AAP policy statement on CPR proposes that this can improve overall community health.[115] CPR training has not been shown to increase caregiver anxiety, and in fact, caregivers have reported a sense of empowerment.[120–122] There are many accessible and effective methods for CPR training (eg, e-learning).

8B. Clinicians Should Educate Caregivers About BRUEs (Grade C, Moderate Recommendation)

Pediatric providers are an important source of this health information and can help guide important conversations around BRUEs. A study by Feudtner et al[123] identified 4 groups of attributes of a "good parent": (1) making sure the child feels loved, (2) focusing on the child's health, (3) advocating for the child and being informed, and (4) ensuring the child's spiritual well-being. Clinicians should be the source of information for caregivers. Informed caregivers can advocate for their child in all of the attribute areas/domains, and regardless of health literacy levels, prefer being offered choices and being asked for information.[124] A patient- and family-centered care approach results in better health outcomes.[125,126]

8C. Clinicians Should Use Shared Decision-Making for Infants Presenting With a Lower-Risk BRUE (Grade C, Moderate Recommendation)

Shared decision-making is a partnership between the clinician and the patient and family.[125,126] The general principles of shared decision-making are as follows: (1) information sharing, (2) respect and honoring differences, (3) partnership and collaboration, (4) negotiation, and (5) care in the context of family and community.[125] The benefits include improved care and outcomes; improved patient, family, and clinician satisfaction; and better use of health resources.[126] It is advocated for by organizations such as the AAP and the Institute of Medicine.[126,127] The 5 principles can be applied to all aspects of the infant who has experienced a BRUE, through each step (assessment, stabilization, management, disposition, and follow-up). Shared decision-making will empower families and foster a stronger clinician-patient/family alliance as they make decisions together in the face of a seemingly uncertain situation.

8A. Clinicians Should Offer Resources for CPR Training to Caregivers (Grade C, Moderate Recommendation)

Aggregate Evidence Quality	Grade C
Benefits	Decrease caregiver anxiety and increase confidence Benefit to society
Risks, harm, cost	May increase caregiver anxiety Cost and availability of training
Benefit-harm assessment	The benefits of decreased caregiver anxiety and increased confidence, as well as societal benefits, outweigh the increase in caregiver anxiety, cost, and resources
Intentional vagueness	None
Role of patient preferences	Caregiver may decide not to seek out the training
Exclusions	None
Strength	Moderate recommendation
Key reference	115

8B. Clinicians Should Educate Caregivers About BRUEs (Grade C, Moderate Recommendation)

Aggregate Evidence Quality	Grade C
Benefits	Improve caregiver empowerment and health literacy and decrease anxiety May reduce unnecessary return visits Promotion of the medical home
Risks, harm, cost	Increase caregiver anxiety and potential for caregiver intimidation in voicing concerns Increase health care costs and length of stay
Benefit-harm assessment	The benefits of decreased caregiver anxiety and increased empowerment and health literacy outweigh the increase in cost, length of stay, and caregiver anxiety and intimidation
Intentional vagueness	None
Role of patient preferences	Caregiver may decide not to listen to clinician
Exclusions	None
Strength	Moderate recommendation
Key references	None

DISSEMINATION AND IMPLEMENTATION

Dissemination and implementation efforts are needed to facilitate guideline use across pediatric medicine, family medicine, emergency medicine, research, and patient/family communities.[128] The following general approaches and a Web-based toolkit are proposed for the dissemination and implementation of this guideline.

8C. Clinicians Should Use Shared Decision-Making for Infants Presenting With a Lower-Risk BRUE (Grade C, Moderate Recommendation)

Aggregate Evidence Quality	Grade C
Benefits	Improve caregiver empowerment and health literacy and decrease anxiety May reduce unnecessary return visits Promotion of the medical home
Risks, harm, cost	Increase cost, length of stay, and caregiver anxiety and intimidation in voicing concerns
Benefit-harm assessment	The benefits of decreased caregiver anxiety and unplanned return visits and increased empowerment, health, literacy, and medical home promotion outweigh the increase in cost, length of stay, and caregiver anxiety and information
Intentional vagueness	None
Role of patient preferences	Caregiver may decide not to listen to clinician
Exclusions	None
Strength	Moderate recommendation
Key references	None

1. Education

Education will be partially achieved through the AAP communication outlets and educational services (*AAP News, Pediatrics,* and PREP). Further support will be sought from stakeholder organizations (American Academy of Family Physicians, American College of Emergency Physicians, American Board of Pediatrics, Society of Hospital Medicine). A Web-based toolkit (to be published online) will include caregiver handouts and a shared decision-making tool to facilitate patient- and family-centered care. Efforts will address appropriate disease classification and diagnosis coding.

2. Integration of Clinical Workflow

An algorithm is provided (Fig 1) for diagnosis and management. Structured history and physical examination templates also are provided to assist in addressing all of the relevant risk factors for BRUEs (Tables 2 and 3). Order sets and modified documents will be hosted on a Web-based learning platform that promotes crowd-sourcing.

3. Administrative and Research

International Classification of Diseases, 9th Revision, and International Classification of Diseases, 10th Revision, diagnostic codes are used for billing, quality improvement, and research; and new codes for lower- and higher-risk BRUEs will need to be developed. In the interim, the current code for an ALTE (799.82) will need to be used for billing purposes. Efforts will be made to better reflect present knowledge and to educate clinicians and payers in appropriate use of codes for this condition.

4. Quality Improvement

Quality improvement initiatives that provide Maintenance of Certification credit, such as the AAP's PREP and EQIPP courses, or collaborative opportunities through the AAP's Quality Improvement Innovation Networks, will engage clinicians in the use and improvement of the guideline. By using proposed quality measures, adherence and outcomes can be assessed and benchmarked with others to inform continual improvement efforts. Proposed measures include process evaluation (use of definition and evaluation), outcome assessment (family experience and diagnostic outcomes), and balancing issues (cost and length of visit). Future research will need to be conducted to validate any measures.

FUTURE RESEARCH

The transition in nomenclature from the term ALTE to BRUE after 30 years reflects the expanded understanding of the etiology and consequences of this entity. Previous research has been largely retrospective or observational in nature, with little long-term follow-up data available. The more-precise definition, the classification of lower- and higher-risk groups, the recommendations for the lower-risk group, and the implementation toolkit will serve as the basis for future research. Important areas for future prospective research include the following.

1. Epidemiology

- Incidence of BRUEs in all infants (in addition to those seeking medical evaluation)
- Influence of race, gender, ethnicity, seasonality, environmental exposures, and socioeconomic status on incidence and outcomes

2. Diagnosis

- Use and effectiveness of the BRUE definition
- Screening tests and risk of UTI
- Quantify and better understand risk in higher- and lower-risk groups
- Risk and benefit of screening tests
- Risk and benefit and optimal duration of observation and monitoring periods
- Effect of prematurity on risk
- Appropriate indications for subspecialty referral
- Early recognition of child maltreatment
- Importance of environmental history taking
- Role of human psychology on accuracy of event characterization

- Type and length of monitoring in the acute setting

3. Pathophysiology

- Role of abnormalities of swallowing, laryngospasm, GER, and autonomic function

4. Outcomes

- Patient- and family-centered outcomes, including caregiver satisfaction, anxiety, and family dynamics (eg, risk of vulnerable child syndrome)
- Long-term health and cognitive consequences

5. Treatment

- Empirical GER treatment on recurrent BRUEs
- Caregiver education strategies, including basic life support, family-centered education, and postpresentation clinical visits

6. Follow-up

- Strategies for timely follow-up and surveillance

SUBCOMMITTEE ON BRIEF RESOLVED UNEXPLAINED EVENTS (FORMERLY REFERRED TO AS APPARENT LIFE THREATENING EVENTS) (OVERSIGHT BY THE COUNCIL ON QUALITY IMPROVEMENT AND PATIENT SAFETY)

Joel S. Tieder, MD, MPH, FAAP, Chair (no financial conflicts, published research related to BRUEs/ALTEs)

Joshua L. Bonkowsky, MD, PhD, FAAP, Pediatric Neurologist

Ruth A. Etzel, MD, PhD, FAAP, Pediatric Epidemiologist

Wayne H. Franklin, MD, MPH, MMM, FAAP, Pediatric Cardiologist

David A. Gremse, MD, FAAP, Pediatric Gastroenterologist

Bruce Herman, MD, FAAP, Child Abuse and Neglect

Eliot Katz, MD, FAAP, Pediatric Pulmonologist

Leonard R. Krilov, MD, FAAP, Pediatric Infectious Diseases

J. Lawrence Merritt II, MD, FAAP, Clinical Genetics and Biochemical Genetics

Chuck Norlin, MD, FAAP, Pediatrician

Robert E. Sapién, MD, MMM, FAAP, Pediatric Emergency Medicine

Richard Shiffman, MD, FAAP, Partnership for Policy Implementation Representative

Michael B.H. Smith, MB, FRCPCH, FAAP, Hospital Medicine

Jack Percelay, MD, MPH, FAAP, Liaison, Society for Hospital Medicine

STAFF

Kymika Okechukwu, MPA

ABBREVIATIONS

AAP: American Academy of Pediatrics
ALTE: apparent life-threatening event
BRUE: brief resolved unexplained event
CI: confidence interval
CNS: central nervous system
CPR: cardiopulmonary resuscitation
ECG: electrocardiogram
GER: gastroesophageal reflux
IEM: inborn error of metabolism
MII: multiple intraluminal impedance
OSA: obstructive sleep apnea
RSV: respiratory syncytial virus
SIDS: sudden infant death syndrome
SUDEP: sudden unexpected death in epilepsy
UTI: urinary tract infection

REFERENCES

1. National Institutes of Health Consensus Development Conference on Infantile Apnea and Home Monitoring, Sept 29 to Oct 1, 1986. *Pediatrics*. 1987;79(2):292–299
2. McGovern MC, Smith MB. Causes of apparent life threatening events in infants: a systematic review. *Arch Dis Child*. 2004;89(11):1043–1048
3. Tieder JS, Altman RL, Bonkowsky JL, et al Management of apparent life-threatening events in infants: a systematic review. *J Pediatr*. 2013;163(1):94–99, e91–e96
4. Brand DA, Altman RL, Purtill K, Edwards KS. Yield of diagnostic testing in infants who have had an apparent life-threatening event. *Pediatrics*. 2005;115(4):885–893
5. Green M. Vulnerable child syndrome and its variants. *Pediatr Rev*. 1986;8(3):75–80
6. Kaji AH, Claudius I, Santillanes G, et al. Apparent life-threatening event: multicenter prospective cohort study to develop a clinical decision rule for admission to the hospital. *Ann Emerg Med*. 2013;61(4):379–387.e4
7. Mittal MK, Sun G, Baren JM. A clinical decision rule to identify infants with apparent life-threatening event who can be safely discharged from the emergency department. *Pediatr Emerg Care*. 2012;28(7):599–605
8. Moher D, Liberati A, Tetzlaff J, Altman DG; PRISMA Group. Preferred reporting items for systematic reviews and meta-analyses: the PRISMA statement. *Ann Intern Med*. 2009;151(4):264–269, W64
9. Haynes RB, Cotoi C, Holland J, et al; McMaster Premium Literature Service (PLUS) Project. Second-order peer review of the medical literature for clinical practitioners. *JAMA*. 2006;295(15):1801–1808
10. Lokker C, McKibbon KA, McKinlay RJ, Wilczynski NL, Haynes RB. Prediction of citation counts for clinical articles at two years using data available within three weeks of publication: retrospective cohort study. *BMJ*. 2008;336(7645):655–657
11. Laupacis A, Wells G, Richardson WS, Tugwell P; Evidence-Based Medicine Working Group. Users' guides to the medical literature. V. How to use an article about prognosis. *JAMA*. 1994;272(3):234–237
12. Jaeschke R, Guyatt G, Sackett DL. Users' guides to the medical literature. III. How to use an article about a diagnostic test. A. Are the results of the study valid? Evidence-Based Medicine Working Group. *JAMA*. 1994;271(5):389–391
13. Anjos AM, Nunes ML. Prevalence of epilepsy and seizure disorders as causes of apparent life-threatening event (ALTE) in children admitted to a tertiary hospital. *Arq Neuropsiquiatr*. 2009;67(3a 3A):616–620

14. Doshi A, Bernard-Stover L, Kuelbs C, Castillo E, Stucky E. Apparent lifethreatening event admissions and gastroesophageal reflux disease: the value of hospitalization. *Pediatr Emerg Care*. 2012;28(1):17–21

15. Franco P, Montemitro E, Scaillet S, et al. Fewer spontaneous arousals in infants with apparent life-threatening event. *Sleep*. 2011;34(6):733–743

16. Hoki R, Bonkowsky JL, Minich LL, Srivastava R, Pinto NM. Cardiac testing and outcomes in infants after an apparent life-threatening event. *Arch Dis Child*. 2012;97(12):1034–1038

17. Kaji AH, Santillanes G, Claudius I, et al. Do infants less than 12 months of age with an apparent life-threatening event need transport to a pediatric critical care center? *Prehosp Emerg Care*. 2013;17(3):304–311

18. Kant S, Fisher JD, Nelson DG, Khan S. Mortality after discharge in clinically stable infants admitted with a fi rsttime apparent life-threatening event. *Am J Emerg Med*. 2013;31(4):730–733

19. Miano S, Castaldo R, Ferri R, et al. Sleep cyclic alternating pattern analysis in infants with apparent life-threatening events: a daytime polysomnographic study. *Clin Neurophysiol*. 2012;123(7):1346–1352

20. Mittal MK, Donda K, Baren JM. Role of pneumography and esophageal pH monitoring in the evaluation of infants with apparent life-threatening event: a prospective observational study. *Clin Pediatr (Phila)*. 2013;52(4):338–343

21. Mosalli RM, Elsayed YY, Paes BA. Acute life threatening events associated with hypocalcemia and vitamin D defi ciency in early infancy: a single center experience from the Kingdom of Saudi Arabia. *Saudi Med J*. 2011;32(5):528–530

22. Parker K, Pitetti R. Mortality and child abuse in children presenting with apparent life-threatening events. *Pediatr Emerg Care*. 2011;27(7):591–595

23. Poets A, Urschitz MS, Steinfeldt R, Poets CF. Risk factors for early sudden deaths and severe apparent lifethreatening events. *Arch Dis Child Fetal Neonatal Ed*. 2012;97(6):F395–F397

24. Semmekrot BA, van Sleuwen BE, Engelberts AC, et al. Surveillance study of apparent life-threatening events (ALTE) in the Netherlands. *Eur J Pediatr*. 2010;169(2):229–236

25. Tieder JS, Altman RL, Bonkowsky JL, et al. Management of apparent life-threatening events in infants: a systematic review. *J Pediatr*. 2013;163(1):94–9.e1, 6

26. Wasilewska J, Sienkiewicz-Szłapka E, Kuźbida E, Jarmołowska B, Kaczmarski M, Kostyra E. The exogenous opioid peptides and DPPIV serum activity in infants with apnoea expressed as apparent life threatening events (ALTE). *Neuropeptides*. 2011;45(3):189–195

27. Weiss K, Fattal-Valevski A, Reif S. How to evaluate the child presenting with an apparent life-threatening event? *Isr Med Assoc J*. 2010;12(3):154–157

28. Zimbric G, Bonkowsky JL, Jackson WD, Maloney CG, Srivastava R. Adverse outcomes associated with gastroesophageal reflux disease are rare following an apparent life-threatening event. *J Hosp Med*. 2012;7(6):476–481

29. American Academy of Pediatrics Steering Committee on Quality Improvement and Management. Classifying recommendations for clinical practice guidelines. *Pediatrics*. 2004;114(3):874–877

30. Shiffman RN, Michel G, Rosenfeld RM, Davidson C. Building better guidelines with BRIDGE-Wiz: development and evaluation of a software assistant to promote clarity, transparency, and implementability. *J Am Med Inform Assoc*. 2012;19(1):94–101

31. Claudius I, Keens T. Do all infants with apparent life-threatening events need to be admitted? *Pediatrics*. 2007;119(4):679–683

32. Bonkowsky JL, Guenther E, Filloux FM, Srivastava R. Death, child abuse, and adverse neurological outcome of infants after an apparent lifethreatening event. *Pediatrics*. 2008;122(1):125–131

33. Al-Kindy HA, Gelinas JF, Hatzakis G, Cote A. Risk factors for extreme events in infants hospitalized for apparent life-threatening events. *J Pediatr*. 2009;154(3):332–337, 337.e1–337.e2

34. Ramanathan R, Corwin MJ, Hunt CE, et al; Collaborative Home Infant Monitoring Evaluation (CHIME) Study Group. Cardiorespiratory events recorded on home monitors: comparison of healthy infants with those at increased risk for SIDS. *JAMA*. 2001;285(17):2199–2207

35. Poets CF, Stebbens VA, Alexander JR, Arrowsmith WA, Salfield SA, Southall DP. Hypoxaemia in infants with respiratory tract infections. *Acta Paediatr*. 1992;81(6–7):536–541

36. Hunt CE, Corwin MJ, Lister G, et al; Collaborative Home Infant Monitoring Evaluation (CHIME) Study Group. Longitudinal assessment of hemoglobin oxygen saturation in healthy infants during the first 6 months of age. *J Pediatr*. 1999;135(5):580–586

37. Altman RL, Li KI, Brand DA. Infections and apparent life-threatening events. *Clin Pediatr (Phila)*. 2008;47(4):372–378

38. Davies F, Gupta R. Apparent life threatening events in infants presenting to an emergency department. *Emerg Med J*. 2002;19(1):11–16

39. Guilleminault C, Ariagno R, Korobkin R, et al. Mixed and obstructive sleep apnea and near miss for sudden infant death syndrome: 2. Comparison of near miss and normal control infants by age. *Pediatrics*. 1979;64(6):882–891

40. Côté A, Hum C, Brouillette RT, Themens M. Frequency and timing of recurrent events in infants using home cardiorespiratory monitors. *J Pediatr*. 1998;132(5):783–789

41. Kahn A, Blum D. Home monitoring of infants considered at risk for the sudden infant death syndrome: four years' experience (1977-1981). *Eur J Pediatr*. 1982;139(2):94–100

42. Daniëls H, Naulaers G, Deroost F, Devlieger H. Polysomnography and home documented monitoring of cardiorespiratory pattern. *Arch Dis Child*. 1999;81(5):434–436

43. Marcus CL, Hamer A. Significance of isolated bradycardia detected

by home monitoring. *J Pediatr*. 1999;135(3):321–326

44. Rebuffat E, Groswasser J, Kelmanson I, Sottiaux M, Kahn A. Polygraphic evaluation of night-to-night variability in sleep characteristics and apneas in infants. *Sleep*. 1994;17(4):329–332
45. Horemuzova E, Katz-Salamon M, Milerad J. Increased inspiratory effort in infants with a history of apparent life-threatening event. *Acta Paediatr*. 2002;91(3):280–286; discussion: 260–261
46. Schechtman VL, Harper RM, Wilson AJ, Southall DP. Sleep state organization in normal infants and victims of the sudden infant death syndrome. *Pediatrics*. 1992;89(5 Pt 1):865–870
47. Arad-Cohen N, Cohen A, Tirosh E. The relationship between gastroesophageal reflux and apnea in infants. *J Pediatr*. 2000;137(3):321–326
48. Harrington C, Kirjavainen T, Teng A, Sullivan CE. Altered autonomic function and reduced arousability in apparent life-threatening event infants with obstructive sleep apnea. *Am J Respir Crit Care Med*. 2002;165(8):1048–1054
49. Guilleminault C, Pelayo R, Leger D, Philip P. Apparent life-threatening events, facial dysmorphia and sleep-disordered breathing. *Eur J Pediatr*. 2000;159(6):444–449
50. Aurora RN, Zak RS, Karippot A, et al; American Academy of Sleep Medicine. Practice parameters for the respiratory indications for polysomnography in children. *Sleep*. 2011;34(3):379–388
51. Kahn A, Groswasser J, Sottiaux M, Rebuffat E, Franco P. Mechanisms of obstructive sleep apneas in infants. *Biol Neonate*. 1994;65(3–4):235–239
52. Leiberman A, Tal A, Brama I, Sofer S. Obstructive sleep apnea in young infants. *Int J Pediatr Otorhinolaryngol*. 1988;16(1):39–44
53. Montgomery-Downs HE, Gozal D. Sleep habits and risk factors for sleep-disordered breathing in infants and young toddlers in Louisville, Kentucky. *Sleep Med*. 2006;7(3):211–219
54. Brouillette RT, Fernbach SK, Hunt CE. Obstructive sleep apnea in infants and children. *J Pediatr*. 1982;100(1):31–40
55. Kahn A, Groswasser J, Sottiaux M, et al. Clinical symptoms associated with brief obstructive sleep apnea in normal infants. *Sleep*. 1993;16(5):409–413
56. Kahn A, Groswasser J, Sottiaux M, et al. Prenatal exposure to cigarettes in infants with obstructive sleep apneas. *Pediatrics*. 1994;93(5):778–783
57. Kahn A, Mozin MJ, Rebuffat E, et al. Sleep pattern alterations and brief airway obstructions in overweight infants. *Sleep*. 1989;12(5):430–438
58. Fajardo C, Alvarez J, Wong A, Kwiatkowski K, Rigatto H. The incidence of obstructive apneas in preterm infants with and without bronchopulmonary dysplasia. *Early Hum Dev*. 1993;32(2–3):197–206
59. Horigome H, Nagashima M, Sumitomo N, et al. Clinical characteristics and genetic background of congenital long-QT syndrome diagnosed in fetal, neonatal, and infantile life: a nationwide questionnaire survey in Japan. *Circ Arrhythm Electrophysiol*. 2010;3(1):10–17
60. Arnestad M, Crotti L, Rognum TO, et al. Prevalence of long-QT syndrome gene variants in sudden infant death syndrome. *Circulation*. 2007;115(3):361–367
61. Goldenberg I, Moss AJ, Peterson DR, et al. Risk factors for aborted cardiac arrest and sudden cardiac death in children with the congenital long-QT syndrome. *Circulation*. 2008;117(17):2184–2191
62. Munger TM, Packer DL, Hammill SC, et al. A population study of the natural history of Wolff-Parkinson-White syndrome in Olmsted County, Minnesota, 1953-1989. *Circulation*. 1993;87(3):866–873
63. American Academy of Pediatrics, Committee on Fetus and Newborn. Apnea, sudden infant death syndrome, and home monitoring. *Pediatrics*. 2003;111(4 pt 1):914–917
64. Krongrad E, O'Neill L. Near miss sudden infant death syndrome episodes? A clinical and electrocardiographic correlation. *Pediatrics*. 1986;77(6):811–815
65. Nathanson I, O'Donnell J, Commins MF. Cardiorespiratory patterns during alarms in infants using apnea/bradycardia monitors. *Am J Dis Child*. 1989;143(4):476–480
66. Weese-Mayer DE, Brouillette RT, Morrow AS, Conway LP, Klemka-Walden LM, Hunt CE. Assessing validity of infant monitor alarms with event recording. *J Pediatr*. 1989;115(5 pt 1):702–708
67. Guenther E, Powers A, Srivastava R, Bonkowsky JL. Abusive head trauma in children presenting with an apparent life-threatening event. *J Pediatr*. 2010;157(5):821–825
68. Pierce MC, Kaczor K, Thompson R. Bringing back the social history. *Pediatr Clin North Am*. 2014;61(5):889–905
69. Pitetti RD, Maffei F, Chang K, Hickey R, Berger R, Pierce MC. Prevalence of retinal hemorrhages and child abuse in children who present with an apparent life-threatening event. *Pediatrics*. 2002;110(3):557–562
70. Jenny C, Hymel KP, Ritzen A, Reinert SE, Hay TC. Analysis of missed cases of abusive head trauma. *JAMA*. 1999;281(7):621–626
71. Southall DP, Plunkett MC, Banks MW, Falkov AF, Samuels MP. Covert video recordings of life-threatening child abuse: lessons for child protection. *Pediatrics*. 1997;100(5):735–760
72. Sugar NF, Taylor JA, Feldman KW; Puget Sound Pediatric Research Network. Bruises in infants and toddlers: those who don't cruise rarely bruise. *Arch Pediatr Adolesc Med*. 1999;153(4):399–403
73. Harper NS, Feldman KW, Sugar NF, Anderst JD, Lindberg DM; Examining Siblings To Recognize Abuse Investigators. Additional injuries in young infants with concern for abuse and apparently isolated bruises. *J Pediatr*. 2014;165(2):383–388, e1
74. DeRidder CA, Berkowitz CD, Hicks RA, Laskey AL. Subconjunctival hemorrhages in infants and children: a sign of nonaccidental trauma. *Pediatr Emerg Care*. 2013;29(2):222–226
75. Buck ML, Blumer JL. Phenothiazine-associated apnea in two siblings. *DICP*. 1991;25(3):244–247
76. Hardoin RA, Henslee JA, Christenson CP, Christenson PJ, White M. Colic

medication and apparent life-threatening events. *Clin Pediatr (Phila)*. 1991;30(5):281–285

77. Hickson GB, Altemeier WA, Martin ED, Campbell PW. Parental administration of chemical agents: a cause of apparent life-threatening events. *Pediatrics*. 1989;83(5):772–776
78. Pitetti RD, Whitman E, Zaylor A. Accidental and nonaccidental poisonings as a cause of apparent life-threatening events in infants. *Pediatrics*. 2008;122(2). Available at: www.pediatrics.org/cgi/content/full/122/2/e359
79. McCormick T, Levine M, Knox O, Claudius I. Ethanol ingestion in two infants under 2 months old: a previously unreported cause of ALTE. *Pediatrics*. 2013;131(2). Available at: www.pediatrics.org/cgi/content/full/131/2/e604
80. Dearborn DG, Smith PG, Dahms BB, et al. Clinical profile of 30 infants with acute pulmonary hemorrhage in Cleveland. *Pediatrics*. 2002;110(3):627–637
81. Leone MA, Solari A, Beghi E; First Seizure Trial (FIRST) Group. Treatment of the first tonic-clonic seizure does not affect long-term remission of epilepsy. *Neurology*. 2006;67(12):2227–2229
82. Musicco M, Beghi E, Solari A, Viani F; First Seizure Trial (FIRST) Group. Treatment of first tonic-clonic seizure does not improve the prognosis of epilepsy. *Neurology*. 1997;49(4):991–998
83. Camfield P, Camfield C, Smith S, Dooley J, Smith E. Long-term outcome is unchanged by antiepileptic drug treatment after a first seizure: a 15-year follow-up from a randomized trial in childhood. *Epilepsia*. 2002;43(6):662–663
84. Gilbert DL, Buncher CR. An EEG should not be obtained routinely after first unprovoked seizure in childhood. *Neurology*. 2000;54(3):635–641
85. Arts WF, Geerts AT. When to start drug treatment for childhood epilepsy: the clinical-epidemiological evidence. *Eur J Paediatr Neurol*. 2009;13(2):93–101
86. Hirtz D, Ashwal S, Berg A, et al. Practice parameter: evaluating a first nonfebrile seizure in children: report of the Quality Standards Subcommittee of the American Academy of Neurology, The Child Neurology Society, and The American Epilepsy Society. *Neurology*. 2000;55(5):616–623
87. Bonkowsky JL, Guenther E, Srivastava R, Filloux FM. Seizures in children following an apparent life-threatening event. *J Child Neurol*. 2009;24(6):709–713
88. Claudius I, Mittal MK, Murray R, Condie T, Santillanes G. Should infants presenting with an apparent life-threatening event undergo evaluation for serious bacterial infections and respiratory pathogens? *J Pediatr*. 2014;164(5):1231–1233, e1
89. Mittal MK, Shofer FS, Baren JM. Serious bacterial infections in infants who have experienced an apparent life-threatening event. *Ann Emerg Med*. 2009;54(4):523–527
90. Roberts KB; Subcommittee on Urinary Tract Infection, Steering Committee on Quality Improvement and Management. Urinary tract infection: clinical practice guideline for the diagnosis and management of the initial UTI in febrile infants and children 2 to 24 months. *Pediatrics*. 2011;128(3):595–610
91. Schroeder AR, Mansbach JM, Stevenson M, et al. Apnea in children hospitalized with bronchiolitis. *Pediatrics*. 2013;132(5). Available at: www.pediatrics.org/cgi/content/full/132/5/e1194
92. Loeffelholz MJ, Trujillo R, Pyles RB, et al. Duration of rhinovirus shedding in the upper respiratory tract in the first year of life. *Pediatrics*. 2014;134(6):1144–1150
93. Crowcroft NS, Booy R, Harrison T, et al. Severe and unrecognised: pertussis in UK infants. *Arch Dis Child*. 2003;88(9):802–806
94. Centers for Disease Control and Prevention. Pertussis (whooping cough): diagnostic testing. Available at: www.cdc.gov/pertussis/clinical/diagnostic-testing/index.html. Accessed June 26, 2015
95. Centers for Disease Control and Prevention. Pertussis (whooping cough): treatment. Available at: www.cdc.gov/pertussis/clinical/treatment.html. Accessed June 26, 2015
96. Campanozzi A, Boccia G, Pensabene L, et al. Prevalence and natural history of gastroesophageal reflux: pediatric prospective survey. *Pediatrics*. 2009;123(3):779–783
97. Lightdale JR, Gremse DA; American Academy of Pediatrics, Section on Gastroenterology, Hepatology, and Nutrition. Gastroesophageal reflux: management guidance for the pediatrician. *Pediatrics*. 2013;131(5). Available at: www.pediatrics.org/cgi/content/full/131/5/e1684
98. Vandenplas Y, Rudolph CD, Di Lorenzo C, et al; North American Society for Pediatric Gastroenterology Hepatology and Nutrition; European Society for Pediatric Gastroenterology Hepatology and Nutrition. Pediatric gastroesophageal reflux clinical practice guidelines: joint recommendations of the North American Society for Pediatric Gastroenterology, Hepatology, and Nutrition (NASPGHAN) and the European Society for Pediatric Gastroenterology, Hepatology, and Nutrition (ESPGHAN). *J Pediatr Gastroenterol Nutr*. 2009;49(4):498–547
99. Kiechl-Kohlendorfer U, Hof D, Peglow UP, Traweger-Ravanelli B, Kiechl S. Epidemiology of apparent life threatening events. *Arch Dis Child*. 2005;90(3):297–300
100. Chung EY, Yardley J. Are there risks associated with empiric acid suppression treatment of infants and children suspected of having gastroesophageal reflux disease? *Hosp Pediatr*. 2013;3(1):16–23
101. Herbst JJ, Minton SD, Book LS. Gastroesophageal reflux causing respiratory distress and apnea in newborn infants. *J Pediatr*. 1979;95(5 pt 1):763–768
102. Orenstein SR. An overview of reflux-associated disorders in infants: apnea, laryngospasm, and aspiration. *Am J Med*. 2001;111(suppl 8A):60S–63S
103. Wenzl TG, Schenke S, Peschgens T, Silny J, Heimann G, Skopnik H. Association of

apnea and nonacid gastroesophageal reflux in infants: investigations with the intraluminal impedance technique. *Pediatr Pulmonol*. 2001;31(2):144–149

104. Mousa H, Woodley FW, Metheney M, Hayes J. Testing the association between gastroesophageal reflux and apnea in infants. *J Pediatr Gastroenterol Nutr*. 2005;41(2):169–177
105. Kahn A, Rebuffat E, Sottiaux M, Dufour D, Cadranel S, Reiterer F. Lack of temporal relation between acid reflux in the proximal oesophagus and cardiorespiratory events in sleeping infants. *Eur J Pediatr*. 1992;151(3):208–212
106. Orenstein SR, McGowan JD. Efficacy of conservative therapy as taught in the primary care setting for symptoms suggesting infant gastroesophageal reflux. *J Pediatr*. 2008;152(3):310–314
107. Kahn A; European Society for the Study and Prevention of Infant Death. Recommended clinical evaluation of infants with an apparent life-threatening event: consensus document of the European Society for the Study and Prevention of Infant Death, 2003. *Eur J Pediatr*. 2004;163(2):108–115
108. Veereman-Wauters G, Bochner A, Van Caillie-Bertrand M. Gastroesophageal reflux in infants with a history of near-miss sudden infant death. *J Pediatr Gastroenterol Nutr*. 1991;12(3):319–323
109. Arens R, Gozal D, Williams JC, Ward SL, Keens TG. Recurrent apparent life-threatening events during infancy: a manifestation of inborn errors of metabolism. *J Pediatr*. 1993;123(3):415–418
110. See CC, Newman LJ, Berezin S, et al. Gastroesophageal reflux-induced hypoxemia in infants with apparent life-threatening event(s). *Am J Dis Child*. 1989;143(8):951–954
111. Penzien JM, Molz G, Wiesmann UN, Colombo JP, Bühlmann R, Wermuth B. Medium-chain acyl-CoA dehydrogenase deficiency does not correlate with apparent life-threatening events and the sudden infant death syndrome: results from phenylpropionate loading tests and DNA analysis. *Eur J Pediatr*. 1994;153(5):352–357
112. Pitetti RD, Lovallo A, Hickey R. Prevalence of anemia in children presenting with apparent life-threatening events. *Acad Emerg Med*. 2005;12(10):926–931
113. Gray C, Davies F, Molyneux E. Apparent life-threatening events presenting to a pediatric emergency department. *Pediatr Emerg Care*. 1999;15(3):195–199
114. Poets CF, Samuels MP, Wardrop CA, Picton-Jones E, Southall DP. Reduced haemoglobin levels in infants presenting with apparent life-threatening events—a retrospective investigation. *Acta Paediatr*. 1992;81(4):319–321
115. Pyles LA, Knapp J; American Academy of Pediatrics Committee on Pediatric Emergency Medicine. Role of pediatricians in advocating life support training courses for parents and the public. *Pediatrics*. 2004;114(6). Available at: www.pediatrics.org/cgi/content/full/114/6/e761
116. Tunik MG, Richmond N, Treiber M, et al. Pediatric prehospital evaluation of NYC respiratory arrest survival (PHENYCS). *Pediatr Emerg Care*. 2012;28(9):859–863
117. Foltin GL, Richmond N, Treiber M, et al. Pediatric prehospital evaluation of NYC cardiac arrest survival (PHENYCS). *Pediatr Emerg Care*. 2012;28(9):864–868
118. Akahane M, Tanabe S, Ogawa T, et al. Characteristics and outcomes of pediatric out-of-hospital cardiac arrest by scholastic age category. *Pediatr Crit Care Med*. 2013;14(2):130–136
119. Atkins DL, Everson-Stewart S, Sears GK, et al; Resuscitation Outcomes Consortium Investigators. Epidemiology and outcomes from out-of-hospital cardiac arrest in children: the Resuscitation Outcomes Consortium Epistry-Cardiac Arrest. *Circulation*. 2009;119(11):1484–1491
120. McLauchlan CA, Ward A, Murphy NM, Griffith MJ, Skinner DV, Camm AJ. Resuscitation training for cardiac patients and their relatives—its effect on anxiety. *Resuscitation*. 1992;24(1):7–11
121. Higgins SS, Hardy CE, Higashino SM. Should parents of children with congenital heart disease and life-threatening dysrhythmias be taught cardiopulmonary resuscitation? *Pediatrics*. 1989;84(6):1102–1104
122. Dracup K, Moser DK, Taylor SE, Guzy PM. The psychological consequences of cardiopulmonary resuscitation training for family members of patients at risk for sudden death. *Am J Public Health*. 1997;87(9):1434–1439
123. Feudtner C, Walter JK, Faerber JA, et al. Good-parent beliefs of parents of seriously ill children. *JAMA Pediatr*. 2015;169(1):39–47
124. Yin HS, Dreyer BP, Vivar KL, MacFarland S, van Schaick L, Mendelsohn AL. Perceived barriers to care and attitudes towards shared decision-making among low socioeconomic status parents: role of health literacy. *Acad Pediatr*. 2012;12(2):117–124
125. Kuo DZ, Houtrow AJ, Arango P, Kuhlthau KA, Simmons JM, Neff JM. Family-centered care: current applications and future directions in pediatric health care. *Matern Child Health J*. 2012;16(2):297–305
126. American Academy of Pediatrics, Committee on Hospital Care; Institute for Patient- and Family-Centered Care. Patient- and family-centered care and the pediatrician's role. *Pediatrics*. 2012;129(2):394–404
127. Institute of Medicine. *Crossing the Quality Chasm: A New Health System for the 21st Century*. Washington, DC: Institute of Medicine, Committee on Quality Healthcare in America National Academies Press; 2001
128. Pronovost PJ. Enhancing physicians' use of clinical guidelines. *JAMA*. 2013;310(23):2501–2502

CLINICAL PRACTICE GUIDELINE Guidance for the Clinician in Rendering Pediatric Care

American Academy of Pediatrics

DEDICATED TO THE HEALTH OF ALL CHILDREN™

Brief Resolved Unexplained Events (Formerly Apparent Life-Threatening Events) and Evaluation of Lower-Risk Infants: Executive Summary

Joel S. Tieder, MD, MPH, FAAP, Joshua L. Bonkowsky, MD, PhD, FAAP, Ruth A. Etzel, MD, PhD, FAAP, Wayne H. Franklin, MD, MPH, MMM, FAAP, David A. Gremse, MD, FAAP, Bruce Herman, MD, FAAP, Eliot S. Katz, MD, FAAP, Leonard R. Krilov, MD, FAAP, J. Lawrence Merritt II, MD, FAAP, Chuck Norlin, MD, FAAP, Jack Percelay, MD, MPH, FAAP, Robert E. Sapién, MD, MMM, FAAP, Richard N. Shiffman, MD, MCIS, FAAP, Michael B.H. Smith, MB, FRCPCH, FAAP, SUBCOMMITTEE ON APPARENT LIFE THREATENING EVENTS

EXECUTIVE SUMMARY

This clinical practice guideline has 2 primary objectives. First, it recommends the replacement of the term "apparent life-threatening event" (ALTE) with a new term, "brief resolved unexplained event" (BRUE). Second, it provides an approach to evaluation and management that is based on the risk that the infant will have a repeat event or has a serious underlying disorder.

Clinicians should use the term BRUE to describe an event occurring in an infant younger than 1 year when the observer reports a sudden, brief, and now resolved episode of ≥1 of the following: (1) cyanosis or pallor; (2) absent, decreased, or irregular breathing; (3) marked change in tone (hyper- or hypotonia); and (4) altered level of responsiveness. Moreover, clinicians should diagnose a BRUE only when there is no explanation for a qualifying event after conducting an appropriate history and physical examination (see Tables 2 and 3 in www.pediatrics.org/cgi/doi/10.1542/peds.2016-0590). Among infants who present for medical attention after a BRUE, the guideline identifies (1) lower-risk patients on the basis of history and physical examination, for whom evidence-based guidelines for evaluation and management are offered, and (2) higher-risk patients, whose history and physical examination suggest the need for further investigation, monitoring, and/or treatment, but for whom recommendations are not offered (because of insufficient evidence or the availability of guidance from other clinical practice guidelines specific to their presentation or diagnosis). Recommendations in this guideline apply only to lower-risk patients,

DOI: 10.1542/peds.2016-0591

PEDIATRICS (ISSN Numbers: Print, 0031-4005; Online, 1098-4275).

To cite: Tieder JS, Bonkowsky JL, Etzel RA, et al. Brief Resolved Unexplained Events (Formerly Apparent Life-Threatening Events) and Evaluation of Lower-Risk Infants: Executive Summary. *Pediatrics*. 2016;137(5):e20160591

who are defined by (1) age >60 days; (2) gestational age ≥32 weeks and postconceptional age ≥45 weeks; (3) occurrence of only 1 BRUE (no prior BRUE ever and not occurring in clusters); (4) duration of BRUE <1 minute; (5) no cardiopulmonary resuscitation by trained medical provider required; (6) no concerning historical features; and (7) no concerning physical examination findings (Fig 1). This clinical practice guideline also provides implementation support and suggests directions for future research.

The term ALTE originated from a 1986 National Institutes of Health Consensus Conference on Infantile Apnea and was intended to replace the term "near-miss sudden infant death syndrome (SIDS)."[1] An ALTE was defined as "[a]n episode that is frightening to the observer and that is characterized by some combination of apnea (central or occasionally obstructive), color change (usually cyanotic or pallid but occasionally erythematous or plethoric), marked change in muscle tone (usually marked limpness), choking, or gagging. In some cases, the observer fears that the infant has died."[2] Although the definition of ALTE enabled researchers to establish over time that these events were a separate entity from SIDS, the clinical application of this classification, which describes a constellation of observed, subjective, and nonspecific symptoms, has raised significant challenges for clinicians and parents in the evaluation and care of these infants.[3] Although a broad range of disorders can present as an ALTE (eg, child abuse, congenital abnormalities, epilepsy, inborn errors of metabolism, and infections), for a majority of well-appearing infants, the risk of a recurrent event or a serious underlying disorder is extremely low.

ALTEs can create a feeling of uncertainty in both the caregiver and the clinician. Clinicians may feel compelled to perform tests and hospitalize the patient even though this may subject the patient to unnecessary risk and is unlikely to lead to a treatable diagnosis or prevent future events.[2,4,5] Understanding the risk of an adverse outcome for an infant who has experienced an ALTE has been difficult because of the nonspecific nature and variable application of the ALTE definition in research. A recent systematic review of nearly 1400 ALTE publications spanning 4 decades concluded that risk of a subsequent or underlying disorder could not be quantified because of the variability in case definitions across studies.[3] Although there are history and physical examination factors that can determine lower or higher risk, it is clear that the term ALTE must be replaced to advance the quality of care and improve research.

This guideline is intended for use primarily by clinicians providing care for infants who have experienced a BRUE, as well as their families. The guideline may be of interest to payers, but it is not intended to be used for reimbursement or to determine insurance coverage. This guideline is not intended as the sole source of guidance in the evaluation and management of BRUEs and specifically does not address higher-risk BRUE patients. Rather, it is intended to assist clinicians by providing a framework for clinical decision making. It is not intended to replace clinical judgment, and these recommendations may not provide the only appropriate approach to the management of this problem.

This guideline is intended to provide a patient- and family-centered approach to care, reduce unnecessary and costly medical interventions, and improve patient outcomes. It includes recommendations for diagnosis, risk-based stratification, monitoring, disposition planning, effective communication with the patient and family, guideline implementation and evaluation, and future research. In addition, it aims to help clinicians determine the presence of a serious underlying cause and a safe disposition by alerting them to the most significant features of the clinical history and physical examination on which to base an approach for diagnostic testing and hospitalization. Key action statements are summarized in Table 1.

SUBCOMMITTEE ON BRIEF RESOLVED UNEXPLAINED EVENTS (FORMERLY REFERRED TO AS APPARENT LIFE THREATENING EVENTS); OVERSIGHT BY THE COUNCIL ON QUALITY IMPROVEMENT AND PATIENT SAFETY

Joel S. Tieder, MD, MPH, FAAP, Chair
Joshua L. Bonkowsky, MD, PhD, FAAP, Pediatric Neurologist
Ruth A. Etzel, MD, PhD, FAAP, Pediatric Epidemiologist
Wayne H. Franklin, MD, MPH, MMM, FAAP, Pediatric Cardiologist
David A. Gremse, MD, FAAP, Pediatric Gastroenterologist
Bruce Herman, MD, FAAP, Child Abuse and Neglect
Eliot Katz, MD, FAAP, Pediatric Pulmonologist
Leonard R. Krilov, MD, FAAP, Pediatric Infectious Diseases
J. Lawrence Merritt, II, MD, FAAP, Clinical Genetics and Biochemical Genetics
Chuck Norlin, MD, FAAP, Pediatrician
Robert E. Sapién, MD, MMM, FAAP, Pediatric Emergency Medicine
Richard Shiffman, MD, FAAP, Partnership for Policy Implementation Representative
Michael B.H. Smith, MB, FRCPCH, FAAP, Hospital Medicine

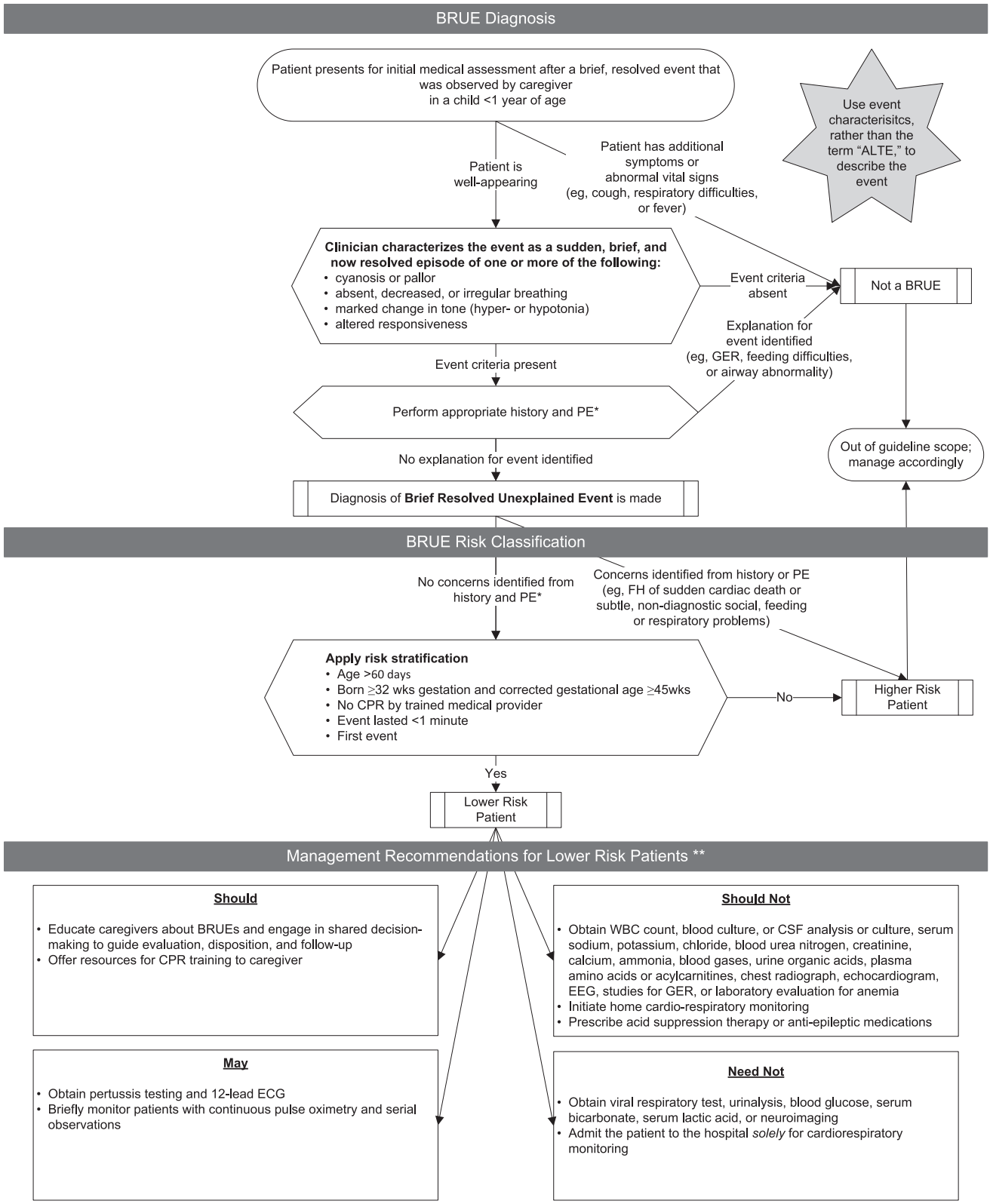


FIGURE 1

Diagnosis, risk classification, and recommended management of a BRUE. *Refer to Tables 3 and 4 in www.pediatrics.org/cgi/doi/10.1542/peds.2016-0591 for the determination of an appropriate and negative history and PE. **Refer to Figure 2 in www.pediatrics.org/cgi/doi/10.1542/peds.2016-0591 for the American Academy of Pediatrics method for rating of evidence and recommendations. CPR, cardiopulmonary resuscitation; CSF, cerebrospinal fluid; ECG, electrocardiogram; FH, family history; GER, gastroesophageal reflux; PE, physical examination; WBC, white blood cell.

Figure 1, shown here, has been updated per the erratum at http://pediatrics.aappublications.org/content/138/2/e20161488.

TABLE 1 Summary of Key Action Statements for Lower-Risk BRUEs

When managing an infant who is >60 d and <1 y of age and who, on the basis of a thorough history and physical examination, meets criteria for having experienced a lower-risk BRUE, clinicians:	Evidence Quality; Strength of Recommendation
1. Cardiopulmonary Evaluation	
1A. Need not admit infants to the hospital solely for cardiorespiratory monitoring.	B; Weak
1B. May briefly monitor patients with continuous pulse oximetry and serial observations.	D; Weak
1C. Should not obtain chest radiograph.	B; Moderate
1D. Should not obtain a measurement of venous or arterial blood gas.	B; Moderate
1E. Should not obtain an overnight polysomnograph.	B; Moderate
1F. May obtain a 12-lead electrocardiogram.	C; Weak
1G. Should not obtain an echocardiogram.	C; Moderate
1H. Should not initiate home cardiorespiratory monitoring.	B; Moderate
2. Child Abuse Evaluation	
2A. Need not obtain neuroimaging (CT, MRI, or ultrasonography) to detect child abuse.	C; Weak
2B. Should obtain an assessment of social risk factors to detect child abuse.	C; Moderate
3. Neurologic Evaluation	
3A. Should not obtain neuroimaging (CT, MRI, or ultrasonography) to detect neurologic disorders.	C; Moderate
3B. Should not obtain an EEG to detect neurologic disorders.	C; Moderate
3C. Should not prescribe antiepileptic medications for potential neurologic disorders.	C; Moderate
4. Infectious Disease Evaluation	
4A. Should not obtain a WBC count, blood culture, or cerebrospinal fluid analysis or culture to detect an occult bacterial infection.	B; Strong
4B. Need not obtain a urinalysis (bag or catheter).	C; Weak
4C. Should not obtain chest radiograph to assess for pulmonary infection.	B; Moderate
4D. Need not obtain respiratory viral testing if rapid testing is available.	C; Weak
4E. May obtain testing for pertussis.	B; Weak
5. Gastrointestinal Evaluation	
5A. Should not obtain investigations for GER (eg, upper gastrointestinal tract series, pH probe, endoscopy, barium contrast study, nuclear scintigraphy, and ultrasonography).	C; Moderate
5B. Should not prescribe acid suppression therapy.	C; Moderate
6. Inborn Error of Metabolism Evaluation	
6A. Need not obtain measurement of serum lactic acid or serum bicarbonate.	C; Weak
6B. Should not obtain a measurement of serum sodium, potassium, chloride, blood urea nitrogen, creatinine, calcium, or ammonia.	C; Moderate
6C. Should not obtain a measurement of venous or arterial blood gases.	C; Moderate
6D. Need not obtain a measurement of blood glucose.	C; Weak
6E. Should not obtain measurements of urine organic acids, plasma amino acids, or plasma acylcarnitines.	C; Moderate
7. Anemia Evaluation	
7A. Should not obtain laboratory evaluation for anemia.	C; Moderate
8. Patient- and Family-Centered Care	
8A. Should offer resources for CPR training to caregiver.	C; Moderate
8B. Should educate caregivers about BRUEs.	C; Moderate
8C. Should use shared decision making.	C; Moderate

CPR, cardiopulmonary resuscitation; CT, computed tomography; GER, gastroesophageal reflux; WBC, white blood cell.

Jack Percelay, MD, MPH, FAAP, Liaison, Society for Hospital Medicine

STAFF

Kymika Okechukwu, MPA

ABBREVIATIONS

ALTE: apparent life-threatening event
BRUE: brief resolved unexplained event
SIDS: sudden infant death syndrome

REFERENCES

1. National Institutes of Health Consensus Development Conference on Infantile Apnea and Home Monitoring, Sept 29 to Oct 1, 1986. *Pediatrics*. 1987;79(2). Available at: www.pediatrics.org/cgi/content/full/79/2/e292
2. McGovern MC, Smith MB. Causes of apparent life threatening events in infants: a systematic review. *Arch Dis Child*. 2004;89(11):1043–1048
3. Tieder JS, Altman RL, Bonkowsky JL, et al Management of apparent life-threatening events in infants: a systematic review. *J Pediatr*. 2013;163(1):94–99, e91–e96
4. Brand DA, Altman RL, Purtill K, Edwards KS. Yield of diagnostic testing in infants who have had an apparent life-threatening event. *Pediatrics*. 2005;115(4). Available at: www.pediatrics.org/cgi/content/full/115/4/e885
5. Green M. Vulnerable child syndrome and its variants. *Pediatr Rev*. 1986; 8(3):75–80

Brief Resolved Unexplained Events Clinical Practice Guideline Quick Reference Tools

- Action Statement Summary
  — Brief Resolved Unexplained Events (Formerly Apparent Life-Threatening Events) and Evaluation of Lower-Risk Infants
- *ICD-10-CM* Coding Quick Reference for Brief Resolved Unexplained Events
- AAP Patient Education Handout
  — *Brief Resolved Unexplained Event: What Parents and Caregivers Need to Know*

Action Statement Summary

Brief Resolved Unexplained Events (Formerly Apparent Life-Threatening Events) and Evaluation of Lower-Risk Infants

Key Action Statement 1

Cardiopulmonary

Key Action Statement 1A

Clinicians need not admit infants presenting with a lower-risk BRUE to the hospital solely for cardiorespiratory monitoring (grade B, weak recommendation)

Key Action Statement 1B

Clinicians may briefly monitor infants presenting with a lower-risk BRUE with continuous pulse oximetry and serial observations (grade D, weak recommendation)

Key Action Statement 1C

Clinicians should not obtain a chest radiograph in infants presenting with a lower-risk BRUE (grade B, moderate recommendation)

Key Action Statement 1D

Clinicians should not obtain measurement of venous or arterial blood gases in infants presenting with a lower-risk BRUE (grade B, moderate recommendation)

Key Action Statement 1E

Clinicians should not obtain an overnight polysomnograph in infants presenting with a lower-risk BRUE (grade B, moderate recommendation)

Key Action Statement 1F

Clinicians may obtain a 12-lead electrocardiogram for infants presenting with lower-risk BRUE (grade C, weak recommendation)

Key Action Statement 1G

Clinicians should not obtain an echocardiogram in infants presenting with lower-risk BRUE (grade C, moderate recommendation)

Key Action Statement 1H

Clinicians should not initiate home cardiorespiratory monitoring in infants presenting with a lower-risk BRUE (grade B, moderate recommendation)

Key Action Statement 2

Child abuse

Key Action Statement 2A

Clinicians need not obtain neuroimaging (computed tomography, MRI, or ultrasonography) to detect child abuse in infants presenting with a lower-risk BRUE (grade C, weak recommendation)

Key Action Statement 2B

Clinicians should obtain an assessment of social risk factors to detect child abuse in infants presenting with a lower-risk BRUE (grade C, moderate recommendation)

Key Action Statement 3

Neurology

Key Action Statement 3A

Clinicians should not obtain neuroimaging (computed tomography, MRI, or ultrasonography) to detect neurologic disorders in infants presenting with a lower-risk BRUE (grade C, moderate recommendation)

Key Action Statement 3B

Clinicians should not obtain an EEG to detect neurologic disorders in infants presenting with a lower-risk BRUE (grade C, moderate recommendation)

Key Action Statement 3C

Clinicians should not prescribe antiepileptic medications for potential neurologic disorders in infants presenting with a lower-risk BRUE (grade C, moderate recommendation)

Key Action Statement 4

Infectious diseases

Key Action Statement 4A

Clinicians should not obtain a white blood cell count, blood culture, or cerebrospinal fluid analysis or culture to detect an occult bacterial infection in infants presenting with a lower-risk BRUE (grade B, strong recommendation)

Key Action Statement 4B

Clinicians need not obtain a urinalysis (bag or catheter) in infants presenting with a lower-risk BRUE (grade C, weak recommendation)

Key Action Statement 4C

Clinicians should not obtain a chest radiograph to assess for pulmonary infection in infants presenting with a lower-risk BRUE (grade B, moderate recommendation)

Key Action Statement 4D

Clinicians need not obtain respiratory viral testing if rapid testing is available in infants presenting with a lower-risk BRUE (grade C, weak recommendation)

Key Action Statement 4E

Clinicians may obtain testing for pertussis in infants presenting with a lower-risk BRUE (grade B, weak recommendation)

Key Action Statement 5

Gastroenterology

Key Action Statement 5A

Clinicians should not obtain investigations for GER (eg, upper gastrointestinal series, pH probe, endoscopy, barium contrast study, nuclear scintigraphy, and ultrasonography) in infants presenting with a lower-risk BRUE (grade C, moderate recommendation)

Key Action Statement 5B

Clinicians should not prescribe acid suppression therapy for infants presenting with a lower-risk BRUE (grade C, moderate recommendation)

Key Action Statement 6

Inborn errors of metabolism

Key Action Statement 6A

Clinicians need not obtain measurement of serum lactic acid or serum bicarbonate to detect an IEM in infants presenting with a lower-risk BRUE (grade C, weak recommendation)

Key Action Statement 6B

Clinicians should not obtain a measurement of serum sodium, potassium, chloride, blood urea nitrogen, creatinine, calcium, or ammonia to detect an IEM in infants presenting with a lower-risk BRUE (grade C, moderate recommendation)

Key Action Statement 6C

Clinicians should not obtain a measurement of venous or arterial blood gases to detect an IEM in infants presenting with lower-risk BRUE (grade C, moderate recommendation)

Key Action Statement 6D

Clinicians need not obtain a measurement of blood glucose to detect an IEM in infants presenting with a lower-risk BRUE (grade C, weak recommendation)

Key Action Statement 6E

Clinicians should not obtain measurements of urine organic acids, plasma amino acids, or plasma acylcarnitines to detect an IEM in infants presenting with a lower-risk BRUE (grade C, moderate recommendation)

Key Action Statement 7

Anemia

Key Action Statement 7A

Clinicians should not obtain laboratory evaluation for anemia in infants presenting with a lower-risk BRUE (grade C, moderate recommendation)

Key Action Statement 8

Patient- and family-centered care

Key Action Statement 8A

Clinicians should offer resources for CPR training to caregivers (grade C, moderate recommendation)

Key Action Statement 8B

Clinicians should educate caregivers about BRUEs (grade C, moderate recommendation)

Key Action Statement 8C

Clinicians should use shared decision-making for infants presenting with a lower-risk BRUE (grade C, moderate recommendation)

Coding Quick Reference for Brief Resolved Unexplained Events
ICD-10-CM
R68.13 Apparent life threatening event (ALTE) in infant (includes brief resolved unexplained events [BRUE])

Brief Resolved Unexplained Event:

What Parents and Caregivers Need to Know

What is a brief resolved unexplained event?

A **b**rief **r**esolved **u**nexplained **e**vent (or BRUE for short) occurs suddenly and can be scary for parents and caregivers. A brief resolved unexplained event is a diagnosis made after your baby's doctor or health care professional has examined your baby and determined that there was no known concerning cause for the event.

When a brief resolved unexplained event occurs, babies may seem to stop breathing, their skin color may change to pale or blue, their muscles may relax or tighten, or they may seem to pass out. After a brief period of time, they recover (with or without any medical help) and are soon back to normal.

Though we can never say that a baby who has had a brief resolved unexplained event is at *no* risk for future problems, we can say that babies are at lower risk if

- They are older than 60 days.
- They were born on time (not premature).
- They did not need CPR (cardiopulmonary resuscitation) by a health care professional.
- The brief resolved unexplained event lasted less than 1 minute.
- This was their only such event.

Frequently asked questions after a brief resolved unexplained event

Q: Why did my baby have this event?

A: Your baby's doctor was unable to find a cause based on the results of your baby's examination and cannot tell you why this event happened. If it happens again or your baby develops additional problems, contact your baby's doctor or health care professional. The doctor may decide to have your baby return for another visit.

Q: Should my baby stay in the hospital?

A: Babies who are felt to be at lower risk by their doctors or health care professionals do not need to stay in the hospital. They are safe to go home without doing blood tests or imaging that uses x-rays, and they do not need home monitoring of their heart or lungs.

Q: Does having a brief resolved unexplained event increase my baby's risk for sudden infant death syndrome (SIDS)?

A: No—though the causes of SIDS are not known, events like these do not increase the risk of SIDS. For all babies, it is important to create a safe home and sleeping environment. Your baby should not be exposed to smoky environments. Visit **www.HealthyChildren.org/safesleep** to learn more about how to create a safe sleeping environment for your baby.

Q: What should I do if it happens again?

A: If you are worried that this new event is life threatening, call 911 or your local emergency numbers. If not, call your baby's doctor if you have any questions or worries and to let the doctor know about the event.

Q: Does my baby need extra care after having a brief resolved unexplained event? Is my baby more delicate or weak?

A: No special care is needed. Continue to love and care for your baby as you normally do.

A few important reminders for parents and caregivers of healthy infants

- Remember to take your baby to regular well-child visits to help keep your child healthy and safe.
- Though your baby is not more likely to need it, it is a good idea for everyone who cares for an infant to learn CPR. If you know CPR, you may also use it one day to help someone else in need. For classes near you, contact your child's doctor, the American Red Cross, the American Heart Association, or a national or local organization that offers training.

From your doctor

American Academy of Pediatrics

DEDICATED TO THE HEALTH OF ALL CHILDREN™

The American Academy of Pediatrics (AAP) is an organization of 64,000 primary care pediatricians, pediatric medical subspecialists, and pediatric surgical specialists dedicated to the health, safety, and well-being of all infants, children, adolescents, and young adults.

American Academy of Pediatrics
Web site— www.HealthyChildren.org

The Diagnosis, Management, and Prevention of Bronchiolitis

- *Clinical Practice Guideline*
  - *PPI: AAP Partnership for Policy Implementation*
    See Appendix 1 for more information.

CLINICAL PRACTICE GUIDELINE

Clinical Practice Guideline: The Diagnosis, Management, and Prevention of Bronchiolitis

abstract

FREE

This guideline is a revision of the clinical practice guideline, "Diagnosis and Management of Bronchiolitis," published by the American Academy of Pediatrics in 2006. The guideline applies to children from 1 through 23 months of age. Other exclusions are noted. Each key action statement indicates level of evidence, benefit-harm relationship, and level of recommendation. Key action statements are as follows: *Pediatrics* 2014;134:e1474–e1502

DIAGNOSIS

1a. Clinicians should diagnose bronchiolitis and assess disease severity on the basis of history and physical examination (Evidence Quality: B; Recommendation Strength: Strong Recommendation).

1b. Clinicians should assess risk factors for severe disease, such as age less than 12 weeks, a history of prematurity, underlying cardiopulmonary disease, or immunodeficiency, when making decisions about evaluation and management of children with bronchiolitis (Evidence Quality: B; Recommendation Strength: Moderate Recommendation).

1c. When clinicians diagnose bronchiolitis on the basis of history and physical examination, radiographic or laboratory studies should not be obtained routinely (Evidence Quality: B; Recommendation Strength: Moderate Recommendation).

TREATMENT

2. Clinicians should not administer albuterol (or salbutamol) to infants and children with a diagnosis of bronchiolitis (Evidence Quality: B; Recommendation Strength: Strong Recommendation).

3. Clinicians should not administer epinephrine to infants and children with a diagnosis of bronchiolitis (Evidence Quality: B; Recommendation Strength: Strong Recommendation).

4a. Nebulized hypertonic saline should not be administered to infants with a diagnosis of bronchiolitis in the emergency department (Evidence Quality: B; Recommendation Strength: Moderate Recommendation).

4b. Clinicians may administer nebulized hypertonic saline to infants and children hospitalized for bronchiolitis (Evidence Quality: B; Recommendation Strength: Weak Recommendation [based on randomized controlled trials with inconsistent findings]).

Shawn L. Ralston, MD, FAAP, Allan S. Lieberthal, MD, FAAP, H. Cody Meissner, MD, FAAP, Brian K. Alverson, MD, FAAP, Jill E. Baley, MD, FAAP, Anne M. Gadomski, MD, MPH, FAAP, David W. Johnson, MD, FAAP, Michael J. Light, MD, FAAP, Nizar F. Maraqa, MD, FAAP, Eneida A. Mendonca, MD, PhD, FAAP, FACMI, Kieran J. Phelan, MD, MSc, Joseph J. Zorc, MD, MSCE, FAAP, Danette Stanko-Lopp, MA, MPH, Mark A. Brown, MD, Ian Nathanson, MD, FAAP, Elizabeth Rosenblum, MD, Stephen Sayles III, MD, FACEP, and Sinsi Hernandez-Cancio, JD

KEY WORDS

bronchiolitis, infants, children, respiratory syncytial virus, evidence-based, guideline

ABBREVIATIONS

AAP—American Academy of Pediatrics
AOM—acute otitis media
CI—confidence interval
ED—emergency department
KAS—Key Action Statement
LOS—length of stay
MD—mean difference
PCR—polymerase chain reaction
RSV—respiratory syncytial virus
SBI—serious bacterial infection

Dedicated to the memory of Dr Caroline Breese Hall.

www.pediatrics.org/cgi/doi/10.1542/peds.2014-2742

doi:10.1542/peds.2014-2742

PEDIATRICS (ISSN Numbers: Print, 0031-4005; Online, 1098-4275).

5. Clinicians should not administer systemic corticosteroids to infants with a diagnosis of bronchiolitis in any setting (Evidence Quality: A; Recommendation Strength: Strong Recommendation).

6a. Clinicians may choose not to administer supplemental oxygen if the oxyhemoglobin saturation exceeds 90% in infants and children with a diagnosis of bronchiolitis (Evidence Quality: D; Recommendation Strength: Weak Recommendation [based on low level evidence and reasoning from first principles]).

6b. Clinicians may choose not to use continuous pulse oximetry for infants and children with a diagnosis of bronchiolitis (Evidence Quality: D; Recommendation Strength: Weak Recommendation [based on low-level evidence and reasoning from first principles]).

7. Clinicians should not use chest physiotherapy for infants and children with a diagnosis of bronchiolitis (Evidence Quality: B; Recommendation Strength: Moderate Recommendation).

8. Clinicians should not administer antibacterial medications to infants and children with a diagnosis of bronchiolitis unless there is a concomitant bacterial infection, or a strong suspicion of one (Evidence Quality: B; Recommendation Strength: Strong Recommendation).

9. Clinicians should administer nasogastric or intravenous fluids for infants with a diagnosis of bronchiolitis who cannot maintain hydration orally (Evidence Quality: X; Recommendation Strength: Strong Recommendation).

PREVENTION

10a. Clinicians should not administer palivizumab to otherwise healthy infants with a gestational age of 29 weeks, 0 days or greater (Evidence Quality: B; Recommendation Strength: Strong Recommendation).

10b. Clinicians should administer palivizumab during the first year of life to infants with hemodynamically significant heart disease or chronic lung disease of prematurity defined as preterm infants <32 weeks 0 days' gestation who require >21% oxygen for at least the first 28 days of life (Evidence Quality: B; Recommendation Strength: Moderate Recommendation).

10c. Clinicians should administer a maximum 5 monthly doses (15 mg/kg/dose) of palivizumab during the respiratory syncytial virus season to infants who qualify for palivizumab in the first year of life (Evidence Quality: B; Recommendation Strength: Moderate Recommendation).

11a. All people should disinfect hands before and after direct contact with patients, after contact with inanimate objects in the direct vicinity of the patient, and after removing gloves (Evidence Quality: B; Recommendation Strength: Strong Recommendation).

11b. All people should use alcohol-based rubs for hand decontamination when caring for children with bronchiolitis. When alcohol-based rubs are not available, individuals should wash their hands with soap and water (Evidence Quality: B; Recommendation Strength: Strong Recommendation).

12a. Clinicians should inquire about the exposure of the infant or child to tobacco smoke when assessing infants and children for bronchiolitis (Evidence Quality: C; Recommendation Strength: Moderate Recommendation).

12b. Clinicians should counsel caregivers about exposing the infant or child to environmental tobacco smoke and smoking cessation when assessing a child for bronchiolitis (Evidence Quality: B; Recommendation Strength: Strong).

13. Clinicians should encourage exclusive breastfeeding for at least 6 months to decrease the morbidity of respiratory infections. (Evidence Quality: B; Recommendation Strength: Moderate Recommendation).

14. Clinicians and nurses should educate personnel and family members on evidence-based diagnosis, treatment, and prevention in bronchiolitis. (Evidence Quality: C; observational studies; Recommendation Strength: Moderate Recommendation).

INTRODUCTION

In October 2006, the American Academy of Pediatrics (AAP) published the clinical practice guideline "Diagnosis and Management of Bronchiolitis."[1] The guideline offered recommendations ranked according to level of evidence and the benefit-harm relationship. Since completion of the original evidence review in July 2004, a significant body of literature on bronchiolitis has been published. This update of the 2006 AAP bronchiolitis guideline evaluates published evidence, including that used in the 2006 guideline as well as evidence published since 2004. Key action statements (KASs) based on that evidence are provided.

The goal of this guideline is to provide an evidence-based approach to the diagnosis, management, and prevention of bronchiolitis in children from 1 month through 23 months of age. The guideline is intended for pediatricians, family physicians, emergency medicine specialists, hospitalists, nurse practitioners,

and physician assistants who care for these children. The guideline does not apply to children with immunodeficiencies, including those with HIV infection or recipients of solid organ or hematopoietic stem cell transplants. Children with underlying respiratory illnesses, such as recurrent wheezing, chronic neonatal lung disease (also known as bronchopulmonary dysplasia), neuromuscular disease, or cystic fibrosis and those with hemodynamically significant congenital heart disease are excluded from the sections on management unless otherwise noted but are included in the discussion of prevention. This guideline will not address long-term sequelae of bronchiolitis, such as recurrent wheezing or risk of asthma, which is a field with a large and distinct literature.

Bronchiolitis is a disorder commonly caused by viral lower respiratory tract infection in infants. Bronchiolitis is characterized by acute inflammation, edema, and necrosis of epithelial cells lining small airways, and increased mucus production. Signs and symptoms typically begin with rhinitis and cough, which may progress to tachypnea, wheezing, rales, use of accessory muscles, and/or nasal flaring.[2]

Many viruses that infect the respiratory system cause a similar constellation of signs and symptoms. The most common etiology of bronchiolitis is respiratory syncytial virus (RSV), with the highest incidence of infection occurring between December and March in North America; however, regional variations occur[3] (Fig 1).[4] Ninety percent of children are infected with RSV in the first 2 years of life,[5] and up to 40% will experience lower respiratory tract infection during the initial infection.[6,7] Infection with RSV does not grant permanent or long-term immunity, with reinfections common throughout life.[8] Other viruses that cause bronchiolitis include human rhinovirus, human metapneumovirus, influenza, adenovirus, coronavirus, human, and parainfluenza viruses. In a study of inpatients and outpatients with bronchiolitis,[9] 76% of patients had RSV, 39% had human rhinovirus, 10% had influenza, 2% had coronavirus, 3% had human metapneumovirus, and 1% had parainfluenza viruses (some patients had coinfections, so the total is greater than 100%).

Bronchiolitis is the most common cause of hospitalization among infants during the first 12 months of life. Approximately 100 000 bronchiolitis admissions occur annually in the United States at an estimated cost of $1.73 billion.[10] One prospective, population-based study sponsored by the Centers for Disease Control and Prevention reported the average RSV hospitalization rate was 5.2 per 1000 children younger than 24 months of age during the 5-year period between 2000 and 2005.[11] The highest age-specific rate of RSV hospitalization occurred among infants between 30 days and 60 days of age (25.9 per 1000 children). For preterm infants (<37 weeks' gestation), the RSV hospitalization rate was 4.6 per 1000 children, a number similar to the RSV hospitalization rate for term infants of 5.2 per 1000. Infants born at <30 weeks' gestation had the highest hospitalization rate at 18.7 children per 1000, although the small number of infants born before 30 weeks' gestation make this number unreliable. Other studies indicate the RSV hospitalization rate in extremely

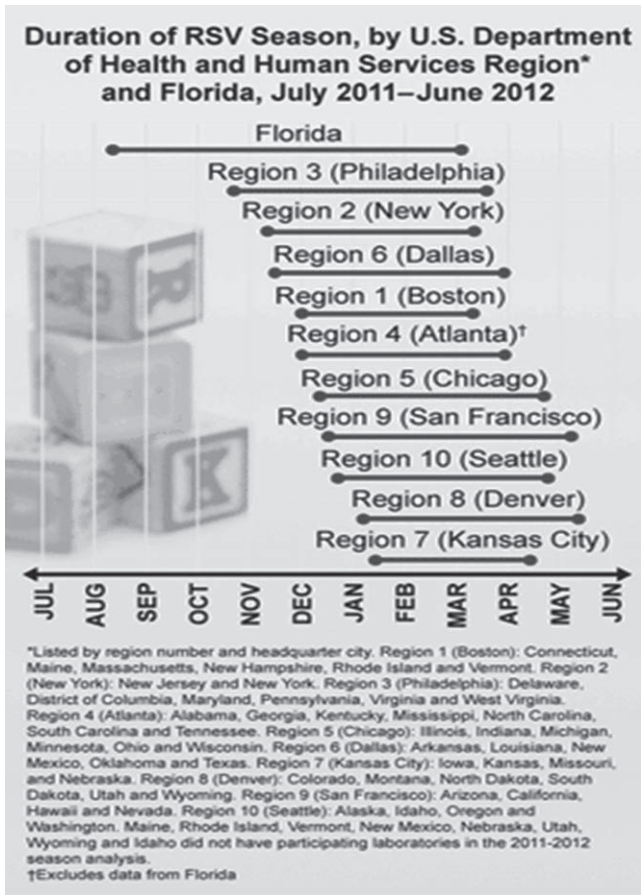


FIGURE 1
RSV season by US regions. Centers for Disease Control and Prevention. RSV activity—United States, July 2011–Jan 2013. *MMWR Morb Mortal Wkly Rep.* 2013;62(8):141–144.

preterm infants is similar to that of term infants.[12,13]

METHODS

In June 2013, the AAP convened a new subcommittee to review and revise the 2006 bronchiolitis guideline. The subcommittee included primary care physicians, including general pediatricians, a family physician, and pediatric subspecialists, including hospitalists, pulmonologists, emergency physicians, a neonatologist, and pediatric infectious disease physicians. The subcommittee also included an epidemiologist trained in systematic reviews, a guideline methodologist/informatician, and a parent representative. All panel members reviewed the AAP Policy on Conflict of Interest and Voluntary Disclosure and were given an opportunity to declare any potential conflicts. Any conflicts can be found in the author listing at the end of this guideline. All funding was provided by the AAP, with travel assistance from the American Academy of Family Physicians, the American College of Chest Physicians, the American Thoracic Society, and the American College of Emergency Physicians for their liaisons.

The evidence search and review included electronic database searches in *The Cochrane Library*, Medline via Ovid, and CINAHL via EBSCO. The search strategy is shown in the Appendix. Related article searches were conducted in PubMed. The bibliographies of articles identified by database searches were also reviewed by 1 of 4 members of the committee, and references identified in this manner were added to the review. Articles included in the 2003 evidence report on bronchiolitis in preparation of the AAP 2006 guideline2 also were reviewed. In addition, the committee reviewed articles published after completion of the systematic review for these updated guidelines. The current literature review encompasses the period from 2004 through May 2014.

The evidence-based approach to guideline development requires that the evidence in support of a policy be identified, appraised, and summarized and that an explicit link between evidence and recommendations be defined. Evidence-based recommendations reflect the quality of evidence and the balance of benefit and harm that is anticipated when the recommendation is followed. The AAP policy statement "Classifying Recommendations for Clinical Practice"[14] was followed in designating levels of recommendation (Fig 2; Table 1).

A draft version of this clinical practice guideline underwent extensive peer review by committees, councils, and sections within AAP; the American Thoracic Society, American College of Chest Physicians, American Academy of Family Physicians, and American College of Emergency Physicians; other outside organizations; and other individuals identified by the subcommittee as experts in the field. The resulting comments were reviewed by the subcommittee and, when appropriate, incorporated into the guideline.

This clinical practice guideline is not intended as a sole source of guidance in the management of children with bronchiolitis. Rather, it is intended to assist clinicians in decision-making. It is not intended to replace clinical judgment or establish a protocol for the care of all children with bronchiolitis. These recommendations may not provide the only appropriate approach to the management of children with bronchiolitis.

All AAP guidelines are reviewed every 5 years.

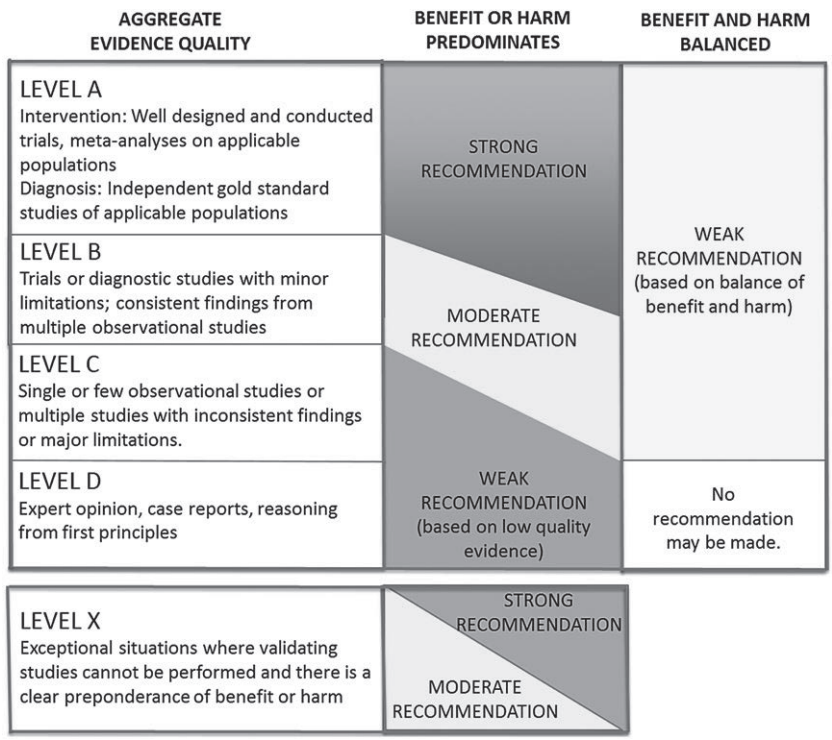


FIGURE 2
Integrating evidence quality appraisal with an assessment of the anticipated balance between benefits and harms leads to designation of a policy as a strong recommendation, moderate recommendation, or weak recommendation.

TABLE 1 Guideline Definitions for Evidence-Based Statements

Statement	Definition	Implication
Strong recommendation	A particular action is favored because anticipated benefits clearly exceed harms (or vice versa), and quality of evidence is excellent or unobtainable.	Clinicians should follow a strong recommendation unless a clear and compelling rationale for an alternative approach is present.
Moderate recommendation	A particular action is favored because anticipated benefits clearly exceed harms (or vice versa), and the quality of evidence is good but not excellent (or is unobtainable).	Clinicians would be prudent to follow a moderate recommendation but should remain alert to new information and sensitive to patient preferences.
Weak recommendation (based on low-quality evidence	A particular action is favored because anticipated benefits clearly exceed harms (or vice versa), but the quality of evidence is weak.	Clinicians would be prudent to follow a weak recommendation but should remain alert to new information and very sensitive to patient preferences.
Weak recommendation (based on balance of benefits and harms)	Weak recommendation is provided when the aggregate database shows evidence of both benefit and harm that appear similar in magnitude for any available courses of action	Clinicians should consider the options in their decision making, but patient preference may have a substantial role.

DIAGNOSIS

Key Action Statement 1a

Clinicians should diagnose bronchiolitis and assess disease severity on the basis of history and physical examination (Evidence Quality: B; Recommendation Strength: Strong Recommendation).

Action Statement Profile KAS 1a

Aggregate evidence quality	B
Benefits	Inexpensive, noninvasive, accurate
Risk, harm, cost	Missing other diagnoses
Benefit-harm assessment	Benefits outweigh harms
Value judgments	None
Intentional vagueness	None
Role of patient preferences	None
Exclusions	None
Strength	Strong recommendation
Differences of opinion	None

Key Action Statement 1b

Clinicians should assess risk factors for severe disease, such as age <12 weeks, a history of prematurity, underlying cardiopulmonary disease, or immunodeficiency, when making decisions about evaluation and management of children with bronchiolitis (Evidence Quality: B; Recommendation Strength: Moderate Recommendation).

Action Statement Profile KAS 1b

Aggregate evidence quality	B
Benefits	Improved ability to predict course of illness, appropriate disposition
Risk, harm, cost	Possible unnecessary hospitalization parental anxiety
Benefit-harm assessment	Benefits outweigh harms
Value judgments	None
Intentional vagueness	"Assess" is not defined
Role of patient preferences	None
Exclusions	None
Strength	Moderate recommendation
Differences of opinion	None

Key Action Statement 1c

When clinicians diagnose bronchiolitis on the basis of history and physical examination, radiographic or laboratory studies should not be obtained routinely (Evidence Quality: B; Recommendation Strength: Moderate Recommendation).

Action Statement Profile KAS 1b

Aggregate evidence quality	B
Benefits	Decreased radiation exposure, noninvasive (less procedure-associated discomfort), decreased antibiotic use, cost savings, time saving
Risk, harm, cost	Misdiagnosis, missed diagnosis of comorbid condition
Benefit-harm assessment	Benefits outweigh harms
Value judgments	None
Intentional vagueness	None
Role of patient preferences	None
Exclusions	Infants and children with unexpected worsening disease
Strength	Moderate recommendation
Differences of opinion	None

The main goals in the history and physical examination of infants presenting with wheeze or other lower respiratory tract symptoms, particularly in the winter season, is to differentiate infants with probable viral bronchiolitis from those with other disorders. In addition, an estimate of disease severity (increased respiratory rate, retractions, decreased oxygen saturation) should

be made. Most clinicians recognize bronchiolitis as a constellation of clinical signs and symptoms occurring in children younger than 2 years, including a viral upper respiratory tract prodrome followed by increased respiratory effort and wheezing. Clinical signs and symptoms of bronchiolitis consist of rhinorrhea, cough, tachypnea, wheezing, rales, and increased respiratory effort manifested as grunting, nasal flaring, and intercostal and/or subcostal retractions.

The course of bronchiolitis is variable and dynamic, ranging from transient events, such as apnea, to progressive respiratory distress from lower airway obstruction. Important issues to assess in the history include the effects of respiratory symptoms on mental status, feeding, and hydration. The clinician should assess the ability of the family to care for the child and to return for further evaluation if needed. History of underlying conditions, such as prematurity, cardiac disease, chronic pulmonary disease, immunodeficiency, or episodes of previous wheezing, should be identified. Underlying conditions that may be associated with an increased risk of progression to severe disease or mortality include hemodynamically significant congenital heart disease, chronic lung disease (bronchopulmonary dysplasia), congenital anomalies,[15–17] in utero smoke exposure,[18] and the presence of an immunocompromising state.[19,20] In addition, genetic abnormalities have been associated with more severe presentation with bronchiolitis.[21]

Assessment of a child with bronchiolitis, including the physical examination, can be complicated by variability in the disease state and may require serial observations over time to fully assess the child's status. Upper airway obstruction contributes to work of breathing. Suctioning and positioning may decrease the work of breathing and improve the quality of the examination. Respiratory rate in otherwise healthy children changes considerably over the first year of life.[22–25] In hospitalized children, the 50th percentile for respiratory rate decreased from 41 at 0 to 3 months of age to 31 at 12 to 18 months of age.[26] Counting respiratory rate over the course of 1 minute is more accurate than shorter observations.[27] The presence of a normal respiratory rate suggests that risk of significant viral or bacterial lower respiratory tract infection or pneumonia in an infant is low (negative likelihood ratio approximately 0.5),[27–29] but the presence of tachypnea does not distinguish between viral and bacterial disease.[30,31]

The evidence relating the presence of specific findings in the assessment of bronchiolitis to clinical outcomes is limited. Most studies addressing this issue have enrolled children when presenting to hospital settings, including a large, prospective, multicenter study that assessed a variety of outcomes from the emergency department (ED) and varied inpatient settings.[18,32,33] Severe adverse events, such as ICU admission and need for mechanical ventilation, are uncommon among children with bronchiolitis and limit the power of these studies to detect clinically important risk factors associated with disease progression.[16,34,35] Tachypnea, defined as a respiratory rate $\geq$70 per minute, has been associated with increased risk of severe disease in some studies[35–37] but not others.[38] Many scoring systems have been developed in an attempt to objectively quantify respiratory distress, although none has achieved widespread acceptance and few have demonstrated any predictive validity, likely because of the substantial temporal variability in physical findings in infants with bronchiolitis.[39]

Pulse oximetry has been rapidly adopted into clinical assessment of children with bronchiolitis on the basis of data suggesting that it reliably detects hypoxemia not suspected on physical examination[36,40]; however, few studies have assessed the effectiveness of pulse oximetry to predict clinical outcomes. Among inpatients, perceived need for supplemental oxygen on the basis of pulse oximetry has been associated with prolonged hospitalization, ICU admission, and mechanical ventilation.[16,34,41] Among outpatients, available evidence differs on whether mild reductions in pulse oximetry (<95% on room air) predict progression of disease or need for a return observational visit.[38]

Apnea has been reported to occur with a wide range of prevalence estimates and viral etiologies.[42,43] Retrospective, hospital-based studies have included a high proportion of infants with risk factors, such as prematurity or neuromuscular disease, that may have biased the prevalence estimates. One large study found no apnea events for infants assessed as low risk by using several risk factors: age >1 month for full-term infants or 48 weeks' postconceptional age for preterm infants, and absence of any previous apneic event at presentation to the hospital.[44] Another large multicenter study found no association between the specific viral agent and risk of apnea in bronchiolitis.[42]

The literature on viral testing for bronchiolitis has expanded in recent years with the availability of sensitive polymerase chain reaction (PCR) assays. Large studies of infants hospitalized for bronchiolitis have consistently found that 60% to 75% have positive test results for RSV, and have noted coinfections in up to one-third of infants.[32,33,45] In the event an infant receiving monthly prophylaxis is hospitalized with bronchiolitis, testing should be performed to determine if RSV is the etiologic agent. If a breakthrough RSV infection is determined to be present based on antigen detection or other

assay, monthly palivizumab prophylaxis should be discontinued because of the very low likelihood of a second RSV infection in the same year. Apart from this setting, routine virologic testing is not recommended.

Infants with non-RSV bronchiolitis, in particular human rhinovirus, appear to have a shorter courses and may represent a different phenotype associated with repeated wheezing.[32] PCR assay results should be interpreted cautiously, given that the assay may detect prolonged viral shedding from an unrelated previous illness, particularly with rhinovirus. In contrast, RSV detected by PCR assay almost always is associated with disease. At the individual patient level, the value of identifying a specific viral etiology causing bronchiolitis has not been demonstrated.[33]

Current evidence does not support routine chest radiography in children with bronchiolitis. Although many infants with bronchiolitis have abnormalities on chest radiography, data are insufficient to demonstrate that chest radiography correlates well with disease severity. Atelectasis on chest radiography was associated with increased risk of severe disease in 1 outpatient study.[16] Further studies, including 1 randomized trial, suggest children with suspected lower respiratory tract infection who had radiography performed were more likely to receive antibiotics without any difference in outcomes.[46,47] Initial radiography should be reserved for cases in which respiratory effort is severe enough to warrant ICU admission or where signs of an airway complication (such as pneumothorax) are present.

TREATMENT

ALBUTEROL

Key Action Statement 2

Clinicians should not administer albuterol (or salbutamol) to infants and children with a diagnosis of bronchiolitis (Evidence Quality: B; Recommendation Strength: Strong Recommendation).

Action Statement Profile KAS 2

Aggregate evidence quality	B
Benefits	Avoid adverse effects, avoid ongoing use of ineffective medication, lower costs
Risk, harm, cost	Missing transient benefit of drug
Benefit-harm assessment	Benefits outweigh harms
Value judgments	Overall ineffectiveness outweighs possible transient benefit
Intentional vagueness	None
Role of patient preferences	None
Exclusions	None
Strength	Strong recommendation
Differences of opinion	None
Notes	This guideline no longer recommends a trial of albuterol, as was considered in the 2006 AAP bronchiolitis guideline

Although several studies and reviews have evaluated the use of bronchodilator medications for viral bronchiolitis, most randomized controlled trials have failed to demonstrate a consistent benefit from α- or β-adrenergic agents. Several meta-analyses and systematic reviews[48–53] have shown that bronchodilators may improve clinical symptom scores, but they do not affect disease resolution, need for hospitalization, or length of stay (LOS). Because clinical scores may vary from one observer to the next[39,54] and do not correlate with more objective measures, such as pulmonary function tests,[55] clinical scores are not validated measures of the efficacy of bronchodilators. Although transient improvements in clinical score have been observed, most infants treated with bronchodilators will not benefit from their use.

A recently updated Cochrane systematic review assessing the impact of bronchodilators on oxygen saturation, the primary outcome measure, reported 30 randomized controlled trials involving 1992 infants in 12 countries.[56] Some studies included in this review evaluated agents other than albuterol/salbutamol (eg, ipratropium and metaproterenol) but did not include epinephrine. Small sample sizes, lack of standardized methods for outcome evaluation (eg, timing of assessments), and lack of standardized intervention (various bronchodilators, drug dosages, routes of administration, and nebulization delivery systems) limit the interpretation of these studies. Because of variable study designs as well as the inclusion of infants who had a history of previous wheezing in some studies, there was considerable heterogeneity in the studies. Sensitivity analysis (ie, including only studies at low risk of bias) significantly reduced heterogeneity measures for oximetry while having little effect on the overall effect size of oximetry (mean difference [MD] –0.38, 95% confidence interval [CI] –0.75 to 0.00). Those studies showing benefit[57–59] are methodologically weaker than other studies and include older children with recurrent wheezing. Results of the Cochrane review indicated no benefit in the clinical course of infants with bronchiolitis who received bronchodilators. The potential adverse effects (tachycardia and tremors) and cost of these agents outweigh any potential benefits.

In the previous iteration of this guideline, a trial of β-agonists was included as an option. However, given the greater strength of the evidence demonstrating no benefit, and that there is no well-established way to determine an "objective method of response" to bronchodilators in bronchiolitis, this option has been removed. Although it is true that a small subset of children

with bronchiolitis may have reversible airway obstruction resulting from smooth muscle constriction, attempts to define a subgroup of responders have not been successful to date. If a clinical trial of bronchodilators is undertaken, clinicians should note that the variability of the disease process, the host's airway, and the clinical assessments, particularly scoring, would limit the clinician's ability to observe a clinically relevant response to bronchodilators.

Chavasse et al[60] reviewed the available literature on use of β-agonists for children younger than 2 years with recurrent wheezing. At the time of that review, there were 3 studies in the outpatient setting, 2 in the ED, and 3 in the pulmonary function laboratory setting. This review concluded there were no clear benefits from the use of β-agonists in this population. The authors noted some conflicting evidence, but further study was recommended only if the population could be clearly defined and meaningful outcome measures could be identified.

The population of children with bronchiolitis studied in most trials of bronchodilators limits the ability to make recommendations for all clinical scenarios. Children with severe disease or with respiratory failure were generally excluded from these trials, and this evidence cannot be generalized to these situations. Studies using pulmonary function tests show no effect of albuterol among infants hospitalized with bronchiolitis.[56,61] One study in a critical care setting showed a small decrease in inspiratory resistance after albuterol in one group and levalbuterol in another group, but therapy was accompanied by clinically significant tachycardia.[62] This small clinical change occurring with significant adverse effects does not justify recommending albuterol for routine care.

EPINEPHRINE

Key Action Statement 3

Clinicians should not administer epinephrine to infants and children with a diagnosis of bronchiolitis (Evidence Quality: B; Recommendation Strength: Strong Recommendation).

Action Statement Profile KAS 3

Aggregate evidence quality	B
Benefits	Avoiding adverse effects, lower costs, avoiding ongoing use of ineffective medication
Risk, harm, cost	Missing transient benefit of drug
Benefit-harm assessment	Benefits outweigh harms
Value judgments	The overall ineffectiveness outweighs possible transient benefit
Intentional vagueness	None
Role of patient preferences	None
Exclusions	Rescue treatment of rapidly deteriorating patients
Strength	Strong recommendation
Differences of opinion	None

Epinephrine is an adrenergic agent with both β- and α-receptor agonist activity that has been used to treat upper and lower respiratory tract illnesses both as a systemic agent and directly into the respiratory tract, where it is typically administered as a nebulized solution. Nebulized epinephrine has been administered in the racemic form and as the purified L-enantiomer, which is commercially available in the United States for intravenous use. Studies in other diseases, such as croup, have found no difference in efficacy on the basis of preparation,[63] although the comparison has not been specifically studied for bronchiolitis. Most studies have compared L-epinephrine to placebo or albuterol. A recent Cochrane meta-analysis by Hartling et al[64] systematically evaluated the evidence on this topic and found no evidence for utility in the inpatient setting. Two large, multicenter randomized trials comparing nebulized epinephrine to placebo[65] or albuterol[66] in the hospital setting found no improvement in LOS or other inpatient outcomes. A recent, large multicenter trial found a similar lack of efficacy compared with placebo and further demonstrated longer LOS when epinephrine was used on a fixed schedule compared with an as-needed schedule.[67] This evidence suggests epinephrine should not be used in children hospitalized for bronchiolitis, except potentially as a rescue agent in severe disease, although formal study is needed before a recommendation for the use of epinephrine in this setting.

The role of epinephrine in the outpatient setting remains controversial. A major addition to the evidence base came from the Canadian Bronchiolitis Epinephrine Steroid Trial.[68] This multicenter randomized trial enrolled 800 patients with bronchiolitis from 8 EDs and compared hospitalization rates over a 7-day period. This study had 4 arms: nebulized epinephrine plus oral dexamethasone, nebulized epinephrine plus oral placebo, nebulized placebo plus oral dexamethasone, and nebulized placebo plus oral placebo. The group of patients who received epinephrine concomitantly with corticosteroids had a lower likelihood of hospitalization by day 7 than the double placebo group, although this effect was no longer statistically significant after adjusting for multiple comparisons.

The systematic review by Hartling et al[64] concluded that epinephrine reduced hospitalizations compared with placebo on the day of the ED visit but not overall. Given that epinephrine

has a transient effect and home administration is not routine practice, discharging an infant after observing a response in a monitored setting raises concerns for subsequent progression of illness. Studies have not found a difference in revisit rates, although the numbers of revisits are small and may not be adequately powered for this outcome. In summary, the current state of evidence does not support a routine role for epinephrine for bronchiolitis in outpatients, although further data may help to better define this question.

HYPERTONIC SALINE

Key Action Statement 4a

Nebulized hypertonic saline should not be administered to infants with a diagnosis of bronchiolitis in the emergency department (Evidence Quality: B; Recommendation Strength: Moderate Recommendation).

Action Statement Profile KAS 4a

Aggregate evidence quality	B
Benefits	Avoiding adverse effects, such as wheezing and excess secretions, cost
Risk, harm, cost	None
Benefit-harm assessment	Benefits outweigh harms
Value judgments	None
Intentional vagueness	None
Role of patient preferences	None
Exclusions	None
Strength	Moderate recommendation
Differences of opinion	None

Key Action Statement 4b

Clinicians may administer nebulized hypertonic saline to infants and children hospitalized for bronchiolitis (Evidence Quality: B; Recommendation Strength: Weak Recommendation [based on randomized controlled trials with inconsistent findings]).

Action Statement Profile KAS 4b

Aggregate evidence quality	B
Benefits	May shorten hospital stay if LOS is >72 h
Risk, harm, cost	Adverse effects such as wheezing and excess secretions; cost
Benefit-harm assessment	Benefits outweigh harms for longer hospital stays
Value judgments	Anticipating an individual child's LOS is difficult. Most US hospitals report an average LOS of <72 h for patients with bronchiolitis. This weak recommendation applies only if the average length of stay is >72 h
Intentional vagueness	This weak recommendation is based on an average LOS and does not address the individual patient.
Role of patient preferences	None
Exclusions	None
Strength	Weak
Differences of opinion	None

Nebulized hypertonic saline is an increasingly studied therapy for acute viral bronchiolitis. Physiologic evidence suggests that hypertonic saline increases mucociliary clearance in both normal and diseased lungs.[69–71] Because the pathology in bronchiolitis involves airway inflammation and resultant mucus plugging, improved mucociliary clearance should be beneficial, although there is only indirect evidence to support such an assertion. A more specific theoretical mechanism of action has been proposed on the basis of the concept of rehydration of the airway surface liquid, although again, evidence remains indirect.[72]

A 2013 Cochrane review[73] included 11 trials involving 1090 infants with mild to moderate disease in both inpatient and emergency settings. There were 6 studies involving 500 inpatients providing data for the analysis of LOS with an aggregate 1-day decrease reported, a result largely driven by the inclusion of 3 studies with relatively long mean length of stay of 5 to 6 days. The analysis of effect on clinical scores included 7 studies involving 640 patients in both inpatient and outpatient settings and demonstrated incremental positive effect with each day posttreatment from day 1 to day 3 (–0.88 MD on day 1, –1.32 MD on day 2, and –1.51 MD on day 3). Finally, Zhang et al[73] found no effect on hospitalization rates in the pooled analysis of 1 outpatient and 3 ED studies including 380 total patients.

Several randomized trials published after the Cochrane review period further informed the current guideline recommendation. Four trials evaluated admission rates from the ED, 3 using 3% saline and 1 using 7% saline.[74–76] A single trial[76] demonstrated a difference in admission rates from the ED favoring hypertonic saline, although the other 4 studies were concordant with the studies included in the Cochrane review. However, contrary to the studies included in the Cochrane review, none of the more recent trials reported improvement in LOS and, when added to the older studies for an updated meta-analysis, they significantly attenuate the summary estimate of the effect on LOS.[76,77] Most of the trials included in the Cochrane review occurred in settings with typical LOS of more than 3 days in their usual care arms. Hence, the significant decrease in LOS noted by Zhang et al[73] may not be generalizable to the United States where the average LOS is 2.4 days.[10] One other ongoing clinical trial performed in the United States, unpublished except in abstract form, further supports the observation that hypertonic saline does not decrease LOS in settings where expected stays are less than 3 days.[78]

The preponderance of the evidence suggests that 3% saline is safe and effective at improving symptoms of mild to moderate bronchiolitis after 24 hours of use and reducing hospital LOS in settings in which

the duration of stay typically exceeds 3 days. It has not been shown to be effective at reducing hospitalization in emergency settings or in areas where the length of usage is brief. It has not been studied in intensive care settings, and most trials have included only patients with mild to moderate disease. Most studies have used a 3% saline concentration, and most have combined it with bronchodilators with each dose; however, there is retrospective evidence that the rate of adverse events is similar without bronchodilators,[79] as well as prospective evidence extrapolated from 2 trials without bronchodilators.[79,80] A single study was performed in the ambulatory outpatient setting[81]; however, future studies in the United States should focus on sustained usage on the basis of pattern of effects discerned in the available literature.

CORTICOSTEROIDS

Key Action Statement 5

Clinicians should not administer systemic corticosteroids to infants with a diagnosis of bronchiolitis in any setting (Evidence Quality: A; Recommendation Strength: Strong Recommendation).

Action Statement Profile KAS 5

Aggregate evidence quality	A
Benefits	No clinical benefit, avoiding adverse effects
Risk, harm, cost	None
Benefit-harm assessment	Benefits outweigh harms
Value judgments	None
Intentional vagueness	None
Role of patient preferences	None
Exclusions	None
Strength	Strong recommendation
Differences of opinion	None

Although there is good evidence of benefit from corticosteroids in other respiratory diseases, such as asthma and croup,[82–84] the evidence on corticosteroid use in bronchiolitis is negative. The most recent Cochrane systematic review shows that corticosteroids do not significantly reduce outpatient admissions when compared with placebo (pooled risk ratio, 0.92; 95% CI, 0.78 to 1.08; and risk ratio, 0.86; 95% CI, 0.7 to 1.06, respectively) and do not reduce LOS for inpatients (MD –0.18 days; 95% CI –0.39 to 0.04).[85] No other comparisons showed relevant differences for either primary or secondary outcomes. This review contained 17 trials with 2596 participants and included 2 large ED-based randomized trials, neither of which showed reductions in hospital admissions with treatment with corticosteroids as compared with placebo.[69,86]

One of these large trials, the Canadian Bronchiolitis Epinephrine Steroid Trial, however, did show a reduction in hospitalizations 7 days after treatment with combined nebulized epinephrine and oral dexamethasone as compared with placebo.[69] Although an unadjusted analysis showed a relative risk for hospitalization of 0.65 (95% CI 0.45 to 0.95; $P = .02$) for combination therapy as compared with placebo, adjustment for multiple comparison rendered the result insignificant ($P = .07$). These results have generated considerable controversy.[87] Although there is no standard recognized rationale for why combination epinephrine and dexamethasone would be synergistic in infants with bronchiolitis, evidence in adults and children older than 6 years with asthma shows that adding inhaled long-acting β agonists to moderate/high doses of inhaled corticosteroids allows reduction of the corticosteroid dose by, on average, 60%.[88] Basic science studies focused on understanding the interaction between β agonists and corticosteroids have shown potential mechanisms for why simultaneous administration of these drugs could be synergistic.[89–92] However, other bronchiolitis trials of corticosteroids administered by using fixed simultaneous bronchodilator regimens have not consistently shown benefit[93–97]; hence, a recommendation regarding the benefit of combined dexamethasone and epinephrine therapy is premature.

The systematic review of corticosteroids in children with bronchiolitis cited previously did not find any differences in short-term adverse events as compared with placebo.[86] However, corticosteroid therapy may prolong viral shedding in patients with bronchiolitis.[17]

In summary, a comprehensive systematic review and large multicenter randomized trials provide clear evidence that corticosteroids alone do not provide significant benefit to children with bronchiolitis. Evidence for potential benefit of combined corticosteroid and agents with both α- and β-agonist activity is at best tentative, and additional large trials are needed to clarify whether this therapy is effective.

Further, although there is no evidence of short-term adverse effects from corticosteroid therapy, other than prolonged viral shedding, in infants and children with bronchiolitis, there is inadequate evidence to be certain of safety.

OXYGEN

Key Action Statement 6a

Clinicians may choose not to administer supplemental oxygen if the oxyhemoglobin saturation exceeds 90% in infants and children with a diagnosis of bronchiolitis (Evidence Quality: D; Recommendation Strength: Weak Recommendation [based on low-level evidence and reasoning from first principles]).

Action Statement Profile KAS 6a

Benefits	Decreased hospitalizations, decreased LOS
Risk, harm, cost	Hypoxemia, physiologic stress, prolonged LOS, increased hospitalizations, increased LOS, cost
Benefit-harm assessment	Benefits outweigh harms
Value judgments	Oxyhemoglobin saturation >89% is adequate to oxygenate tissues; the risk of hypoxemia with oxyhemoglobin saturation >89% is minimal
Intentional vagueness	None
Role of patient preferences	Limited
Exclusions	Children with acidosis or fever
Strength	Weak recommendation (based on low-level evidence/ reasoning from first principles)
Differences of opinion	None

Key Action Statement 6b

Clinicians may choose not to use continuous pulse oximetry for infants and children with a diagnosis of bronchiolitis (Evidence Quality: C; Recommendation Strength: Weak Recommendation [based on lower-level evidence]).

Action Statement Profile KAS 6b

Aggregate evidence quality	C
Benefits	Shorter LOS, decreased alarm fatigue, decreased cost
Risk, harm, cost	Delayed detection of hypoxemia, delay in appropriate weaning of oxygen
Benefit-harm assessment	Benefits outweigh harms
Value judgments	None
Intentional vagueness	None
Role of patient preferences	Limited
Exclusions	None
Strength	Weak recommendation (based on lower level of evidence)
Differences of opinion	None

Although oxygen saturation is a poor predictor of respiratory distress, it is associated closely with a perceived need for hospitalization in infants with bronchiolitis.[98,99] Additionally, oxygen saturation has been implicated as a primary determinant of LOS in bronchiolitis.[40,100,101]

Physiologic data based on the oxyhemoglobin dissociation curve (Fig 3) demonstrate that small increases in arterial partial pressure of oxygen are associated with marked improvement in pulse oxygen saturation when the latter is less than 90%; with pulse oxygen saturation readings greater than 90% it takes very large elevations in arterial partial pressure of oxygen to affect further increases. In infants and children with bronchiolitis, no data exist to suggest such increases result in any clinically significant difference in physiologic function, patient symptoms, or clinical outcomes. Although it is well understood that acidosis, temperature, and 2,3-diphosphoglutarate influence the oxyhemoglobin dissociation curve, there has never been research to demonstrate how those influences practically affect infants with hypoxemia. The risk of hypoxemia must be weighed against the risk of hospitalization when making any decisions about site of care. One study of hospitalized children with bronchiolitis, for example, noted a 10% adverse error or near-miss rate for harm-causing interventions.[103] There are no studies on the effect of short-term, brief periods of hypoxemia such as may be seen in bronchiolitis. Transient hypoxemia is common in healthy infants.[104] Travel of healthy children even to moderate altitudes of 1300 m results in transient sleep desaturation to an average of 84% with no known adverse consequences.[105] Although children with chronic hypoxemia do incur developmental and behavioral problems, children who suffer intermittent hypoxemia from diseases such as asthma do not have impaired intellectual abilities or behavioral disturbance.[106–108]

Supplemental oxygen provided for infants not requiring additional respiratory support is best initiated with nasal prongs, although exact measurement of fraction of inspired oxygen is unreliable with this method.[109]

Pulse oximetry is a convenient method to assess the percentage of hemoglobin bound by oxygen in children. Pulse oximetry has been erroneously used in bronchiolitis as a proxy for respiratory distress. Accuracy of pulse oximetry is poor, especially in the 76% to 90% range.[110] Further, it has been well demonstrated that oxygen saturation has much less impact on respiratory drive than carbon dioxide concentrations in the blood.[111] There is very poor correlation between respiratory distress and oxygen saturations among infants with lower respiratory tract infections.[112] Other than cyanosis, no published clinical sign, model, or score accurately identifies hypoxemic children.[113]

Among children admitted for bronchiolitis, continuous pulse oximetry measurement is not well studied and potentially problematic for children who do not require oxygen. Transient desaturation is a normal phenomenon in healthy infants. In 1 study of 64 healthy infants between 2 weeks and 6 months of age, 60% of these infants exhibited a transient oxygen desaturation below 90%, to values as low as 83%.[105] A retrospective study of the role of continuous measurement of oxygenation in infants hospitalized with bronchiolitis found that 1 in 4 patients incur unnecessarily prolonged hospitalization as a result of a perceived need for oxygen outside of other symptoms[40] and no evidence of benefit was found.

Pulse oximetry is prone to errors of measurement. Families of infants hospitalized with continuous pulse oximeters are exposed to frequent alarms that

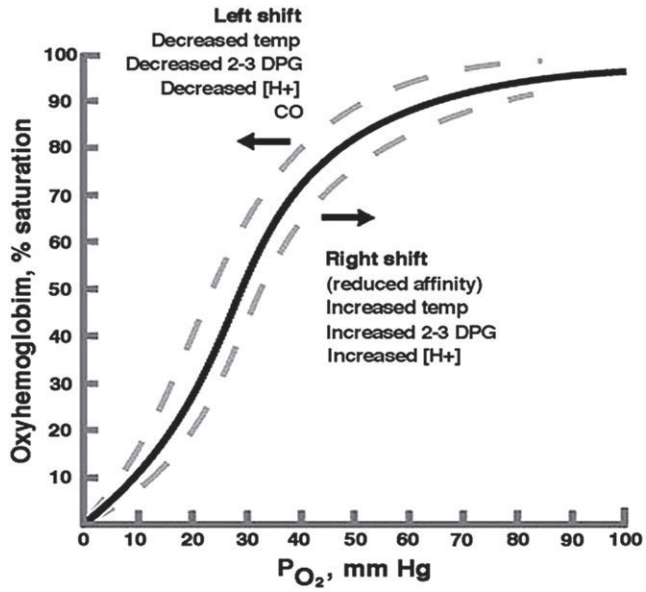


FIGURE 3
Oxyhemoglobin dissociation curve showing percent saturation of hemoglobin at various partial pressures of oxygen (reproduced with permission from the educational Web site www.anaesthesiauk.com).[102]

may negatively affect sleep. Alarm fatigue is recognized by The Joint Commission as a contributor toward in-hospital morbidity and mortality.[114] One adult study demonstrated very poor documentation of hypoxemia alerts by pulse oximetry, an indicator of alarm fatigue.[115] Pulse oximetry probes can fall off easily, leading to inaccurate measurements and alarms.[116] False reliance on pulse oximetry may lead to less careful monitoring of respiratory status. In one study, continuous pulse oximetry was associated with increased risk of minor adverse events in infants admitted to a general ward.[117] The pulse oximetry–monitored patients were found to have less-effective surveillance of their severity of illness when controlling for other variables.

There are a number of new approaches to oxygen delivery in bronchiolitis, 2 of which are home oxygen and high-frequency nasal cannula. There is emerging evidence for the role of home oxygen in reducing LOS or admission rate for infants with bronchiolitis, including 2 randomized trials.[118,119] Most of the studies have been performed in areas of higher altitude, where prolonged hypoxemia is a prime determinant of LOS in the hospital.[120,121] Readmission rates may be moderately higher in patients discharged with home oxygen; however, overall hospital use may be reduced,[122] although not in all settings.[123] Concerns have been raised that home pulse oximetry may complicate care or confuse families.[124] Communication with follow-up physicians is important, because primary care physicians may have difficulty determining safe pulse oximetry levels for discontinuation of oxygen.[125] Additionally, there may be an increased demand for follow-up outpatient visits associated with home oxygen use.[124]

Use of humidified, heated, high-flow nasal cannula to deliver air-oxygen mixtures provides assistance to infants with bronchiolitis through multiple proposed mechanisms.[126] There is evidence that high-flow nasal cannula improves physiologic measures of respiratory effort and can generate continuous positive airway pressure in bronchiolitis.[127–130] Clinical evidence suggests it reduces work of breathing[131,132] and may decrease need for intubation,[133–136] although studies are generally retrospective and small. The therapy has been studied in the ED[136,137] and the general inpatient setting,[134,138] as well as the ICU. The largest and most rigorous retrospective study to date was from Australia,[138] which showed a decline in intubation rate in the subgroup of infants with bronchiolitis (n = 330) from 37% to 7% after the introduction of high-flow nasal cannula, while the national registry intubation rate remained at 28%. A single pilot for a randomized trial has been published to date.[139] Although promising, the absence of any completed randomized trial of the efficacy of high-flow nasal cannula in bronchiolitis precludes specific recommendations on it use at present. Pneumothorax is a reported complication.

CHEST PHYSIOTHERAPY

Key Action Statement 7

Clinicians should not use chest physiotherapy for infants and children with a diagnosis of bronchiolitis (Evidence Quality: B; Recommendation Strength: Moderate Recommendation).

Action Statement Profile KAS 7

Aggregate evidence quality	B
Benefits	Decreased stress from therapy, reduced cost
Risk, harm, cost	None
Benefit-harm assessment	Benefits outweigh harms
Value judgments	None
Intentional vagueness	None
Role of patient preferences	None
Exclusions	None
Strength	Moderate recommendation
Differences of opinion	None

Airway edema, sloughing of respiratory epithelium into airways, and generalized hyperinflation of the lungs, coupled with poorly developed collateral ventilation, put infants with bronchiolitis at risk for atelectasis. Although lobar atelectasis is not characteristic of this disease, chest radiographs may show evidence of subsegmental atelectasis, prompting clinicians to consider ordering chest physiotherapy to promote airway clearance. A Cochrane Review[140] found 9 randomized controlled trials that evaluated chest physiotherapy in hospitalized patients with bronchiolitis. No clinical benefit was found by using vibration or percussion (5 trials)[141–144] or passive expiratory techniques (4 trials).[145–148] Since that review, a study[149] of the passive expiratory technique found a small, but significant reduction in duration of oxygen therapy, but no other benefits.

Suctioning of the nasopharynx to remove secretions is a frequent practice in infants with bronchiolitis. Although suctioning the nares may provide temporary relief of nasal congestion or upper airway obstruction, a retrospective study reported that deep suctioning[150] was associated with longer LOS in hospitalized infants 2 to 12 months of age. The same study also noted that lapses of greater than 4 hours in noninvasive, external nasal suctioning were also associated with longer LOS. Currently, there are insufficient data to make a recommendation about suctioning, but it appears that routine use of "deep" suctioning[151,153] may not be beneficial.

ANTIBACTERIALS

Key Action Statement 8

Clinicians should not administer antibacterial medications to infants and children with a diagnosis of bronchiolitis unless there is a concomitant bacterial infection, or a strong suspicion of one. (Evidence Quality: B; Recommendation Strength: Strong Recommendation).

Action Statement Profile KAS 8

Aggregate evidence quality	B
Benefits	Fewer adverse effects, less resistance to antibacterial agents, lower cost
Risk, harm, cost	None
Benefit-harm assessment	Benefits outweigh harms
Value judgments	None
Intentional vagueness	Strong suspicion is not specifically defined and requires clinician judgment. An evaluation for the source of possible serious bacterial infection should be completed before antibiotic use
Role of patient preferences	None
Exclusions	None
Strength	Strong recommendation
Differences of opinion	None

Infants with bronchiolitis frequently receive antibacterial therapy because of fever,[152] young age,[153] and concern for secondary bacterial infection.[154] Early randomized controlled trials[155,156] showed no benefit from routine antibacterial therapy for children with bronchiolitis. Nonetheless, antibiotic therapy continues to be overused in young infants with bronchiolitis because of concern for an undetected bacterial infection. Studies have shown that febrile infants without an identifiable source of fever have a risk of bacteremia that may be as high as 7%. However, a child with a distinct viral syndrome, such as bronchiolitis, has a lower risk (much less than 1%) of bacterial infection of the cerebrospinal fluid or blood.[157]

Ralston et al[158] conducted a systematic review of serious bacterial infections (SBIs) occurring in hospitalized febrile infants between 30 and 90 days of age with bronchiolitis. Instances of bacteremia or meningitis were extremely rare. Enteritis was not evaluated. Urinary tract infection occurred at a rate of approximately 1%, but asymptomatic bacteriuria may have explained this finding. The authors concluded routine screening for SBI among hospitalized febrile infants with bronchiolitis between 30 and 90 days of age is not justified. Limited data suggest the risk of bacterial infection in hospitalized infants with bronchiolitis younger than 30 days of age is similar to the risk in older infants. An abnormal white blood cell count is not useful for predicting a concurrent SBI in infants and young children hospitalized with RSV lower respiratory tract infection.[159] Several retrospective studies support this conclusion.[160–166] Four prospective studies of SBI in patients with bronchiolitis and/or RSV infections also demonstrated low rates of SBI.[167–171]

Approximately 25% of hospitalized infants with bronchiolitis have radiographic evidence of atelectasis, and it may be difficult to distinguish between atelectasis and bacterial infiltrate or consolidation.[169] Bacterial pneumonia in infants with bronchiolitis without consolidation is unusual.[170] Antibiotic therapy may be justified in some children with bronchiolitis who require intubation and mechanical ventilation for respiratory failure.[172,173]

Although acute otitis media (AOM) in infants with bronchiolitis may be attributable to viruses, clinical features generally do not permit differentiation of viral AOM from those with a bacterial component.[174] Two studies address the frequency of AOM in patients with bronchiolitis. Andrade et al[175] prospectively identified AOM in 62% of 42 patients who presented with bronchiolitis. AOM was present in 50% on entry to the study and developed in an additional 12% within 10 days. A subsequent report[176] followed 150 children hospitalized for bronchiolitis for the development of AOM. Seventy-nine (53%) developed AOM, two-thirds within the

first 2 days of hospitalization. AOM did not influence the clinical course or laboratory findings of bronchiolitis. The current AAP guideline on AOM[177] recommends that a diagnosis of AOM should include bulging of the tympanic membrane. This is based on bulging being the best indicator for the presence of bacteria in multiple tympanocentesis studies and on 2 articles comparing antibiotic to placebo therapy that used a bulging tympanic membrane as a necessary part of the diagnosis.[178,179] New studies are needed to determine the incidence of AOM in bronchiolitis by using the new criterion of bulging of the tympanic membrane. Refer to the AOM guideline[180] for recommendations regarding the management of AOM.

NUTRITION AND HYDRATION

Key Action Statement 9

Clinicians should administer nasogastric or intravenous fluids for infants with a diagnosis of bronchiolitis who cannot maintain hydration orally (Evidence Quality: X; Recommendation Strength: Strong Recommendation).

Action Statement Profile KAS 9

Aggregate evidence quality	X
Benefits	Maintaining hydration
Risk, harm, cost	Risk of infection, risk of aspiration with nasogastric tube, discomfort, hyponatremia, intravenous infiltration, overhydration
Benefit-harm assessment	Benefits outweigh harms
Value judgments	None
Intentional vagueness	None
Role of patient preferences	Shared decision as to which mode is used
Exclusions	None
Strength	Strong recommendation
Differences of opinion	None

The level of respiratory distress attributable to bronchiolitis guides the indications for fluid replacement. Conversely, food intake in the previous 24 hours may be a predictor of oxygen saturation among infants with bronchiolitis. One study found that food intake at less than 50% of normal for the previous 24 hours is associated with a pulse oximetry value of <95%.[180] Infants with mild respiratory distress may require only observation, particularly if feeding remains unaffected. When the respiratory rate exceeds 60 to 70 breaths per minute, feeding may be compromised, particularly if nasal secretions are copious. There is limited evidence to suggest coordination of breathing with swallowing may be impaired among infants with bronchiolitis.[181] These infants may develop increased nasal flaring, retractions, and prolonged expiratory wheezing when fed and may be at increased risk of aspiration.[182]

One study estimated that one-third of infants hospitalized for bronchiolitis require fluid replacement.[183] One case series[184] and 2 randomized trials,[185,186] examined the comparative efficacy and safety of the intravenous and nasogastric routes for fluid replacement. A pilot trial in Israel that included 51 infants younger than 6 months demonstrated no significant differences in the duration of oxygen needed or time to full oral feeds between infants receiving intravenous 5% dextrose in normal saline solution or nasogastric breast milk or formula.[187] Infants in the intravenous group had a shorter LOS (100 vs 120 hours) but it was not statistically significant. In a larger open randomized trial including infants between 2 and 12 months of age and conducted in Australia and New Zealand, there were no significant differences in rates of admission to ICUs, need for ventilatory support, and adverse events between 381 infants assigned to nasogastric hydration and 378 infants assigned to intravenous hydration.[188] There was a difference of 4 hours in mean LOS between the intravenous group (82.2 hours) and the nasogastric group (86.2 hours) that was not statistically significant. The nasogastric route had a higher success rate of insertion than the intravenous route. Parental satisfaction scores did not differ between the intravenous and nasogastric groups. These studies suggest that infants who have difficulty feeding safely because of respiratory distress can receive either intravenous or nasogastric fluid replacement; however, more evidence is needed to increase the strength of this recommendation.

The possibility of fluid retention related to production of antidiuretic hormone has been raised in patients with bronchiolitis.[187–189] Therefore, receipt of hypotonic fluid replacement and maintenance fluids may increase the risk of iatrogenic hyponatremia in these infants. A recent meta-analysis demonstrated that among hospitalized children requiring maintenance fluids, the use of hypotonic fluids was associated with significant hyponatremia compared with isotonic fluids in older children.[190] Use of isotonic fluids, in general, appears to be safer.

PREVENTION

Key Action Statement 10a

Clinicians should not administer palivizumab to otherwise healthy

infants with a gestational age of 29 weeks, 0 days or greater (Evidence Quality: B; Recommendation Strength: Strong Recommendation).

Action Statement Profile KAS 10a

Aggregate evidence quality	B
Benefits	Reduced pain of injections, reduced use of a medication that has shown minimal benefit, reduced adverse effects, reduced visits to health care provider with less exposure to illness
Risk, harm, cost	Minimal increase in risk of RSV hospitalization
Benefit-harm assessment	Benefits outweigh harms
Value judgments	None
Intentional vagueness	None
Role of patient preferences	Parents may choose to not accept palivizumab
Exclusions	Infants with chronic lung disease of prematurity and hemodynamically significant cardiac disease (as described in KAS 10b)
Strength	Recommendation
Differences of opinion	None
Notes	This KAS is harmonized with the AAP policy statement on palivizumab

Key Action Statement 10b

Clinicians should administer palivizumab during the first year of life to infants with hemodynamically significant heart disease or chronic lung disease of prematurity defined as preterm infants <32 weeks, 0 days' gestation who require >21% oxygen for at least the first 28 days of life (Evidence Quality: B; Recommendation Strength: Moderate Recommendation).

Action Statement Profile KAS 10b

Aggregate evidence quality	B
Benefits	Reduced risk of RSV hospitalization
Risk, harm, cost	Injection pain; increased risk of illness from increased visits to clinician office or clinic; cost; side effects from palivizumab
Benefit-harm assessment	Benefits outweigh harms
Value judgments	None
Intentional vagueness	None
Role of patient preferences	Parents may choose to not accept palivizumab
Exclusions	None
Strength	Moderate recommendation
Differences of opinion	None
Notes	This KAS is harmonized with the AAP policy statement on palivizumab[191,192]

Key Action Statement 10c

Clinicians should administer a maximum 5 monthly doses (15 mg/kg/dose) of palivizumab during the RSV season to infants who qualify for palivizumab in the first year of life (Evidence Quality: B, Recommendation Strength: Moderate Recommendation).

Action Statement Profile KAS 10c

Aggregate evidence quality	B
Benefits	Reduced risk of hospitalization; reduced admission to ICU
Risk, harm, cost	Injection pain; increased risk of illness from increased visits to clinician office or clinic; cost; adverse effects of palivizumab
Benefit-harm assessment	Benefits outweigh harms
Value judgments	None
Intentional vagueness	None
Role of patient preferences	None
Exclusions	Fewer doses should be used if the bronchiolitis season ends before the completion of 5 doses; if the child is hospitalized with a breakthrough RSV, monthly prophylaxis should be discontinued
Strength	Moderate recommendation
Differences of opinion	None
Notes	This KAS is harmonized with the AAP policy statement on palivizumab[191,192]

Detailed evidence to support the policy statement on palivizumab and this palivizumab section can be found in the technical report on palivizumab.[192]

Palivizumab was licensed by the US Food and Drug Administration in June 1998 largely on the basis of results of 1 clinical trial.[193] The results of a second clinical trial among children with congenital heart disease were reported in December 2003.[194] No other prospective, randomized, placebo-controlled trials have been conducted in any subgroup. Since licensure of palivizumab, new peer-reviewed publications provide greater insight into the epidemiology of disease caused by RSV.[195–197] As a result of new data, the Bronchiolitis Guideline Committee and the Committee on Infectious Diseases have updated recommendations for use of prophylaxis.

PREMATURITY

Monthly palivizumab prophylaxis should be restricted to infants born before 29 weeks, 0 days' gestation, except for infants who qualify on the basis of congenital heart disease or chronic lung disease of prematurity. Data show that infants born at or after 29 weeks, 0 days' gestation have an RSV hospitalization rate similar to the rate of full-term infants.[11,198] Infants with a gestational age of 28 weeks, 6 days or less who will be younger than 12 months at the start of the RSV season should receive a maximum of 5 monthly doses of palivizumab or until the end of the RSV season, whichever comes first. Depending on the month of birth, fewer than 5 monthly doses

will provide protection for most infants for the duration of the season.

CONGENITAL HEART DISEASE

Despite the large number of subjects enrolled, little benefit from palivizumab prophylaxis was found in the industry-sponsored cardiac study among infants in the cyanotic group (7.9% in control group versus 5.6% in palivizumab group, or 23 fewer hospitalizations per1000 children; P = .285).[197] In the acyanotic group (11.8% vs 5.0%), there were 68 fewer RSV hospitalizations per 1000 prophylaxis recipients (P = .003).[197,199,200]

CHRONIC LUNG DISEASE OF PREMATURITY

Palivizumab prophylaxis should be administered to infants and children younger than 12 months who develop chronic lung disease of prematurity, defined as a requirement for 28 days of more than 21% oxygen beginning at birth. If a child meets these criteria and is in the first 24 months of life and continues to require supplemental oxygen, diuretic therapy, or chronic corticosteroid therapy within 6 months of the start of the RSV season, monthly prophylaxis should be administered for the remainder of the season.

NUMBER OF DOSES

Community outbreaks of RSV disease usually begin in November or December, peak in January or February, and end by late March or, at times, in April.[4] Figure 1 shows the 2011–2012 bronchiolitis season, which is typical of most years. Because 5 monthly doses will provide more than 24 weeks of protective serum palivizumab concentration, administration of more than 5 monthly doses is not recommended within the continental United States. For infants who qualify for 5 monthly doses, initiation of prophylaxis in November and continuation for a total of 5 doses will provide protection into April.[201] If prophylaxis is initiated in October, the fifth and final dose should be administered in February, and protection will last into March for most children.

SECOND YEAR OF LIFE

Because of the low risk of RSV hospitalization in the second year of life, palivizumab prophylaxis is not recommended for children in the second year of life with the following exception. Children who satisfy the definition of chronic lung disease of infancy and continue to require supplemental oxygen, chronic corticosteroid therapy, or diuretic therapy within 6 months of the onset of the second RSV season may be considered for a second season of prophylaxis.

OTHER CONDITIONS

Insufficient data are available to recommend routine use of prophylaxis in children with Down syndrome, cystic fibrosis, pulmonary abnormality, neuromuscular disease, or immune compromise.

Down Syndrome

Routine use of prophylaxis for children in the first year of life with Down syndrome is not recommended unless the child qualifies because of cardiac disease or prematurity.[202]

Cystic Fibrosis

Routine use of palivizumab prophylaxis in patients with cystic fibrosis is not recommended.[203,204] Available studies indicate the incidence of RSV hospitalization in children with cystic fibrosis is low and unlikely to be different from children without cystic fibrosis. No evidence suggests a benefit from palivizumab prophylaxis in patients with cystic fibrosis. A randomized clinical trial involving 186 children with cystic fibrosis from 40 centers reported 1 subject in each group was hospitalized because of RSV infection. Although this study was not powered for efficacy, no clinically meaningful differences in outcome were reported.[205] A survey of cystic fibrosis center directors published in 2009 noted that palivizumab prophylaxis is not the standard of care for patients with cystic fibrosis.[206] If a neonate is diagnosed with cystic fibrosis by newborn screening, RSV prophylaxis should not be administered if no other indications are present. A patient with cystic fibrosis with clinical evidence of chronic lung disease in the first year of life may be considered for prophylaxis.

Neuromuscular Disease and Pulmonary Abnormality

The risk of RSV hospitalization is not well defined in children with pulmonary abnormalities or neuromuscular disease that impairs ability to clear secretions from the lower airway because of ineffective cough, recurrent gastroesophageal tract reflux, pulmonary malformations, tracheoesophageal fistula, upper airway conditions, or conditions requiring tracheostomy. No data on the relative risk of RSV hospitalization are available for this cohort. Selected infants with disease or congenital anomaly that impairs their ability to clear secretions from the lower airway because of ineffective cough may be considered for prophylaxis during the first year of life.

Immunocompromised Children

Population-based data are not available on the incidence or severity of RSV hospitalization in children who undergo solid organ or hematopoietic stem cell transplantation, receive chemotherapy, or are immunocompromised because of other conditions. Prophylaxis may be considered for hematopoietic stem cell transplant

patients who undergo transplantation and are profoundly immunosuppressed during the RSV season.[207]

MISCELLANEOUS ISSUES

Prophylaxis is not recommended for prevention of nosocomial RSV disease in the NICU or hospital setting.[208,209]

No evidence suggests palivizumab is a cost-effective measure to prevent recurrent wheezing in children. Prophylaxis should not be administered to reduce recurrent wheezing in later years.[210,211]

Monthly prophylaxis in Alaska Native children who qualify should be determined by locally generated data regarding season onset and end.

Continuation of monthly prophylaxis for an infant or young child who experiences breakthrough RSV hospitalization is not recommended.

HAND HYGIENE

Key Action Statement 11a

All people should disinfect hands before and after direct contact with patients, after contact with inanimate objects in the direct vicinity of the patient, and after removing gloves (Evidence Quality: B; Recommendation Strength: Strong Recommendation).

Action Statement Profile KAS 11a

Aggregate evidence quality	B
Benefits	Decreased transmission of disease
Risk, harm, cost	Possible hand irritation
Benefit-harm assessment	Benefits outweigh harms
Value judgments	None
Intentional vagueness	None
Role of patient preferences	None
Exclusions	None
Strength	Strong recommendation
Differences of opinion	None

Key Action Statement 11b

All people should use alcohol-based rubs for hand decontamination when caring for children with bronchiolitis. When alcohol-based rubs are not available, individuals should wash their hands with soap and water (Evidence Quality: B; Recommendation Strength: Strong Recommendation).

Action Statement Profile KAS 11b

Aggregate evidence quality	B
Benefits	Less hand irritation
Risk, harm, cost	If there is visible dirt on the hands, hand washing is necessary; alcohol-based rubs are not effective for *Clostridium difficile,* present a fire hazard, and have a slight increased cost
Benefit-harm assessment	Benefits outweigh harms
Value judgments	None
Intentional vagueness	None
Role of patient preferences	None
Exclusions	None
Strength	Strong recommendation
Differences of opinion	None

Efforts should be made to decrease the spread of RSV and other causative agents of bronchiolitis in medical settings, especially in the hospital. Secretions from infected patients can be found on beds, crib railings, tabletops, and toys.[12] RSV, as well as many other viruses, can survive better on hard surfaces than on porous surfaces or hands. It can remain infectious on counter tops for ≥6 hours, on gowns or paper tissues for 20 to 30 minutes, and on skin for up to 20 minutes.[212]

It has been shown that RSV can be carried and spread to others on the hands of caregivers.[213] Studies have shown that health care workers have acquired infection by performing activities such as feeding, diaper change, and playing with the RSV-infected infant. Caregivers who had contact only with surfaces contaminated with the infants' secretions or touched inanimate objects in patients' rooms also acquired RSV. In these studies, health care workers contaminated their hands (or gloves) with RSV and inoculated their oral or conjunctival mucosa.[214] Frequent hand washing by health care workers has been shown to reduce the spread of RSV in the health care setting.[215]

The Centers for Disease Control and Prevention published an extensive review of the hand-hygiene literature and made recommendations as to indications for hand washing and hand antisepsis.[216] Among the recommendations are that hands should be disinfected before and after direct contact with every patient, after contact with inanimate objects in the direct vicinity of the patient, and before putting on and after removing gloves. If hands are not visibly soiled, an alcohol-based rub is preferred. In guidelines published in 2009, the World Health Organization also recommended alcohol-based hand-rubs as the standard for hand hygiene in health care.[217] Specifically, systematic reviews show them to remove organisms more effectively, require less time, and irritate skin less often than hand washing with soap or other antiseptic agents and water. The availability of bedside alcohol-based solutions increased compliance with hand hygiene among health care workers.[214]

When caring for hospitalized children with clinically diagnosed bronchiolitis, strict adherence to hand decontamination and use of personal protective equipment (ie, gloves and gowns) can reduce the risk of cross-infection in the health care setting.[215]

Other methods of infection control in viral bronchiolitis include education of personnel and family members, surveillance for the onset of RSV season, and wearing masks when anticipating exposure to aerosolized secretions while performing patient care activities. Programs that implement the aforementioned principles, in conjunction with effective hand decontamination and cohorting of patients, have been shown to reduce the spread of RSV in the health care setting by 39% to 50%.[218,219]

TOBACCO SMOKE

Key Action Statement 12a

Clinicians should inquire about the exposure of the infant or child to tobacco smoke when assessing infants and children for bronchiolitis (Evidence Quality: C; Recommendation Strength: Moderate Recommendation).

Action Statement Profile KAS 12a

Aggregate evidence quality	C
Benefits	Can identify infants and children at risk whose family may benefit from counseling, predicting risk of severe disease
Risk, harm, cost	Time to inquire
Benefit-harm assessment	Benefits outweigh harms
Value judgments	None
Intentional vagueness	None
Role of patient preferences	Parent may choose to deny tobacco use even though they are, in fact, users
Exclusions	None
Strength	Moderate recommendation
Differences of opinion	None

Key Action Statement 12b

Clinicians should counsel caregivers about exposing the infant or child to environmental tobacco smoke and smoking cessation when assessing a child for bronchiolitis (Evidence Quality: B; Recommendation Strength: Strong Recommendation).

Action Statement Profile KAS 12b

Aggregate evidence quality	B
Benefits	Reinforces the detrimental effects of smoking, potential to decrease smoking
Risk, harm, cost	Time to counsel
Benefit-harm assessment	Benefits outweigh harms
Value judgments	None
Intentional vagueness	None
Role of patient preferences	Parents may choose to ignore counseling
Exclusions	None
Strength	Moderate recommendation
Differences of opinion	None
Notes	Counseling for tobacco smoke prevention should begin in the prenatal period and continue in family-centered care and at all well-infant visits

Tobacco smoke exposure increases the risk and severity of bronchiolitis. Strachan and Cook[220] first delineated the effects of environmental tobacco smoke on rates of lower respiratory tract disease in infants in a meta-analysis including 40 studies. In a more recent systematic review, Jones et al[221] found a pooled odds ratio of 2.51 (95% CI 1.96 to 3.21) for tobacco smoke exposure and bronchiolitis hospitalization among the 7 studies specific to the condition. Other investigators have consistently reported tobacco smoke exposure increases both severity of illness and risk of hospitalization for bronchiolitis.[222–225] The AAP issued a technical report on the risks of secondhand smoke in 2009. The report makes recommendations regarding effective ways to eliminate or reduce secondhand smoke exposure, including education of parents.[226]

Despite our knowledge of this important risk factor, there is evidence to suggest health care providers identify fewer than half of children exposed to tobacco smoke in the outpatient, inpatient, or ED settings.[227–229] Furthermore, there is evidence that counseling parents in these settings is well received and has a measurable impact. Rosen et al[230] performed a meta-analysis of the effects of interventions in pediatric settings on parental cessation and found a pooled risk ratio of 1.3 for cessation among the 18 studies reviewed.

In contrast to many of the other recommendations, protecting children from tobacco exposure is a recommendation that is primarily implemented outside of the clinical setting. As such, it is critical that parents are fully educated about the importance of not allowing smoking in the home and that smoke lingers on clothes and in the environment for prolonged periods.[231] It should be provided in plain language and in a respectful, culturally effective manner that is family centered, engages parents as partners in their child's health, and factors in their literacy, health literacy, and primary language needs.

BREASTFEEDING

Key Action Statement 13

Clinicians should encourage exclusive breastfeeding for at least 6 months to decrease the morbidity of respiratory infections (Evidence Quality: Grade B; Recommendation Strength: Moderate Recommendation).

Action Statement Profile KAS 13

Aggregate evidence quality	B
Benefits	May reduce the risk of bronchiolitis and other illnesses; multiple benefits of breastfeeding unrelated to bronchiolitis
Risk, harm, cost	None
Benefit-harm assessment	Benefits outweigh risks
Value judgments	None
Intentional vagueness	None
Role of patient preferences	Parents may choose to feed formula rather than breastfeed
Exclusions	None
Strength	Moderate recommendation
Notes	Education on breastfeeding should begin in the prenatal period

In 2012, the AAP presented a general policy on breastfeeding.[232] The policy statement was based on the proven benefits of breastfeeding for at least 6 months. Respiratory infections were shown to be significantly less common in breastfed children. A primary resource was a meta-analysis from the Agency for Healthcare Research and Quality that showed an overall 72% reduction in the risk of hospitalization secondary to respiratory diseases in infants who were exclusively breastfed for 4 or more months compared with those who were formula fed.[233]

The clinical evidence also supports decreased incidence and severity of illness in breastfed infants with bronchiolitis. Dornelles et al[234] concluded that the duration of exclusive breastfeeding was inversely related to the length of oxygen use and the length of hospital stay in previously healthy infants with acute bronchiolitis. In a large prospective study in Australia, Oddy et al[235] showed that breastfeeding for less than 6 months was associated with an increased risk for 2 or more medical visits and hospital admission for wheezing lower respiratory illness. In Japan, Nishimura et al[236] looked at 3 groups of RSV-positive infants defined as full, partial, or token breastfeeding. There were no significant differences in the hospitalization rate among the 3 groups; however, there were significant differences in the duration of hospitalization and the rate of requiring oxygen therapy, both favoring breastfeeding.

FAMILY EDUCATION

Key Action Statement 14

Clinicians and nurses should educate personnel and family members on evidence-based diagnosis, treatment, and prevention in bronchiolitis (Evidence Quality: C; observational studies; Recommendation Strength; Moderate Recommendation).

Action Statement Profile KAS 14

Aggregate evidence quality	C
Benefits	Decreased transmission of disease, benefits of breastfeeding, promotion of judicious use of antibiotics, risks of infant lung damage attributable to tobacco smoke
Risk, harm, cost	Time to educate properly
Benefit-harm assessment	Benefits outweigh harms
Value judgments	None
Intentional vagueness	Personnel is not specifically defined but should include all people who enter a patient's room
Role of patient preferences	None
Exclusions	None
Strength	Moderate recommendation
Differences of opinion	None

Shared decision-making with parents about diagnosis and treatment of bronchiolitis is a key tenet of patient-centered care. Despite the absence of effective therapies for viral bronchiolitis, caregiver education by clinicians may have a significant impact on care patterns in the disease. Children with bronchiolitis typically suffer from symptoms for 2 to 3 weeks, and parents often seek care in multiple settings during that time period.[237] Given that children with RSV generally shed virus for 1 to 2 weeks and from 30% to 70% of family members may become ill,[238,239] education about prevention of transmission of disease is key. Restriction of visitors to newborns during the respiratory virus season should be considered. Consistent evidence suggests that parental education is helpful in the promotion of judicious use of antibiotics and that clinicians may misinterpret parental expectations about therapy unless the subject is openly discussed.[240–242]

FUTURE RESEARCH NEEDS

- Better algorithms for predicting the course of illness
- Impact of clinical score on patient outcomes
- Evaluating different ethnic groups and varying response to treatments
- Does epinephrine alone reduce admission in outpatient settings?
- Additional studies on epinephrine in combination with dexamethasone or other corticosteroids
- Hypertonic saline studies in the outpatient setting and in in hospitals with shorter LOS
- More studies on nasogastric hydration
- More studies on tonicity of intravenous fluids

- Incidence of true AOM in bronchiolitis by using 2013 guideline definition
- More studies on deep suctioning and nasopharyngeal suctioning
- Strategies for monitoring oxygen saturation
- Use of home oxygen
- Appropriate cutoff for use of oxygen in high altitude
- Oxygen delivered by high-flow nasal cannula
- RSV vaccine and antiviral agents
- Use of palivizumab in special populations, such as cystic fibrosis, neuromuscular diseases, Down syndrome, immune deficiency
- Emphasis on parent satisfaction/patient-centered outcomes in all research (ie, not LOS as the only measure)

SUBCOMMITTEE ON BRONCHIOLITIS (OVERSIGHT BY THE COUNCIL ON QUALITY IMPROVEMENT AND PATIENT SAFETY, 2013–2014)

Shawn L. Ralston, MD, FAAP: Chair, Pediatric Hospitalist (no financial conflicts; published research related to bronchiolitis)

Allan S. Lieberthal, MD, FAAP: Chair, General Pediatrician with Expertise in Pulmonology (no conflicts)

Brian K. Alverson, MD, FAAP: Pediatric Hospitalist, AAP Section on Hospital Medicine Representative (no conflicts)

Jill E. Baley, MD, FAAP: Neonatal-Perinatal Medicine, AAP Committee on Fetus and Newborn Representative (no conflicts)

Anne M. Gadomski, MD, MPH, FAAP: General Pediatrician and Research Scientist (no financial conflicts; published research related to bronchiolitis including Cochrane review of bronchodilators)

David W. Johnson, MD, FAAP: Pediatric Emergency Medicine Physician (no financial conflicts; published research related to bronchiolitis)

Michael J. Light, MD, FAAP: Pediatric Pulmonologist, AAP Section on Pediatric Pulmonology Representative (no conflicts)

Nizar F. Maraqa, MD, FAAP: Pediatric Infectious Disease Physician, AAP Section on Infectious Diseases Representative (no conflicts)

H. Cody Meissner, MD, FAAP: Pediatric Infectious Disease Physician, AAP Committee on Infectious Diseases Representative (no conflicts)

Eneida A. Mendonca, MD, PhD, FAAP, FACMI: Informatician/Academic Pediatric Intensive Care Physician, Partnership for Policy Implementation Representative (no conflicts)

Kieran J. Phelan, MD, MSc: General Pediatrician (no conflicts)

Joseph J. Zorc, MD, MSCE, FAAP: Pediatric Emergency Physician, AAP Section on Emergency Medicine Representative (no financial conflicts; published research related to bronchiolitis)

Danette Stanko-Lopp, MA, MPH: Methodologist, Epidemiologist (no conflicts)

Mark A. Brown, MD: Pediatric Pulmonologist, American Thoracic Society Liaison (no conflicts)

Ian Nathanson, MD, FAAP: Pediatric Pulmonologist, American College of Chest Physicians Liaison (no conflicts)

Elizabeth Rosenblum, MD: Academic Family Physician, American Academy of Family Physicians liaison (no conflicts).

Stephen Sayles, III, MD, FACEP: Emergency Medicine Physician, American College of Emergency Physicians Liaison (no conflicts)

Sinsi Hernández-Cancio, JD: Parent/Consumer Representative (no conflicts)

STAFF

Caryn Davidson, MA

Linda Walsh, MAB

REFERENCES

1. American Academy of Pediatrics Subcommittee on Diagnosis and Management of Bronchiolitis. Diagnosis and management of bronchiolitis. *Pediatrics*. 2006;118(4):1774–1793
2. Agency for Healthcare Research and Quality. Management of Bronchiolitis in Infants and Children. Evidence Report/Technology Assessment No. 69. Rockville, MD: Agency for Healthcare Research and Quality; 2003. AHRQ Publication No. 03-E014
3. Mullins JA, Lamonte AC, Bresee JS, Anderson LJ. Substantial variability in community respiratory syncytial virus season timing. *Pediatr Infect Dis J*. 2003;22(10):857–862
4. Centers for Disease Control and Prevention. Respiratory syncytial virus activity—United States, July 2011-January 2013. *MMWR Morb Mortal Wkly Rep*. 2013;62(8):141–144
5. Greenough A, Cox S, Alexander J, et al. Health care utilisation of infants with chronic lung disease, related to hospitalisation for RSV infection. *Arch Dis Child*. 2001;85(6):463–468
6. Parrott RH, Kim HW, Arrobio JO, et al. Epidemiology of respiratory syncytial virus infection in Washington, D.C. II. Infection and disease with respect to age, immunologic status, race and sex. *Am J Epidemiol*. 1973;98(4):289–300
7. Meissner HC. Selected populations at increased risk from respiratory syncytial virus infection. *Pediatr Infect Dis J*. 2003;22(suppl 2):S40–S44, discussion S44–S45
8. Shay DK, Holman RC, Roosevelt GE, Clarke MJ, Anderson LJ. Bronchiolitis-associated mortality and estimates of respiratory syncytial virus-associated deaths among US children, 1979-1997. *J Infect Dis*. 2001;183(1):16–22
9. Miller EK, Gebretsadik T, Carroll KN, et al. Viral etiologies of infant bronchiolitis, croup and upper respiratory illness during 4 consecutive years. *Pediatr Infect Dis J*. 2013;32(9):950–955
10. Hasegawa K, Tsugawa Y, Brown DF, Mansbach JM, Camargo CA Jr. Trends in bronchiolitis hospitalizations in the United States, 2000-2009. *Pediatrics*. 2013;132(1):28–36
11. Hall CB, Weinberg GA, Blumkin AK, et al. Respiratory syncytial virus-associated hospitalizations among children less than 24 months of age. *Pediatrics*. 2013;132(2). Available at: www.pediatrics.org/cgi/content/full/132/2/e341
12. Hall CB. Nosocomial respiratory syncytial virus infections: the "Cold War" has not ended. *Clin Infect Dis*. 2000;31(2):590–596
13. Stevens TP, Sinkin RA, Hall CB, Maniscalco WM, McConnochie KM. Respiratory syncytial virus and premature infants born at 32 weeks' gestation or earlier: hospitalization and economic implications of prophylaxis. *Arch Pediatr Adolesc Med*. 2000;154(1):55–61
14. American Academy of Pediatrics Steering Committee on Quality Improvement and Management. Classifying recommendations for clinical practice guidelines. *Pediatrics*. 2004;114(3):874–877

15. Ricart S, Marcos MA, Sarda M, et al. Clinical risk factors are more relevant than respiratory viruses in predicting bronchiolitis severity. *Pediatr Pulmonol*. 2013;48(5):456–463
16. Shaw KN, Bell LM, Sherman NH. Outpatient assessment of infants with bronchiolitis. *Am J Dis Child*. 1991;145(2):151–155
17. Hall CB, Powell KR, MacDonald NE, et al. Respiratory syncytial viral infection in children with compromised immune function. *N Engl J Med*. 1986;315(2):77–81
18. Mansbach JM, Piedra PA, Stevenson MD, et al; MARC-30 Investigators. Prospective multicenter study of children with bronchiolitis requiring mechanical ventilation. *Pediatrics*. 2012;130(3). Available at: www.pediatrics.org/cgi/content/full/130/3/e492
19. Prescott WA Jr, Hutchinson DJ. Respiratory syncytial virus prophylaxis in special populations: is it something worth considering in cystic fibrosis and immunosuppression? *J Pediatr Pharmacol Ther*. 2011;16(2):77–86
20. Armstrong D, Grimwood K, Carlin JB, et al. Severe viral respiratory infections in infants with cystic fibrosis. *Pediatr Pulmonol*. 1998;26(6):371–379
21. Alvarez AE, Marson FA, Bertuzzo CS, Arns CW, Ribeiro JD. Epidemiological and genetic characteristics associated with the severity of acute viral bronchiolitis by respiratory syncytial virus. *J Pediatr (Rio J)*. 2013;89(6):531–543
22. Iliff A, Lee VA. Pulse rate, respiratory rate, and body temperature of children between two months and eighteen years of age. *Child Dev*. 1952;23(4):237–245
23. Rogers MC. Respiratory monitoring. In: Rogers MC, Nichols DG, eds. *Textbook of Pediatric Intensive Care*. Baltimore, MD: Williams & Wilkins; 1996:332–333
24. Berman S, Simoes EA, Lanata C. Respiratory rate and pneumonia in infancy. *Arch Dis Child*. 1991;66(1):81–84
25. Fleming S, Thompson M, Stevens R, et al. Normal ranges of heart rate and respiratory rate in children from birth to 18 years of age: a systematic review of observational studies. *Lancet*. 2011;377(9770):1011–1018
26. Bonafide CP, Brady PW, Keren R, Conway PH, Marsolo K, Daymont C. Development of heart and respiratory rate percentile curves for hospitalized children. *Pediatrics*. 2013;131(4). Available at: www.pediatrics.org/cgi/content/full/131/4/e1150
27. Margolis P, Gadomski A. The rational clinical examination. Does this infant have pneumonia? *JAMA*. 1998;279(4):308–313
28. Mahabee-Gittens EM, Grupp-Phelan J, Brody AS, et al. Identifying children with pneumonia in the emergency department. *Clin Pediatr (Phila)*. 2005;44(5):427–435
29. Brooks AM, McBride JT, McConnochie KM, Aviram M, Long C, Hall CB. Predicting deterioration in previously healthy infants hospitalized with respiratory syncytial virus infection. *Pediatrics*. 1999;104(3 pt 1):463–467
30. Neuman MI, Monuteaux MC, Scully KJ, Bachur RG. Prediction of pneumonia in a pediatric emergency department. *Pediatrics*. 2011;128(2):246–253
31. Shah S, Bachur R, Kim D, Neuman MI. Lack of predictive value of tachypnea in the diagnosis of pneumonia in children. *Pediatr Infect Dis J*. 2010;29(5):406–409
32. Mansbach JM, McAdam AJ, Clark S, et al. Prospective multicenter study of the viral etiology of bronchiolitis in the emergency department. *Acad Emerg Med*. 2008;15(2):111–118
33. Mansbach JM, Piedra PA, Teach SJ, et al; MARC-30 Investigators. Prospective multicenter study of viral etiology and hospital length of stay in children with severe bronchiolitis. *Arch Pediatr Adolesc Med*. 2012;166(8):700–706
34. Navas L, Wang E, de Carvalho V, Robinson J; Pediatric Investigators Collaborative Network on Infections in Canada. Improved outcome of respiratory syncytial virus infection in a high-risk hospitalized population of Canadian children. *J Pediatr*. 1992;121(3):348–354
35. Wang EE, Law BJ, Stephens D. Pediatric Investigators Collaborative Network on Infections in Canada (PICNIC) prospective study of risk factors and outcomes in patients hospitalized with respiratory syncytial viral lower respiratory tract infection. *J Pediatr*. 1995;126(2):212–219
36. Chan PW, Lok FY, Khatijah SB. Risk factors for hypoxemia and respiratory failure in respiratory syncytial virus bronchiolitis. *Southeast Asian J Trop Med Public Health*. 2002;33(4):806–810
37. Roback MG, Baskin MN. Failure of oxygen saturation and clinical assessment to predict which patients with bronchiolitis discharged from the emergency department will return requiring admission. *Pediatr Emerg Care*. 1997;13(1):9–11
38. Lowell DI, Lister G, Von Koss H, McCarthy P. Wheezing in infants: the response to epinephrine. *Pediatrics*. 1987;79(6):939–945
39. Destino L, Weisgerber MC, Soung P, et al. Validity of respiratory scores in bronchiolitis. *Hosp Pediatr*. 2012;2(4):202–209
40. Schroeder AR, Marmor AK, Pantell RH, Newman TB. Impact of pulse oximetry and oxygen therapy on length of stay in bronchiolitis hospitalizations. *Arch Pediatr Adolesc Med*. 2004;158(6):527–530
41. Dawson KP, Long A, Kennedy J, Mogridge N. The chest radiograph in acute bronchiolitis. *J Paediatr Child Health*. 1990;26(4):209–211
42. Schroeder AR, Mansbach JM, Stevenson M, et al. Apnea in children hospitalized with bronchiolitis. *Pediatrics*. 2013;132(5). Available at: www.pediatrics.org/cgi/content/full/132/5/e1194
43. Ralston S, Hill V. Incidence of apnea in infants hospitalized with respiratory syncytial virus bronchiolitis: a systematic review. *J Pediatr*. 2009;155(5):728–733
44. Willwerth BM, Harper MB, Greenes DS. Identifying hospitalized infants who have bronchiolitis and are at high risk for apnea. *Ann Emerg Med*. 2006;48(4):441–447
45. García CG, Bhore R, Soriano-Fallas A, et al. Risk factors in children hospitalized with RSV bronchiolitis versus non-RSV bronchiolitis. *Pediatrics*. 2010;126(6). Available at: www.pediatrics.org/cgi/content/full/126/6/e1453
46. Swingler GH, Hussey GD, Zwarenstein M. Randomised controlled trial of clinical outcome after chest radiograph in ambulatory acute lower-respiratory infection in children. *Lancet*. 1998;351(9100):404–408
47. Schuh S, Lalani A, Allen U, et al. Evaluation of the utility of radiography in acute bronchiolitis. *J Pediatr*. 2007;150(4):429–433
48. Kellner JD, Ohlsson A, Gadomski AM, Wang EE. Efficacy of bronchodilator therapy in bronchiolitis. A meta-analysis. *Arch Pediatr Adolesc Med*. 1996;150(11):1166–1172
49. Flores G, Horwitz RI. Efficacy of beta2-agonists in bronchiolitis: a reappraisal and meta-analysis. *Pediatrics*. 1997;100(2 pt 1):233–239
50. Hartling L, Wiebe N, Russell K, Patel H, Klassen TP. A meta-analysis of randomized controlled trials evaluating the efficacy of epinephrine for the treatment of acute viral bronchiolitis. *Arch Pediatr Adolesc Med*. 2003;157(10):957–964
51. King VJ, Viswanathan M, Bordley WC, et al. Pharmacologic treatment of bronchiolitis in infants and children: a systematic review. *Arch Pediatr Adolesc Med*. 2004;158(2):127–137
52. Zorc JJ, Hall CB. Bronchiolitis: recent evidence on diagnosis and management. *Pediatrics*. 2010;125(2):342–349
53. Wainwright C. Acute viral bronchiolitis in children—a very common condition with few therapeutic options. *Paediatr Respir Rev*. 2010;11(1):39–45, quiz 45

54. Walsh P, Caldwell J, McQuillan KK, Friese S, Robbins D, Rothenberg SJ. Comparison of nebulized epinephrine to albuterol in bronchiolitis. *Acad Emerg Med.* 2008;15(4):305–313
55. Scarlett EE, Walker S, Rovitelli A, Ren CL. Tidal breathing responses to albuterol and normal saline in infants with viral bronchiolitis. *Pediatr Allergy Immunol Pulmonol.* 2012;25(4):220–225
56. Gadomski AM, Scribani MB. Bronchodilators for bronchiolitis. *Cochrane Database Syst Rev.* 2014;(6):CD001266
57. Mallol J, Barrueto L, Girardi G, et al. Use of nebulized bronchodilators in infants under 1 year of age: analysis of four forms of therapy. *Pediatr Pulmonol.* 1987;3(5):298–303
58. Lines DR, Kattampallil JS, Liston P. Efficacy of nebulized salbutamol in bronchiolitis. *Pediatr Rev Commun.* 1990;5(2):121–129
59. Alario AJ, Lewander WJ, Dennehy P, Seifer R, Mansell AL. The efficacy of nebulized metaproterenol in wheezing infants and young children. *Am J Dis Child.* 1992;146(4):412–418
60. Chavasse RJPG, Seddon P, Bara A, McKean MC. Short acting beta2-agonists for recurrent wheeze in children under two years of age. *Cochrane Database Syst Rev.* 2009;(2):CD002873
61. Totapally BR, Demerci C, Zureikat G, Nolan B. Tidal breathing flow-volume loops in bronchiolitis in infancy: the effect of albuterol [ISRCTN47364493]. *Crit Care.* 2002;6(2):160–165
62. Levin DL, Garg A, Hall LJ, Slogic S, Jarvis JD, Leiter JC. A prospective randomized controlled blinded study of three bronchodilators in infants with respiratory syncytial virus bronchiolitis on mechanical ventilation. *Pediatr Crit Care Med.* 2008;9(6):598–604
63. Bjornson C, Russell K, Vandermeer B, Klassen TP, Johnson DW. Nebulized epinephrine for croup in children. *Cochrane Database Syst Rev.* 2013;(10):CD006619
64. Hartling L, Fernandes RM, Bialy L, et al. Steroids and bronchodilators for acute bronchiolitis in the first two years of life: systematic review and meta-analysis. *BMJ.* 2011;342:d1714
65. Wainwright C, Altamirano L, Cheney M, et al. A multicenter, randomized, double-blind, controlled trial of nebulized epinephrine in infants with acute bronchiolitis. *N Engl J Med.* 2003;349(1):27–35
66. Patel H, Gouin S, Platt RW. Randomized, double-blind, placebo-controlled trial of oral albuterol in infants with mild-to-moderate acute viral bronchiolitis. *J Pediatr.* 2003;142(5):509–514
67. Skjerven HO, Hunderi JO, Brügmann-Pieper SK, et al. Racemic adrenaline and inhalation strategies in acute bronchiolitis. *N Engl J Med.* 2013;368(24):2286–2293
68. Plint AC, Johnson DW, Patel H, et al; Pediatric Emergency Research Canada (PERC). Epinephrine and dexamethasone in children with bronchiolitis. *N Engl J Med.* 2009;360(20):2079–2089
69. Wark PA, McDonald V, Jones AP. Nebulised hypertonic saline for cystic fibrosis. *Cochrane Database Syst Rev.* 2005;(3):CD001506
70. Daviskas E, Anderson SD, Gonda I, et al. Inhalation of hypertonic saline aerosol enhances mucociliary clearance in asthmatic and healthy subjects. *Eur Respir J.* 1996;9(4):725–732
71. Sood N, Bennett WD, Zeman K, et al. Increasing concentration of inhaled saline with or without amiloride: effect on mucociliary clearance in normal subjects. *Am J Respir Crit Care Med.* 2003;167(2):158–163
72. Mandelberg A, Amirav I. Hypertonic saline or high volume normal saline for viral bronchiolitis: mechanisms and rationale. *Pediatr Pulmonol.* 2010;45(1):36–40
73. Zhang L, Mendoza-Sassi RA, Wainwright C, Klassen TP. Nebulized hypertonic saline solution for acute bronchiolitis in infants. *Cochrane Database Syst Rev.* 2008;(4):CD006458
74. Jacobs JD, Foster M, Wan J, Pershad J. 7% Hypertonic saline in acute bronchiolitis: a randomized controlled trial. *Pediatrics.* 2014;133(1). Available at: www.pediatrics.org/cgi/content/full/133/1/e8
75. Wu S, Baker C, Lang ME, et al. Nebulized hypertonic saline for bronchiolitis: a randomized clinical trial. *JAMA Pediatr.* 2014;168(7):657–663
76. Florin TA, Shaw KN, Kittick M, Yakscoe S, Zorc JJ. Nebulized hypertonic saline for bronchiolitis in the emergency department: a randomized clinical trial. *JAMA Pediatr.* 2014;168(7):664–670
77. Sharma BS, Gupta MK, Rafik SP. Hypertonic (3%) saline vs 0.93% saline nebulization for acute viral bronchiolitis: a randomized controlled trial. *Indian Pediatr.* 2013;50(8):743–747
78. Silver AH. Randomized controlled trial of the efficacy of nebulized 3% saline without bronchodilators for infants admitted with bronchiolitis: preliminary data [abstr E-PAS2014:2952.685]. Paper presented at: Pediatric Academic Societies Annual Meeting; May 3–6, 2014; Vancouver, British Columbia, Canada
79. Ralston S, Hill V, Martinez M. Nebulized hypertonic saline without adjunctive bronchodilators for children with bronchiolitis. *Pediatrics.* 2010;126(3). Available at: www.pediatrics.org/cgi/content/full/126/3/e520
80. Luo Z, Liu E, Luo J, et al. Nebulized hypertonic saline/salbutamol solution treatment in hospitalized children with mild to moderate bronchiolitis. *Pediatr Int.* 2010;52(2):199–202
81. Sarrell EM, Tal G, Witzling M, et al. Nebulized 3% hypertonic saline solution treatment in ambulatory children with viral bronchiolitis decreases symptoms. *Chest.* 2002;122(6):2015–2020
82. Rowe BH, Spooner C, Ducharme FM, Bretzlaff JA, Bota GW. Early emergency department treatment of acute asthma with systemic corticosteroids. *Cochrane Database Syst Rev.* 2001;(1):CD002178
83. Smith M, Iqbal S, Elliott TM, Everard M, Rowe BH. Corticosteroids for hospitalised children with acute asthma. *Cochrane Database Syst Rev.* 2003;(2):CD002886
84. Russell KF, Liang Y, O'Gorman K, Johnson DW, Klassen TP. Glucocorticoids for croup. *Cochrane Database Syst Rev.* 2011;(1):CD001955
85. Fernandes RM, Bialy LM, Vandermeer B, et al. Glucocorticoids for acute viral bronchiolitis in infants and young children. *Cochrane Database Syst Rev.* 2013;(6):CD004878
86. Corneli HM, Zorc JJ, Mahajan P, et al; Bronchiolitis Study Group of the Pediatric Emergency Care Applied Research Network (PECARN). A multicenter, randomized, controlled trial of dexamethasone for bronchiolitis [published correction appears in *N Engl J Med* 2008;359(18):1972]. *N Engl J Med.* 2007;357(4):331–339
87. Frey U, von Mutius E. The challenge of managing wheezing in infants. *N Engl J Med.* 2009;360(20):2130–2133
88. Gibson PG, Powell H, Ducharme F. Long-acting beta2-agonists as an inhaled corticosteroid-sparing agent for chronic asthma in adults and children. *Cochrane Database Syst Rev.* 2005;(4):CD005076
89. Barnes PJ. Scientific rationale for using a single inhaler for asthma control. *Eur Respir J.* 2007;29(3):587–595
90. Giembycz MA, Kaur M, Leigh R, Newton R. A Holy Grail of asthma management: toward understanding how long-acting beta (2)-adrenoceptor agonists enhance the clinical efficacy of inhaled corticosteroids. *Br J Pharmacol.* 2008;153(6):1090–1104
91. Kaur M, Chivers JE, Giembycz MA, Newton R. Long-acting beta2-adrenoceptor agonists synergistically enhance glucocorticoid-dependent transcription in human airway

epithelial and smooth muscle cells. *Mol Pharmacol*. 2008;73(1):203–214

92. Holden NS, Bell MJ, Rider CF, et al. β2-Adrenoceptor agonist-induced RGS2 expression is a genomic mechanism of bronchoprotection that is enhanced by glucocorticoids. *Proc Natl Acad Sci U S A*. 2011;108(49):19713–19718
93. Schuh S, Coates AL, Binnie R, et al. Efficacy of oral dexamethasone in outpatients with acute bronchiolitis. *J Pediatr*. 2002;140(1):27–32
94. Bentur L, Shoseyov D, Feigenbaum D, Gorichovsky Y, Bibi H. Dexamethasone inhalations in RSV bronchiolitis: a double-blind, placebo-controlled study. *Acta Paediatr*. 2005;94(7):866–871
95. Kuyucu S, Unal S, Kuyucu N, Yilgor E. Additive effects of dexamethasone in nebulized salbutamol or L-epinephrine treated infants with acute bronchiolitis. *Pediatr Int*. 2004;46(5):539–544
96. Mesquita M, Castro-Rodríguez JA, Heinichen L, Fariña E, Iramain R. Single oral dose of dexamethasone in outpatients with bronchiolitis: a placebo controlled trial. *Allergol Immunopathol (Madr)*. 2009;37(2):63–67
97. Alansari K, Sakran M, Davidson BL, Ibrahim K, Alrefai M, Zakaria I. Oral dexamethasone for bronchiolitis: a randomized trial. *Pediatrics*. 2013;132(4). Available at: www.pediatrics.org/cgi/content/full/132/4/e810
98. Mallory MD, Shay DK, Garrett J, Bordley WC. Bronchiolitis management preferences and the influence of pulse oximetry and respiratory rate on the decision to admit. *Pediatrics*. 2003;111(1). Available at: www.pediatrics.org/cgi/content/full/111/1/e45
99. Corneli HM, Zorc JJ, Holubkov R, et al; Bronchiolitis Study Group for the Pediatric Emergency Care Applied Research Network. Bronchiolitis: clinical characteristics associated with hospitalization and length of stay. *Pediatr Emerg Care*. 2012;28(2):99–103
100. Unger S, Cunningham S. Effect of oxygen supplementation on length of stay for infants hospitalized with acute viral bronchiolitis. *Pediatrics*. 2008;121(3):470–475
101. Cunningham S, McMurray A. Observational study of two oxygen saturation targets for discharge in bronchiolitis. *Arch Dis Child*. 2012;97(4):361–363
102. Anaesthesia UK. Oxygen dissociation curve. Available at: http://www.anaesthesiauk.com/SearchRender.aspx?DocId=1419&Index=D%3a\dtSearch\UserData\AUK&HitCount=19&hits=4+5+d+e+23+24+37+58+59+a7+a8+14a+14b+17e+180+181+1a9+1aa+1d4 Accessed July 15, 2014
103. McBride SC, Chiang VW, Goldmann DA, Landrigan CP. Preventable adverse events in infants hospitalized with bronchiolitis. *Pediatrics*. 2005;116(3):603–608
104. Hunt CE, Corwin MJ, Lister G, et al; Collaborative Home Infant Monitoring Evaluation (CHIME) Study Group. Longitudinal assessment of hemoglobin oxygen saturation in healthy infants during the first 6 months of age. *J Pediatr*. 1999;135(5):580–586
105. Gavlak JC, Stocks J, Laverty A, et al. The Young Everest Study: preliminary report of changes in sleep and cerebral blood flow velocity during slow ascent to altitude in unacclimatised children. *Arch Dis Child*. 2013;98(5):356–362
106. O'Neil SL, Barysh N, Setear SJ. Determining school programming needs of special population groups: a study of asthmatic children. *J Sch Health*. 1985;55(6):237–239
107. Bender BG, Belleau L, Fukuhara JT, Mrazek DA, Strunk RC. Psychomotor adaptation in children with severe chronic asthma. *Pediatrics*. 1987;79(5):723–727
108. Rietveld S, Colland VT. The impact of severe asthma on schoolchildren. *J Asthma*. 1999;36(5):409–417
109. Sung V, Massie J, Hochmann MA, Carlin JB, Jamsen K, Robertson CF. Estimating inspired oxygen concentration delivered by nasal prongs in children with bronchiolitis. *J Paediatr Child Health*. 2008;44(1-2):14–18
110. Ross PA, Newth CJL, Khemani RG. Accuracy of pulse oximetry in children. *Pediatrics*. 2014;133(1):22–29
111. Hasselbalch KA. Neutralitatsregulation und reizbarkeit des atemzentrums in ihren Wirkungen auf die koklensaurespannung des Blutes. *Biochem Ztschr*. 1912;46:403–439
112. Wang EE, Milner RA, Navas L, Maj H. Observer agreement for respiratory signs and oximetry in infants hospitalized with lower respiratory infections. *Am Rev Respir Dis*. 1992;145(1):106–109
113. Rojas MX, Granados Rugeles C, Charry-Anzola LP. Oxygen therapy for lower respiratory tract infections in children between 3 months and 15 years of age. *Cochrane Database Syst Rev*. 2009;(1):CD005975
114. Mitka M. Joint commission warns of alarm fatigue: multitude of alarms from monitoring devices problematic. *JAMA*. 2013;309(22):2315–2316
115. Bowton DL, Scuderi PE, Harris L, Haponik EF. Pulse oximetry monitoring outside the intensive care unit: progress or problem? *Ann Intern Med*. 1991;115(6):450–454
116. Groothuis JR, Gutierrez KM, Lauer BA. Respiratory syncytial virus infection in children with bronchopulmonary dysplasia. *Pediatrics*. 1988;82(2):199–203
117. Voepel-Lewis T, Pechlavanidis E, Burke C, Talsma AN. Nursing surveillance moderates the relationship between staffing levels and pediatric postoperative serious adverse events: a nested case-control study. *Int J Nurs Stud*. 2013;50(7):905–913
118. Bajaj L, Turner CG, Bothner J. A randomized trial of home oxygen therapy from the emergency department for acute bronchiolitis. *Pediatrics*. 2006;117(3):633–640
119. Tie SW, Hall GL, Peter S, et al. Home oxygen for children with acute bronchiolitis. *Arch Dis Child*. 2009;94(8):641–643
120. Halstead S, Roosevelt G, Deakyne S, Bajaj L. Discharged on supplemental oxygen from an emergency department in patients with bronchiolitis. *Pediatrics*. 2012;129(3). Available at: www.pediatrics.org/cgi/content/full/129/3/e605
121. Sandweiss DR, Mundorff MB, Hill T, et al. Decreasing hospital length of stay for bronchiolitis by using an observation unit and home oxygen therapy. *JAMA Pediatr*. 2013;167(5):422–428
122. Flett KB, Breslin K, Braun PA, Hambidge SJ. Outpatient course and complications associated with home oxygen therapy for mild bronchiolitis. *Pediatrics*. 2014;133(5):769–775
123. Gauthier M, Vincent M, Morneau S, Chevalier I. Impact of home oxygen therapy on hospital stay for infants with acute bronchiolitis. *Eur J Pediatr*. 2012;171(12):1839–1844
124. Bergman AB. Pulse oximetry: good technology misapplied. *Arch Pediatr Adolesc Med*. 2004;158(6):594–595
125. Sandweiss DR, Kadish HA, Campbell KA. Outpatient management of patients with bronchiolitis discharged home on oxygen: a survey of general pediatricians. *Clin Pediatr (Phila)*. 2012;51(5):442–446
126. Dysart K, Miller TL, Wolfson MR, Shaffer TH. Research in high flow therapy: mechanisms of action. *Respir Med*. 2009;103(10):1400–1405
127. Milési C, Baleine J, Matecki S, et al. Is treatment with a high flow nasal cannula effective in acute viral bronchiolitis? A physiologic study [published correction appears in *Intensive Care Med*. 2013;39(6):1170]. *Intensive Care Med*. 2013;39(6):1088–1094

128. Arora B, Mahajan P, Zidan MA, Sethuraman U. Nasopharyngeal airway pressures in bronchiolitis patients treated with high-flow nasal cannula oxygen therapy. *Pediatr Emerg Care*. 2012;28(11):1179–1184
129. Spentzas T, Minarik M, Patters AB, Vinson B, Stidham G. Children with respiratory distress treated with high-flow nasal cannula. *J Intensive Care Med*. 2009;24(5):323–328
130. Hegde S, Prodhan P. Serious air leak syndrome complicating high-flow nasal cannula therapy: a report of 3 cases. *Pediatrics*. 2013;131(3). Available at: www.pediatrics.org/cgi/content/full/131/3/e939
131. Pham TM, O'Malley L, Mayfield S, Martin S, Schibler A. The effect of high flow nasal cannula therapy on the work of breathing in infants with bronchiolitis [published online ahead of print May 21, 2014]. *Pediatr Pulmonol*. doi:doi:10.1002/ppul.23060
132. Bressan S, Balzani M, Krauss B, Pettenazzo A, Zanconato S, Baraldi E. High-flow nasal cannula oxygen for bronchiolitis in a pediatric ward: a pilot study. *Eur J Pediatr*. 2013;172(12):1649–1656
133. Ganu SS, Gautam A, Wilkins B, Egan J. Increase in use of non-invasive ventilation for infants with severe bronchiolitis is associated with decline in intubation rates over a decade. *Intensive Care Med*. 2012;38(7):1177–1183
134. Wing R, James C, Maranda LS, Armsby CC. Use of high-flow nasal cannula support in the emergency department reduces the need for intubation in pediatric acute respiratory insufficiency. *Pediatr Emerg Care*. 2012;28(11):1117–1123
135. McKiernan C, Chua LC, Visintainer PF, Allen H. High flow nasal cannulae therapy in infants with bronchiolitis. *J Pediatr*. 2010;156(4):634–638
136. Schibler A, Pham TM, Dunster KR, et al. Reduced intubation rates for infants after introduction of high-flow nasal prong oxygen delivery. *Intensive Care Med*. 2011;37(5):847–852
137. Kelly GS, Simon HK, Sturm JJ. High-flow nasal cannula use in children with respiratory distress in the emergency department: predicting the need for subsequent intubation. *Pediatr Emerg Care*. 2013;29(8):888–892
138. Kallappa C, Hufton M, Millen G, Ninan TK. Use of high flow nasal cannula oxygen (HFNCO) in infants with bronchiolitis on a paediatric ward: a 3-year experience. *Arch Dis Child*. 2014;99(8):790–791
139. Hilliard TN, Archer N, Laura H, et al. Pilot study of vapotherm oxygen delivery in moderately severe bronchiolitis. *Arch Dis Child*. 2012;97(2):182–183
140. Roqué i Figuls M, Giné-Garriga M, Granados Rugeles C, Perrotta C. Chest physiotherapy for acute bronchiolitis in paediatric patients between 0 and 24 months old. *Cochrane Database Syst Rev*. 2012;(2):CD004873
141. Aviram M, Damri A, Yekutielli C, Bearman J, Tal A. Chest physiotherapy in acute bronchiolitis [abstract]. *Eur Respir J*. 1992;5(suppl 15):229–230
142. Webb MS, Martin JA, Cartlidge PH, Ng YK, Wright NA. Chest physiotherapy in acute bronchiolitis. *Arch Dis Child*. 1985;60(11):1078–1079
143. Nicholas KJ, Dhouieb MO, Marshal TG, Edmunds AT, Grant MB. An evaluation of chest physiotherapy in the management of acute bronchiolitis: changing clinical practice. *Physiotherapy*. 1999;85(12):669–674
144. Bohé L, Ferrero ME, Cuestas E, Polliotto L, Genoff M. Indications of conventional chest physiotherapy in acute bronchiolitis [in Spanish]. *Medicina (B Aires)*. 2004;64(3):198–200
145. De Córdoba F, Rodrigues M, Luque A, Cadrobbi C, Faria R, Solé D. Fisioterapia respiratória em lactentes com bronquiolite: realizar ou não? *Mundo Saúde*. 2008;32(2):183–188
146. Gajdos V, Katsahian S, Beydon N, et al. Effectiveness of chest physiotherapy in infants hospitalized with acute bronchiolitis: a multicenter, randomized, controlled trial. *PLoS Med*. 2010;7(9):e1000345
147. Rochat I, Leis P, Bouchardy M, et al. Chest physiotherapy using passive expiratory techniques does not reduce bronchiolitis severity: a randomised controlled trial. *Eur J Pediatr*. 2012;171(3):457–462
148. Postiaux G, Louis J, Labasse HC, et al. Evaluation of an alternative chest physiotherapy method in infants with respiratory syncytial virus bronchiolitis. *Respir Care*. 2011;56(7):989–994
149. Sánchez Bayle M, Martín Martín R, Cano Fernández J, et al. Chest physiotherapy and bronchiolitis in the hospitalised infant. Double-blind clinical trial [in Spanish]. *An Pediatr (Barc)*. 2012;77(1):5–11
150. Mussman GM, Parker MW, Statile A, Sucharew H, Brady PW. Suctioning and length of stay in infants hospitalized with bronchiolitis. *JAMA Pediatr*. 2013;167(5):414–421
151. Weisgerber MC, Lye PS, Li SH, et al. Factors predicting prolonged hospital stay for infants with bronchiolitis. *J Hosp Med*. 2011;6(5):264–270
152. Nichol KP, Cherry JD. Bacterial-viral interrelations in respiratory infections of children. *N Engl J Med*. 1967;277(13):667–672
153. Field CM, Connolly JH, Murtagh G, Slattery CM, Turkington EE. Antibiotic treatment of epidemic bronchiolitis—a double-blind trial. *BMJ*. 1966;1(5479):83–85
154. Antonow JA, Hansen K, McKinstry CA, Byington CL. Sepsis evaluations in hospitalized infants with bronchiolitis. *Pediatr Infect Dis J*. 1998;17(3):231–236
155. Friis B, Andersen P, Brenøe E, et al. Antibiotic treatment of pneumonia and bronchiolitis. A prospective randomised study. *Arch Dis Child*. 1984;59(11):1038–1045
156. Greenes DS, Harper MB. Low risk of bacteremia in febrile children with recognizable viral syndromes. *Pediatr Infect Dis J*. 1999;18(3):258–261
157. Spurling GK, Doust J, Del Mar CB, Eriksson L. Antibiotics for bronchiolitis in children. *Cochrane Database Syst Rev*. 2011;(6):CD005189
158. Ralston S, Hill V, Waters A. Occult serious bacterial infection in infants younger than 60 to 90 days with bronchiolitis: a systematic review. *Arch Pediatr Adolesc Med*. 2011;165(10):951–956
159. Purcell K, Fergie J. Lack of usefulness of an abnormal white blood cell count for predicting a concurrent serious bacterial infection in infants and young children hospitalized with respiratory syncytial virus lower respiratory tract infection. *Pediatr Infect Dis J*. 2007;26(4):311–315
160. Purcell K, Fergie J. Concurrent serious bacterial infections in 2396 infants and children hospitalized with respiratory syncytial virus lower respiratory tract infections. *Arch Pediatr Adolesc Med*. 2002;156(4):322–324
161. Purcell K, Fergie J. Concurrent serious bacterial infections in 912 infants and children hospitalized for treatment of respiratory syncytial virus lower respiratory tract infection. *Pediatr Infect Dis J*. 2004;23(3):267–269
162. Kuppermann N, Bank DE, Walton EA, Senac MO Jr, McCaslin I. Risks for bacteremia and urinary tract infections in young febrile children with bronchiolitis. *Arch Pediatr Adolesc Med*. 1997;151(12):1207–1214
163. Titus MO, Wright SW. Prevalence of serious bacterial infections in febrile infants with respiratory syncytial virus infection. *Pediatrics*. 2003;112(2):282–284
164. Melendez E, Harper MB. Utility of sepsis evaluation in infants 90 days of age or younger with fever and clinical bronchiolitis. *Pediatr Infect Dis J*. 2003;22(12):1053–1056
165. Hall CB, Powell KR, Schnabel KC, Gala CL, Pincus PH. Risk of secondary bacterial

infection in infants hospitalized with respiratory syncytial viral infection. *J Pediatr*. 1988;113(2):266–271

166. Hall CB. Respiratory syncytial virus: a continuing culprit and conundrum. *J Pediatr*. 1999;135(2 pt 2):2–7
167. Davies HD, Matlow A, Petric M, Glazier R, Wang EE. Prospective comparative study of viral, bacterial and atypical organisms identified in pneumonia and bronchiolitis in hospitalized Canadian infants. *Pediatr Infect Dis J*. 1996;15(4):371–375
168. Levine DA, Platt SL, Dayan PS, et al; Multicenter RSV-SBI Study Group of the Pediatric Emergency Medicine Collaborative Research Committee of the American Academy of Pediatrics. Risk of serious bacterial infection in young febrile infants with respiratory syncytial virus infections. *Pediatrics*. 2004;113(6):1728–1734
169. Kellner JD, Ohlsson A, Gadomski AM, Wang EE. Bronchodilators for bronchiolitis. *Cochrane Database Syst Rev*. 2000;(2):CD001266
170. Pinto LA, Pitrez PM, Luisi F, et al. Azithromycin therapy in hospitalized infants with acute bronchiolitis is not associated with better clinical outcomes: a randomized, double-blinded, and placebo-controlled clinical trial. *J Pediatr*. 2012;161(6):1104–1108
171. McCallum GB, Morris PS, Chang AB. Antibiotics for persistent cough or wheeze following acute bronchiolitis in children. *Cochrane Database Syst Rev*. 2012;(12):CD009834
172. Levin D, Tribuzio M, Green-Wrzesinki T, et al. Empiric antibiotics are justified for infants with RSV presenting with respiratory failure. *Pediatr Crit Care*. 2010;11(3):390–395
173. Thorburn K, Reddy V, Taylor N, van Saene HK. High incidence of pulmonary bacterial co-infection in children with severe respiratory syncytial virus (RSV) bronchiolitis. *Thorax*. 2006;61(7):611–615
174. Gomaa MA, Galal O, Mahmoud MS. Risk of acute otitis media in relation to acute bronchiolitis in children. *Int J Pediatr Otorhinolaryngol*. 2012;76(1):49–51
175. Andrade MA, Hoberman A, Glustein J, Paradise JL, Wald ER. Acute otitis media in children with bronchiolitis. *Pediatrics*. 1998;101(4 pt 1):617–619
176. Shazberg G, Revel-Vilk S, Shoseyov D, Ben-Ami A, Klar A, Hurvitz H. The clinical course of bronchiolitis associated with acute otitis media. *Arch Dis Child*. 2000;83(4):317–319
177. Lieberthal AS, Carroll AE, Chonmaitree T, et al. The diagnosis and management of acute otitis media [published correction appears in *Pediatrics*. 2014;133(2):346]. *Pediatrics*. 2013;131(3). Available at: www.pediatrics.org/cgi/content/full/131/3/e964
178. Hoberman A, Paradise JL, Rockette HE, et al. Treatment of acute otitis media in children under 2 years of age. *N Engl J Med*. 2011;364(2):105–115
179. Tähtinen PA, Laine MK, Huovinen P, Jalava J, Ruuskanen O, Ruohola A. A placebo-controlled trial of antimicrobial treatment for acute otitis media. *N Engl J Med*. 2011;364(2):116–126
180. Corrard F, de La Rocque F, Martin E, et al. Food intake during the previous 24 h as a percentage of usual intake: a marker of hypoxia in infants with bronchiolitis: an observational, prospective, multicenter study. *BMC Pediatr*. 2013;13:6
181. Pinnington LL, Smith CM, Ellis RE, Morton RE. Feeding efficiency and respiratory integration in infants with acute viral bronchiolitis. *J Pediatr*. 2000;137(4):523–526
182. Khoshoo V, Edell D. Previously healthy infants may have increased risk of aspiration during respiratory syncytial viral bronchiolitis. *Pediatrics*. 1999;104(6):1389–1390
183. Kennedy N, Flanagan N. Is nasogastric fluid therapy a safe alternative to the intravenous route in infants with bronchiolitis? *Arch Dis Child*. 2005;90(3):320–321
184. Sammartino L, James D, Goutzamanis J, Lines D. Nasogastric rehydration does have a role in acute paediatric bronchiolitis. *J Paediatr Child Health*. 2002;38(3):321–322
185. Kugelman A, Raibin K, Dabbah H, et al. Intravenous fluids versus gastric-tube feeding in hospitalized infants with viral bronchiolitis: a randomized, prospective pilot study. *J Pediatr*. 2013;162(3):640–642.e1
186. Oakley E, Borland M, Neutze J, et al; Paediatric Research in Emergency Departments International Collaborative (PREDICT). Nasogastric hydration versus intravenous hydration for infants with bronchiolitis: a randomised trial. *Lancet Respir Med*. 2013;1(2):113–120
187. Gozal D, Colin AA, Jaffe M, Hochberg Z. Water, electrolyte, and endocrine homeostasis in infants with bronchiolitis. *Pediatr Res*. 1990;27(2):204–209
188. van Steensel-Moll HA, Hazelzet JA, van der Voort E, Neijens HJ, Hackeng WH. Excessive secretion of antidiuretic hormone in infections with respiratory syncytial virus. *Arch Dis Child*. 1990;65(11):1237–1239
189. Rivers RP, Forsling ML, Olver RP. Inappropriate secretion of antidiuretic hormone in infants with respiratory infections. *Arch Dis Child*. 1981;56(5):358–363
190. Wang J, Xu E, Xiao Y. Isotonic versus hypotonic maintenance IV fluids in hospitalized children: a meta-analysis. *Pediatrics*. 2014;133(1):105–113
191. American Academy of Pediatrics, Committee on Infectious Diseases and Bronchiolitis Guidelines Committee. Policy statement: updated guidance for palivizumab prophylaxis among infants and young children at increased risk of hospitalization for respiratory syncytial virus infection. *Pediatrics*. 2014;134(2):415–420
192. American Academy of Pediatrics; Committee on Infectious Diseases and Bronchiolitis Guidelines Committee. Technical report: updated guidance for palivizumab prophylaxis among infants and young children at increased risk of hospitalization for respiratory syncytial virus infection. *Pediatrics*. 2014;134(2):e620–e638.
193. IMpact-RSV Study Group. Palivizumab, a humanized respiratory syncytial virus monoclonal antibody, reduces hospitalization from respiratory syncytial virus infection in high-risk infants. The IMpact-RSV Study Group. *Pediatrics*. 1998;102(3):531–537
194. Feltes TF, Cabalk AK, Meissner HC, et al. Palivizumab prophylaxis reduces hospitalization due to respiratory syncytial virus in young children with hemodynamically significant congenital heart disease. *J Pediatr*. 2003;143(4):532–540
195. Andabaka T, Nickerson JW, Rojas-Reyes MX, Rueda JD, Bacic VV, Barsic B. Monoclonal antibody for reducing the risk of respiratory syncytial virus infection in children. *Cochrane Database Syst Rev*. 2013;(4):CD006602
196. Wang D, Bayliss S, Meads C. Palivizumab for immunoprophylaxis of respiratory syncytial virus (RSV) bronchiolitis in high-risk infants and young children: a systematic review and additional economic modelling of subgroup analyses. *Health Technol Assess*. 2011;1(5):iii–iv, 1–124
197. Hampp C, Kauf TL, Saidi AS, Winterstein AG. Cost-effectiveness of respiratory syncytial virus prophylaxis in various indications. *Arch Pediatr Adolesc Med*. 2011;165(6):498–505
198. Hall CB, Weinberg GA, Iwane MK, et al. The burden of respiratory syncytial virus infection in young children. *N Engl J Med*. 2009;360(6):588–598
199. Dupenthaler A, Ammann RA, Gorgievski-Hrisoho M, et al. Low incidence of respiratory syncytial virus hospitalisations in haemodynamically significant congenital

heart disease. *Arch Dis Child*. 2004;89:961–965

200. Geskey JM, Thomas NJ, Brummel GL. Palivizumab in congenital heart disease: should international guidelines be revised? *Expert Opin Biol Ther*. 2007;7(11):1615–1620
201. Robbie GJ, Zhao L, Mondick J, Losonsky G, Roskos LK. Population pharmacokinetics of palivizumab, a humanized anti-respiratory syncytial virus monoclonal antibody, in adults and children. *Antimicrob Agents Chemother*. 2012;56(9):4927–4936
202. Megged O, Schlesinger Y. Down syndrome and respiratory syncytial virus infection. *Pediatr Infect Dis J*. 2010;29(7):672–673
203. Robinson KA, Odelola OA, Saldanha IJ, Mckoy NA. Palivizumab for prophylaxis against respiratory syncytial virus infection in children with cystic fibrosis. *Cochrane Database Syst Rev*. 2012;(2):CD007743
204. Winterstein AG, Eworuke E, Xu D, Schuler P. Palivizumab immunoprophylaxis effectiveness in children with cystic fibrosis. *Pediatr Pulmonol*. 2013;48(9):874–884
205. Cohen AH, Boron ML, Dingivan C. A phase IV study of the safety of palivizumab for prophylaxis of RSV disease in children with cystic fibrosis [abstract]. *American Thoracic Society Abstracts*, 2005 International Conference; 2005. p. A178
206. Giusti R. North American synagis prophylaxis survey. *Pediatr Pulmonol*. 2009;44(1):96–98
207. El Saleeby CM, Somes GW, DeVincenzo HP, Gaur AH. Risk factors for severe respiratory syncytial virus disease in children with cancer: the importance of lymphopenia and young age. *Pediatrics*. 2008;121(2):235–243
208. Berger A, Obwegeser E, Aberle SW, Langgartner M, Popow-Kraupp T. Nosocomial transmission of respiratory syncytial virus in neonatal intensive care and intermediate care units. *Pediatr Infect Dis J*. 2010;29(7):669–670
209. Ohler KH, Pham JT. Comparison of the timing of initial prophylactic palivizumab dosing on hospitalization of neonates for respiratory syncytial virus. *Am J Health Syst Pharm*. 2013;70(15):1342–1346
210. Blanken MO, Robers MM, Molenaar JM, et al. Respiratory syncytial virus and recurrent wheeze in healthy preterm infants. *N Engl J Med*. 2013;368(19):1794–1799
211. Yoshihara S, Kusuda S, Mochizuki H, Okada K, Nishima S, Simões EAF; C-CREW Investigators. Effect of palivizumab prophylaxis on subsequent recurrent wheezing in preterm infants. *Pediatrics*. 2013;132(5):811–818
212. Hall CB, Douglas RG Jr, Geiman JM. Possible transmission by fomites of respiratory syncytial virus. *J Infect Dis*. 1980;141(1):98–102
213. Sattar SA, Springthorpe VS, Tetro J, Vashon R, Keswick B. Hygienic hand antiseptics: should they not have activity and label claims against viruses? *Am J Infect Control*. 2002;30(6):355–372
214. Picheansathian W. A systematic review on the effectiveness of alcohol-based solutions for hand hygiene. *Int J Nurs Pract*. 2004;10(1):3–9
215. Hall CB. The spread of influenza and other respiratory viruses: complexities and conjectures. *Clin Infect Dis*. 2007;45(3):353–359
216. Boyce JM, Pittet D; Healthcare Infection Control Practices Advisory Committee; HICPAC/SHEA/APIC/IDSA Hand Hygiene Task Force; Society for Healthcare Epidemiology of America/Association for Professionals in Infection Control/Infectious Diseases Society of America. Guideline for Hand Hygiene in Health-Care Settings. Recommendations of the Healthcare Infection Control Practices Advisory Committee and the HICPAC/SHEA/APIC/IDSA Hand Hygiene Task Force. *MMWR Recomm Rep*. 2002;51(RR-16):1–45, quiz CE1–CE4
217. World Health Organization. Guidelines on hand hygiene in health care. Geneva, Switzerland: World Health Organization; 2009. Available at: http://whqlibdoc.who.int/publications/2009/9789241597906_eng.pdf. Accessed July 15, 2014
218. Karanfil LV, Conlon M, Lykens K, et al. Reducing the rate of nosocomially transmitted respiratory syncytial virus. [published correction appears in Am J Infect Control. 1999;27(3):303] *Am J Infect Control*. 1999;27(2):91–96
219. Macartney KK, Gorelick MH, Manning ML, Hodinka RL, Bell LM. Nosocomial respiratory syncytial virus infections: the cost-effectiveness and cost-benefit of infection control. *Pediatrics*. 2000;106(3):520–526
220. Strachan DP, Cook DG. Health effects of passive smoking. 1. Parental smoking and lower respiratory illness in infancy and early childhood. *Thorax*. 1997;52(10):905–914
221. Jones LL, Hashim A, McKeever T, Cook DG, Britton J, Leonardi-Bee J. Parental and household smoking and the increased risk of bronchitis, bronchiolitis and other lower respiratory infections in infancy: systematic review and meta-analysis. *Respir Res*. 2011;12:5
222. Bradley JP, Bacharier LB, Bonfiglio J, et al. Severity of respiratory syncytial virus bronchiolitis is affected by cigarette smoke exposure and atopy. *Pediatrics*. 2005;115(1). Available at: www.pediatrics.org/cgi/content/full/115/1/e7
223. Al-Shawwa B, Al-Huniti N, Weinberger M, Abu-Hasan M. Clinical and therapeutic variables influencing hospitalisation for bronchiolitis in a community-based paediatric group practice. *Prim Care Respir J*. 2007;16(2):93–97
224. Carroll KN, Gebretsadik T, Griffin MR, et al. Maternal asthma and maternal smoking are associated with increased risk of bronchiolitis during infancy. *Pediatrics*. 2007;119(6):1104–1112
225. Semple MG, Taylor-Robinson DC, Lane S, Smyth RL. Household tobacco smoke and admission weight predict severe bronchiolitis in infants independent of deprivation: prospective cohort study. *PLoS ONE*. 2011;6(7):e22425
226. Best D; Committee on Environmental Health; Committee on Native American Child Health; Committee on Adolescence. From the American Academy of Pediatrics: Technical report—Secondhand and prenatal tobacco smoke exposure. *Pediatrics*. 2009;124(5). Available at: www.pediatrics.org/cgi/content/full/124/5/e1017
227. Wilson KM, Wesgate SC, Best D, Blumkin AK, Klein JD. Admission screening for secondhand tobacco smoke exposure. *Hosp Pediatr*. 2012;2(1):26–33
228. Mahabee-Gittens M. Smoking in parents of children with asthma and bronchiolitis in a pediatric emergency department. *Pediatr Emerg Care*. 2002;18(1):4–7
229. Dempsey DA, Meyers MJ, Oh SS, et al. Determination of tobacco smoke exposure by plasma cotinine levels in infants and children attending urban public hospital clinics. *Arch Pediatr Adolesc Med*. 2012;166(9):851–856
230. Rosen LJ, Noach MB, Winickoff JP, Hovell MF. Parental smoking cessation to protect young children: a systematic review and meta-analysis. *Pediatrics*. 2012;129(1):141–152
231. Matt GE, Quintana PJ, Destaillats H, et al. Thirdhand tobacco smoke: emerging evidence and arguments for a multidisciplinary research agenda. *Environ Health Perspect*. 2011;119(9):1218–1226
232. Section on Breastfeeding. Breastfeeding and the use of human milk. *Pediatrics*. 2012;129(3). Available at: www.pediatrics.org/cgi/content/full/129/3/e827
233. Ip S, Chung M, Raman G, et al. *Breastfeeding and Maternal and Infant Health Outcomes in Developed Countries*. Rockville,

MD: Agency for Healthcare Research and Quality; 2007

234. Dornelles CT, Piva JP, Marostica PJ. Nutritional status, breastfeeding, and evolution of infants with acute viral bronchiolitis. *J Health Popul Nutr*. 2007;25(3):336–343
235. Oddy WH, Sly PD, de Klerk NH, et al. Breast feeding and respiratory morbidity in infancy: a birth cohort study. *Arch Dis Child*. 2003;88(3):224–228
236. Nishimura T, Suzue J, Kaji H. Breastfeeding reduces the severity of respiratory syncytial virus infection among young infants: a multi-center prospective study. *Pediatr Int*. 2009;51(6):812–816
237. Petruzella FD, Gorelick MH. Duration of illness in infants with bronchiolitis evaluated in the emergency department. *Pediatrics*. 2010;126(2):285–290
238. von Linstow ML, Eugen-Olsen J, Koch A, Winther TN, Westh H, Hogh B. Excretion patterns of human metapneumovirus and respiratory syncytial virus among young children. *Eur J Med Res*. 2006;11(8):329–335
239. Sacri AS, De Serres G, Quach C, Boulianne N, Valiquette L, Skowronski DM. Transmission of acute gastroenteritis and respiratory illness from children to parents. *Pediatr Infect Dis J*. 2014;33(6):583–588
240. Taylor JA, Kwan-Gett TS, McMahon EM Jr. Effectiveness of an educational intervention in modifying parental attitudes about antibiotic usage in children. *Pediatrics*. 2003;111 (5 pt 1). Available at: www.pediatrics.org/cgi/content/full/111/5pt1/e548
241. Kuzujanakis M, Kleinman K, Rifas-Shiman S, Finkelstein JA. Correlates of parental antibiotic knowledge, demand, and reported use. *Ambul Pediatr*. 2003;3(4):203–210
242. Mangione-Smith R, McGlynn EA, Elliott MN, Krogstad P, Brook RH. The relationship between perceived parental expectations and pediatrician antimicrobial prescribing behavior. *Pediatrics*. 1999;103(4 pt 1):711–718

APPENDIX 1 SEARCH TERMS BY TOPIC

Introduction

MedLine

((“bronchiolitis”[MeSH]) OR (“respiratory syncytial viruses”[MeSH]) NOT “bronchiolitis obliterans”[All Fields])

1. and exp Natural History/
2. and exp Epidemiology/
3. and (exp economics/ or exp “costs and cost analysis”/ or exp “cost allocation”/ or exp cost-benefit analysis/ or exp “cost control”/ or exp “cost of illness”/ or exp “cost sharing”/ or exp health care costs/ or exp health expenditures/)
4. and exp Risk Factors/

Limit to English Language AND Humans AND (“all infant (birth to 23 months)” or “newborn infant (birth to 1 month)” or “infant (1 to 23 months)”)

CINAHL

(MM “Bronchiolitis+”) AND (“natural history” OR (MM “Epidemiology”) OR (MM “Costs and Cost Analysis”) OR (MM “Risk Factors”))

The Cochrane Library

Bronchiolitis AND (epidemiology OR risk factor OR cost)

Diagnosis/Severity

MedLine

exp BRONCHIOLITIS/di [Diagnosis] OR exp Bronchiolitis, Viral/di [Diagnosis]

limit to English Language AND (“all infant (birth to 23 months)” or “newborn infant (birth to 1 month)” or “infant (1 to 23 months)”)

CINAHL

(MH “Bronchiolitis/DI”)

The Cochrane Library

Bronchiolitis AND Diagnosis

*Upper Respiratory Infection Symptoms

MedLine

(exp Bronchiolitis/ OR exp Bronchiolitis, Viral/) AND exp *Respiratory Tract Infections/

Limit to English Language

Limit to “all infant (birth to 23 months)” OR “newborn infant (birth to 1 month)” OR “infant (1 to 23 months)”)

CINAHL

(MM “Bronchiolitis+”) AND (MM “Respiratory Tract Infections+”)

The Cochrane Library

Bronchiolitis AND Respiratory Infection

Inhalation Therapies

*Bronchodilators & Corticosteroids

MedLine

((“bronchiolitis”[MeSH]) OR (“respiratory syncytial viruses”[MeSH]) NOT “bronchiolitis obliterans”[All Fields])

AND (exp Receptors, Adrenergic, β-2/ OR exp Receptors, Adrenergic, β/ OR exp Receptors, Adrenergic, β-1/ OR β adrenergic*.mp. OR exp ALBUTEROL/ OR levalbuterol.mp. OR exp EPINEPHRINE/ OR exp Cholinergic Antagonists/ OR exp IPRATROPIUM/ OR exp Anti-Inflammatory Agents/ OR ics.mp. OR inhaled corticosteroid*.mp. OR exp Adrenal Cortex Hormones/ OR exp Leukotriene Antagonists/ OR montelukast.mp. OR exp Bronchodilator Agents/)

Limit to English Language AND (“all infant (birth to 23 months)” or “newborn infant (birth to 1 month)” or “infant (1 to 23 months)”)

CINAHL

(MM “Bronchiolitis+”) AND (MM “Bronchodilator Agents”)

The Cochrane Library

Bronchiolitis AND (bronchodilator OR epinephrine OR albuterol OR salbutamol OR corticosteroid OR steroid)

*Hypertonic Saline

MedLine

((“bronchiolitis”[MeSH]) OR (“respiratory syncytial viruses”[MeSH]) NOT “bronchiolitis obliterans”[All Fields])

AND (exp Saline Solution, Hypertonic/ OR (aerosolized saline.mp. OR (exp AEROSOLS/ AND exp Sodium Chloride/)) OR (exp Sodium Chloride/ AND exp “Nebulizers and Vaporizers”/) OR nebulized saline.mp.)

Limit to English Language

Limit to “all infant (birth to 23 months)” OR “newborn infant (birth to 1 month)” OR “infant (1 to 23 months)”)

CINAHL

(MM “Bronchiolitis+”) AND (MM “Saline Solution, Hypertonic”)

The Cochrane Library

Bronchiolitis AND Hypertonic Saline

Oxygen

MedLine

((“bronchiolitis”[MeSH]) OR (“respiratory syncytial viruses”[MeSH]) NOT “bronchiolitis obliterans”[All Fields])

1. AND (exp Oxygen Inhalation Therapy/ OR supplemental oxygen.mp. OR oxygen saturation.mp. OR *Oxygen/ad, st [Administration & Dosage, Standards] OR oxygen treatment.mp.)
2. AND (exp OXIMETRY/ OR oximeters.mp.) AND (exp “Reproducibility of Results”/ OR reliability.mp. OR function.mp. OR technical specifications.mp.) OR (percutaneous measurement*.mp. OR exp Blood Gas Analysis/)

Limit to English Language

Limit to “all infant (birth to 23 months)” OR “newborn infant (birth to 1 month)” OR “infant (1 to 23 months)”)

CINAHL

(MM "Bronchiolitis+") AND

((MM "Oxygen Therapy") OR (MM "Oxygen+") OR (MM "Oxygen Saturation") OR (MM "Oximetry+") OR (MM "Pulse Oximetry") OR (MM "Blood Gas Monitoring, Transcutaneous"))

The Cochrane Library

Bronchiolitis AND (oxygen OR oximetry)

Chest Physiotherapy and Suctioning

MedLine

(("bronchiolitis"[MeSH]) OR ("respiratory syncytial viruses"[MeSH]) NOT "bronchiolitis obliterans"[All Fields])

1. AND (Chest physiotherapy.mp. OR (exp Physical Therapy Techniques/ AND exp Thorax/))
2. AND (Nasal Suction.mp. OR (exp Suction/))

Limit to English Language

Limit to "all infant (birth to 23 months)" OR "newborn infant (birth to 1 month)" OR "infant (1 to 23 months)")

CINAHL

(MM "Bronchiolitis+")

1. AND ((MH "Chest Physiotherapy (Saba CCC)") OR (MH "Chest Physical Therapy+") OR (MH "Chest Physiotherapy (Iowa NIC)"))
2. AND (MH "Suctioning, Nasopharyngeal")

The Cochrane Library

Bronchiolitis AND (chest physiotherapy OR suction*)

Hydration

MedLine

(("bronchiolitis"[MeSH]) OR ("respiratory syncytial viruses"[MeSH]) NOT "bronchiolitis obliterans"[All Fields])

AND (exp Fluid Therapy/ AND (exp infusions, intravenous OR exp administration, oral))

Limit to English Language

Limit to ("all infant (birth to 23 months)" or "newborn infant (birth to 1 month)" or "infant (1 to 23 months)")

CINAHL

(MM "Bronchiolitis+") AND

((MM "Fluid Therapy+") OR (MM "Hydration Control (Saba CCC)") OR (MM "Hydration (Iowa NOC)"))

The Cochrane Library

Bronchiolitis AND (hydrat* OR fluid*)

SBI and Antibacterials

MedLine

(("bronchiolitis"[MeSH]) OR ("respiratory syncytial viruses"[MeSH]) NOT "bronchiolitis obliterans"[All Fields])

AND

(exp Bacterial Infections/ OR exp Bacterial Pneumonia/ OR exp Otitis Media/ OR exp Meningitis/ OR exp *Anti-bacterial Agents/ OR exp Sepsis/ OR exp Urinary Tract Infections/ OR exp Bacteremia/ OR exp Tracheitis OR serious bacterial infection.mp.)

Limit to English Language

Limit to ("all infant (birth to 23 months)" or "newborn infant (birth to 1 month)" or "infant (1 to 23 months)")

CINAHL

(MM "Bronchiolitis+") AND

((MM "Pneumonia, Bacterial+") OR (MM "Bacterial Infections+") OR (MM "Otitis Media+") OR (MM "Meningitis, Bacterial+") OR (MM "Antiinfective Agents+") OR (MM "Sepsis+") OR (MM "Urinary Tract Infections+") OR (MM "Bacteremia"))

The Cochrane Library

Bronchiolitis AND (serious bacterial infection OR sepsis OR otitis media OR meningitis OR urinary tract infection or bacteremia OR pneumonia OR antibacterial OR antimicrobial OR antibiotic)

Hand Hygiene, Tobacco, Breastfeeding, Parent Education

MedLine

(("bronchiolitis"[MeSH]) OR ("respiratory syncytial viruses"[MeSH]) NOT "bronchiolitis obliterans"[All Fields])

1. AND (exp Hand Disinfection/ OR hand decontamination.mp. OR handwashing.mp.)
2. AND exp Tobacco/
3. AND (exp Breast Feeding/ OR exp Milk, Human/ OR exp Bottle Feeding/)

Limit to English Language

Limit to ("all infant (birth to 23 months)" or "newborn infant (birth to 1 month)" or "infant (1 to 23 months)")

CINAHL

(MM "Bronchiolitis+")

1. AND (MH "Handwashing+")
2. AND (MH "Tobacco+")
3. AND (MH "Breast Feeding+" OR MH "Milk, Human+" OR MH "Bottle Feeding+")

The Cochrane Library

Bronchiolitis

1. AND (Breast Feeding OR breastfeeding)
2. AND tobacco
3. AND (hand hygiene OR handwashing OR hand decontamination)

Bronchiolitis Clinical Practice Guideline Quick Reference Tools

- Action Statement Summary
  — The Diagnosis, Management, and Prevention of Bronchiolitis
- *ICD-10-CM* Coding Quick Reference for Bronchiolitis
- AAP Patient Education Handout
  — *Bronchiolitis and Your Young Child*

Action Statement Summary

The Diagnosis, Management, and Prevention of Bronchiolitis

Key Action Statement 1a

Clinicians should diagnose bronchiolitis and assess disease severity on the basis of history and physical examination (Evidence Quality: B; Recommendation Strength: Strong Recommendation).

Key Action Statement 1b

Clinicians should assess risk factors for severe disease, such as age <12 weeks, a history of prematurity, underlying cardiopulmonary disease, or immunodeficiency, when making decisions about evaluation and management of children with bronchiolitis (Evidence Quality: B; Recommendation Strength: Moderate Recommendation).

Key Action Statement 1c

When clinicians diagnose bronchiolitis on the basis of history and physical examination, radiographic or laboratory studies should not be obtained routinely (Evidence Quality: B; Recommendation Strength: Moderate Recommendation).

Key Action Statement 2

Clinicians should not administer albuterol (or salbutamol) to infants and children with a diagnosis of bronchiolitis (Evidence Quality: B; Recommendation Strength: Strong Recommendation).

Key Action Statement 3

Clinicians should not administer epinephrine to infants and children with a diagnosis of bronchiolitis (Evidence Quality: B; Recommendation Strength: Strong Recommendation).

Key Action Statement 4a

Nebulized hypertonic saline should not be administered to infants with a diagnosis of bronchiolitis in the emergency department (Evidence Quality: B; Recommendation Strength: Moderate Recommendation).

Key Action Statement 4b

Clinicians may administer nebulized hypertonic saline to infants and children hospitalized for bronchiolitis (Evidence Quality: B; Recommendation Strength: Weak Recommendation [based on randomized controlled trials with inconsistent findings]).

Key Action Statement 5

Clinicians should not administer systemic corticosteroids to infants with a diagnosis of bronchiolitis in any setting (Evidence Quality: A; Recommendation Strength: Strong Recommendation).

Key Action Statement 6a

Clinicians may choose not to administer supplemental oxygen if the oxyhemoglobin saturation exceeds 90% in infants and children with a diagnosis of bronchiolitis (Evidence Quality: D; Recommendation Strength: Weak Recommendation [based on low-level evidence and reasoning from first principles]).

Key Action Statement 6b

Clinicians may choose not to use continuous pulse oximetry for infants and children with a diagnosis of bronchiolitis (Evidence Quality: C; Recommendation Strength: Weak Recommendation [based on lower-level evidence]).

Key Action Statement 7

Clinicians should not use chest physiotherapy for infants and children with a diagnosis of bronchiolitis (Evidence Quality: B; Recommendation Strength: Moderate Recommendation).

Key Action Statement 8

Clinicians should not administer antibacterial medications to infants and children with a diagnosis of bronchiolitis unless there is a concomitant bacterial infection, or a strong suspicion of one. (Evidence Quality: B; Recommendation Strength: Strong Recommendation).

Key Action Statement 9

Clinicians should administer nasogastric or intravenous fluids for infants with a diagnosis of bronchiolitis who cannot maintain hydration orally (Evidence Quality: X; Recommendation Strength: Strong Recommendation).

Key Action Statement 10a

Clinicians should not administer palivizumab to otherwise healthy infants with a gestational age of 29 weeks, 0 days or greater (Evidence Quality: B; Recommendation Strength: Strong Recommendation).

Key Action Statement 10b

Clinicians should administer palivizumab during the first year of life to infants with hemodynamically significant heart disease or chronic lung disease of prematurity defined as preterm infants <32 weeks, 0 days' gestation who require >21% oxygen for at least the first 28 days of life (Evidence Quality: B; Recommendation Strength: Moderate Recommendation).

Key Action Statement 10c

Clinicians should administer a maximum 5 monthly doses (15 mg/kg/dose) of palivizumab during the RSV season to infants who qualify for palivizumab in the first year of life (Evidence Quality: B, Recommendation Strength: Moderate Recommendation).

Key Action Statement 11a

All people should disinfect hands before and after direct contact with patients, after contact with inanimate objects in the direct vicinity of the patient, and after removing gloves (Evidence Quality: B; Recommendation Strength: Strong Recommendation).

Key Action Statement 11b

All people should use alcohol-based rubs for hand decontamination when caring for children with bronchiolitis. When alcohol-based rubs are not available, individuals should wash their hands with soap and water (Evidence Quality: B; Recommendation Strength: Strong Recommendation).

Key Action Statement 12a

Clinicians should inquire about the exposure of the infant or child to tobacco smoke when assessing infants and children for bronchiolitis (Evidence Quality: C; Recommendation Strength: Moderate Recommendation).

Key Action Statement 12b

Clinicians should counsel caregivers about exposing the infant or child to environmental tobacco smoke and smoking cessation when assessing a child for bronchiolitis (Evidence Quality: B; Recommendation Strength: Strong Recommendation).

Key Action Statement 13

Clinicians should encourage exclusive breastfeeding for at least 6 months to decrease the morbidity of respiratory infections (Evidence Quality: Grade B; Recommendation Strength: Moderate Recommendation).

Key Action Statement 14

Clinicians and nurses should educate personnel and family members on evidence-based diagnosis, treatment, and prevention in bronchiolitis (Evidence Quality: C; observational studies; Recommendation Strength; Moderate Recommendation).

Coding Quick Reference for Bronchiolitis
ICD-10-CM
J21.0 Acute bronchiolitis due to syncytial virus
J21.1 Acute bronchiolitis due to human metapneumovirus
J21.8 Acute bronchiolitis due to other specified organisms
J21.9 Acute bronchiolitis, unspecified

Bronchiolitis and Your Young Child

Bronchiolitis is a common respiratory illness among infants. One of its symptoms is trouble breathing, which can be scary for parents and young children. Read on for more information from the American Academy of Pediatrics about bronchiolitis, its causes, signs and symptoms, how to treat it, and how to prevent it.

What is bronchiolitis?

Bronchiolitis is an infection that causes the small breathing tubes of the lungs (bronchioles) to swell. This blocks airflow through the lungs, making it hard to breathe. It occurs most often in infants because their airways are smaller and more easily blocked than in older children. Bronchiolitis is not the same as bronchitis, which is an infection of the larger, more central airways that typically causes problems in adults.

What causes bronchiolitis?

Bronchiolitis is caused by one of several respiratory viruses such as influenza, respiratory syncytial virus (RSV), parainfluenza, and human metapneumovirus. Other viruses can also cause bronchiolitis.

Infants with RSV infection are more likely to get bronchiolitis with wheezing and difficulty breathing. Most adults and many older children with RSV infection only get a cold. RSV is spread by contact with an infected person's mucus or saliva (respiratory droplets produced during coughing or wheezing). It often spreads through families and child care centers. (See "How can you prevent your baby from getting bronchiolitis?")

What are the signs and symptoms of bronchiolitis?

Bronchiolitis often starts with signs of a cold, such as a runny nose, mild cough, and fever. After 1 or 2 days, the cough may get worse and an infant will begin to breathe faster. Your child may become dehydrated if he cannot comfortably drink fluids.

If your child shows any signs of troubled breathing or dehydration, call your child's doctor.

Signs of troubled breathing

- He may widen his nostrils and squeeze the muscles under his rib cage to try to get more air into and out of his lungs.
- When he breathes, he may grunt and tighten his stomach muscles.
- He will make a high-pitched whistling sound, called a wheeze, when he breathes out.
- He may have trouble drinking because he may have trouble sucking and swallowing.
- If it gets very hard for him to breathe, you may notice a bluish tint around his lips and fingertips. This tells you his airways are so blocked that there is not enough oxygen getting into his blood.

Signs of dehydration

- Drinking less than normal
- Dry mouth
- Crying without tears
- Urinating less often than normal

Can bronchiolitis be treated at home?

There is no specific treatment for RSV or other viruses that cause bronchiolitis. Antibiotics are not helpful because they treat illnesses caused by bacteria, not viruses. However, you can try to ease your child's symptoms.

To relieve a stuffy nose

- Thin the mucus using saline nose drops recommended by your child's doctor. Never use nonprescription nose drops that contain medicine.
- Clear your baby's nose with a suction bulb.Squeeze the bulb first. Gently put the rubber tip into one nostril, and slowly release the bulb. This suction will draw the clogged mucus out of the nose. This works best when your baby is younger than 6 months.

To relieve fever

Give your baby acetaminophen. (Follow the recommended dosage for your baby's age.) Do not give your baby aspirin because it has been associated with Reye syndrome, a disease that affects the liver and brain. Check with your child's doctor first before giving any other cold medicines.

To prevent dehydration

Make sure your baby drinks lots of fluid. She may want clear liquids rather than milk or formula. She may feed more slowly or not feel like eating because she is having trouble breathing.

Bronchiolitis and children with severe chronic illness

Bronchiolitis may cause more severe illness in children who have a chronic illness. If you think your child has bronchiolitis and she has any of the following conditions, call her doctor:

- Cystic fibrosis
- Congenital heart disease
- Chronic lung disease (seen in some infants who were on breathing machines or respirators as newborns)
- Immune deficiency disease (eg, acquired immunodeficiency syndrome [AIDS])
- Organ or bone marrow transplant
- A cancer for which she is receiving chemotherapy

How will your child's doctor treat bronchiolitis?

Your child's doctor will evaluate your child and advise you on nasal suctioning, fever control, and observation, as well as when to call back.

Some children with bronchiolitis need to be treated in a hospital for breathing problems or dehydration. Breathing problems may need to be treated with oxygen and medicine. Dehydration is treated with a special liquid diet or intravenous (IV) fluids.

In very rare cases when these treatments aren't working, an infant might have to be put on a respirator. This is usually only temporary until the infection is gone.

How can you prevent your baby from getting bronchiolitis?

The best steps you can follow to reduce the risk that your baby becomes infected with RSV or other viruses that cause bronchiolitis include

- Make sure everyone washes their hands before touching your baby.
- Keep your baby away from anyone who has a cold, fever, or runny nose.
- Avoid sharing eating utensils and drinking cups with anyone who has a cold, fever, or runny nose.

If you have questions about the treatment of bronchiolitis, call your child's doctor.

From Your Doctor

American Academy of Pediatrics
DEDICATED TO THE HEALTH OF ALL CHILDREN®

healthychildren.org
Powered by pediatricians. Trusted by parents.
from the American Academy of Pediatrics

The American Academy of Pediatrics (AAP) is an organization of 67,000 primary care pediatricians, pediatric medical subspecialists, and pediatric surgical specialists dedicated to the health, safety, and well-being of all infants, children, adolescents, and young adults.

Management of Newly Diagnosed Type 2 Diabetes Mellitus (T2DM) in Children and Adolescents

- *Clinical Practice Guideline*
  - *PPI: AAP Partnership for Policy Implementation*
    See Appendix 1 for more information.

CLINICAL PRACTICE GUIDELINE

Management of Newly Diagnosed Type 2 Diabetes Mellitus (T2DM) in Children and Adolescents

abstract

FREE

Over the past 3 decades, the prevalence of childhood obesity has increased dramatically in North America, ushering in a variety of health problems, including type 2 diabetes mellitus (T2DM), which previously was not typically seen until much later in life. The rapid emergence of childhood T2DM poses challenges to many physicians who find themselves generally ill-equipped to treat adult diseases encountered in children. This clinical practice guideline was developed to provide evidence-based recommendations on managing 10- to 18-year-old patients in whom T2DM has been diagnosed. The American Academy of Pediatrics (AAP) convened a Subcommittee on Management of T2DM in Children and Adolescents with the support of the American Diabetes Association, the Pediatric Endocrine Society, the American Academy of Family Physicians, and the Academy of Nutrition and Dietetics (formerly the American Dietetic Association). These groups collaborated to develop an evidence report that served as a major source of information for these practice guideline recommendations. The guideline emphasizes the use of management modalities that have been shown to affect clinical outcomes in this pediatric population. Recommendations are made for situations in which either insulin or metformin is the preferred first-line treatment of children and adolescents with T2DM. The recommendations suggest integrating lifestyle modifications (ie, diet and exercise) in concert with medication rather than as an isolated initial treatment approach. Guidelines for frequency of monitoring hemoglobin A1c (HbA1c) and finger-stick blood glucose (BG) concentrations are presented. Decisions were made on the basis of a systematic grading of the quality of evidence and strength of recommendation. The clinical practice guideline underwent peer review before it was approved by the AAP. This clinical practice guideline is not intended to replace clinical judgment or establish a protocol for the care of all children with T2DM, and its recommendations may not provide the only appropriate approach to the management of children with T2DM. Providers should consult experts trained in the care of children and adolescents with T2DM when treatment goals are not met or when therapy with insulin is initiated. The AAP acknowledges that some primary care clinicians may not be confident of their ability to successfully treat T2DM in a child because of the child's age, coexisting conditions, and/or other concerns. At any point at which a clinician feels he or she is not adequately trained or is uncertain about treatment, a referral to a pediatric medical subspecialist should be made. If a diagnosis of T2DM is made by a pediatric medical subspecialist, the primary care clinician should develop a comanagement strategy with the subspecialist to ensure that the child continues to receive appropriate care consistent with a medical home model in which the pediatrician partners with parents to ensure that all health needs are met. *Pediatrics* 2013;131:364–382

Kenneth C. Copeland, MD, Janet Silverstein, MD, Kelly R. Moore, MD, Greg E. Prazar, MD, Terry Raymer, MD, CDE, Richard N. Shiffman, MD, Shelley C. Springer, MD, MBA, Vidhu V. Thaker, MD, Meaghan Anderson, MS, RD, LD, CDE, Stephen J. Spann, MD, MBA, and Susan K. Flinn, MA

KEY WORDS

diabetes, type 2 diabetes mellitus, childhood, youth, clinical practice guidelines, comanagement, management, treatment

ABBREVIATIONS

AAP—American Academy of Pediatrics
AAFP—American Academy of Family Physicians
BG—blood glucose
FDA—US Food and Drug Administration
HbA1c—hemoglobin A1c
PES—Pediatric Endocrine Society
T1DM—type 1 diabetes mellitus
T2DM—type 2 diabetes mellitus
TODAY—Treatment Options for type 2 Diabetes in Adolescents and Youth

www.pediatrics.org/cgi/doi/10.1542/peds.2012-3494

doi:10.1542/peds.2012-3494

PEDIATRICS (ISSN Numbers: Print, 0031-4005; Online, 1098-4275).

Key action statements are as follows:

1. Clinicians must ensure that insulin therapy is initiated for children and adolescents with T2DM who are ketotic or in diabetic ketoacidosis and in whom the distinction between types 1 and 2 diabetes mellitus is unclear and, in usual cases, should initiate insulin therapy for patients
   a. who have random venous or plasma BG concentrations ≥250 mg/dL; or
   b. whose HbA1c is >9%.

2. In all other instances, clinicians should initiate a lifestyle modification program, including nutrition and physical activity, and start metformin as first-line therapy for children and adolescents at the time of diagnosis of T2DM.

3. The committee suggests that clinicians monitor HbA1c concentrations every 3 months and intensify treatment if treatment goals for finger-stick BG and HbA1c concentrations are not being met (intensification is defined in the Definitions box).

4. The committee suggests that clinicians advise patients to monitor finger-stick BG (see Key Action Statement 4 in the guideline for further details) concentrations in patients who
   a. are taking insulin or other medications with a risk of hypoglycemia; or
   b. are initiating or changing their diabetes treatment regimen; or
   c. have not met treatment goals; or
   d. have intercurrent illnesses.

5. The committee suggests that clinicians incorporate the Academy of Nutrition and Dietetics' *Pediatric Weight Management Evidence-Based Nutrition Practice Guidelines* in their dietary or nutrition counseling of patients with T2DM at the time of diagnosis and as part of ongoing management.

6. The committee suggests that clinicians encourage children and adolescents with T2DM to engage in moderate-to-vigorous exercise for at least 60 minutes daily and to limit nonacademic "screen time" to less than 2 hours a day.

Definitions

Adolescent: an individual in various stages of maturity, generally considered to be between 12 and 18 years of age.

Childhood T2DM: disease in the child who typically

- is overweight or obese (BMI ≥85th–94th and >95th percentile for age and gender, respectively);
- has a strong family history of T2DM;
- has substantial residual insulin secretory capacity at diagnosis (reflected by normal or elevated insulin and C-peptide concentrations);
- has insidious onset of disease;
- demonstrates insulin resistance (including clinical evidence of polycystic ovarian syndrome or acanthosis nigricans);
- lacks evidence for diabetic autoimmunity (negative for autoantibodies typically associated with T1DM). These patients are more likely to have hypertension and dyslipidemia than are those with T1DM.

Clinician: any provider within his or her scope of practice; includes medical practitioners (including physicians and physician extenders), dietitians, psychologists, and nurses.
Diabetes: according to the American Diabetes Association criteria, defined as

1. HbA1c ≥6.5% (test performed in an appropriately certified laboratory); or
2. fasting (defined as no caloric intake for at least 8 hours) plasma glucose ≥126 mg/dL (7.0 mmol/L); or
3. 2-hour plasma glucose ≥200 mg/dL (11.1 mmol/L) during an oral glucose tolerance test performed as described by the World Health Organization by using a glucose load containing the equivalent of 75 g anhydrous glucose dissolved in water; or
4. a random plasma glucose ≥200 mg/dL (11.1 mmol/L) with symptoms of hyperglycemia.

(In the absence of unequivocal hyperglycemia, criteria 1–3 should be confirmed by repeat testing.)

Diabetic ketoacidosis: acidosis resulting from an absolute or relative insulin deficiency, causing fat breakdown and formation of β hydroxybutyrate. Symptoms include nausea, vomiting, dehydration, Kussmaul respirations, and altered mental status.

Fasting blood glucose: blood glucose obtained before the first meal of the day and after a fast of at least 8 hours.

Glucose toxicity: The effect of high blood glucose causing both insulin resistance and impaired β-cell production of insulin.

Intensification: Increase frequency of blood glucose monitoring and adjustment of the dose and type of medication in an attempt to normalize blood glucose concentrations.

Intercurrent illnesses: Febrile illnesses or associated symptoms severe enough to cause the patient to stay home from school and/or seek medical care.

Microalbuminuria: Albumin:creatinine ratio ≥30 mg/g creatinine but <300 mg/g creatinine.

Moderate hyperglycemia: blood glucose = 180–250 mg/dL.

Moderate-to-vigorous exercise: exercise that makes the individual breathe hard and perspire and that raises his or her heart rate. An easy way to define exercise intensity for patients is the "talk test": during moderate physical activity a person can talk, but not sing. During vigorous activity, a person cannot talk without pausing to catch a breath.

Obese: BMI ≥95th percentile for age and gender.

Overweight: BMI between the 85th and 94th percentile for age and gender.

Prediabetes: Fasting plasma glucose ≥100–125 mg/dL or 2-hour glucose concentration during an oral glucose tolerance test ≥126 but <200 mg/dL or an HbA1c of 5.7% to 6.4%.

Severe hyperglycemia: blood glucose >250 mg/dL.

Thiazolidinediones (TZDs): Oral hypoglycemic agents that exert their effect at least in part by activation of the peroxisome proliferator-activated receptor γ.

Type 1 diabetes mellitus (T1DM): Diabetes secondary to autoimmune destruction of β cells resulting in absolute (complete or near complete) insulin deficiency and requiring insulin injections for management.

Type 2 diabetes mellitus (T2DM): The investigators' designation of the diagnosis was used for the purposes of the literature review. The committee acknowledges the distinction between T1DM and T2DM in this population is not always clear cut, and clinical judgment plays an important role. Typically, this diagnosis is made when hyperglycemia is secondary to insulin resistance accompanied by impaired β-cell function resulting in inadequate insulin production to compensate for the degree of insulin resistance.

Youth: used interchangeably with "adolescent" in this document.

INTRODUCTION

Over the past 3 decades, the prevalence of childhood obesity has increased dramatically in North America,[1–5] ushering in a variety of health problems, including type 2 diabetes mellitus (T2DM), which previously was not typically seen until much later in life. Currently, in the United States, up to 1 in 3 new cases of diabetes mellitus diagnosed in youth younger than 18 years is T2DM (depending on the ethnic composition of the patient population),[6,7] with a disproportionate representation in ethnic minorities[8,9] and occurring most commonly among youth between 10 and 19 years of age.[5,10] This trend is not limited to the United States but is occurring internationally[11]; it is projected that by the year 2030, an estimated 366 million people worldwide will have diabetes mellitus.[12]

The rapid emergence of childhood T2DM poses challenges to many physicians who find themselves generally ill-equipped to treat adult diseases encountered in children. Most diabetes education materials designed for pediatric patients are directed primarily to families of children with type 1 diabetes mellitus (T1DM) and emphasize insulin treatment and glucose monitoring, which may or may not be appropriate for children with

T2DM.[13,14] The National Diabetes Education Program TIP sheets (which can be ordered or downloaded from www.yourdiabetesinfo.org or ndep.nih.gov) provide guidance on healthy eating, physical activity, and dealing with T2DM in children and adolescents, but few other resources are available that are directly targeted at youth with this disease.[15] Most medications used for T2DM have been tested for safety and efficacy only in people older than 18 years, and there is scant scientific evidence for optimal management of children with T2DM.[16,17] Recognizing the scarcity of evidence-based data, this report provides a set of guidelines for the management and treatment of children with T2DM that is based on a review of current medical literature covering a period from January 1, 1990, to July 1, 2008.

Despite these limitations, the practicing physician is likely to be faced with the need to provide care for children with T2DM. Thus, the American Academy of Pediatrics (AAP), the Pediatric Endocrine Society (PES), the American Academy of Family Physicians (AAFP), American Diabetes Association, and the Academy of Nutrition and Dietetics (formerly the American Dietetic Association) partnered to develop a set of guidelines that might benefit endocrinologists and generalists, including pediatricians and family physicians alike. This clinical practice guideline may not provide the only appropriate approach to the management of children with T2DM. It is not expected to serve as a sole source of guidance in the management of children and adolescents with T2DM, nor is it intended to replace clinical judgment or establish a protocol for the care of all children with this condition. Rather, it is intended to assist clinicians in decision-making.

Primary care providers should endeavor to obtain the requisite skills to care for children and adolescents with T2DM, and should communicate and work closely with a diabetes team of subspecialists when such consultation is available, practical, and appropriate. The frequency of such consultations will vary, but should usually be obtained at diagnosis and then at least annually if possible. When treatment goals are not met, the committee encourages clinicians to consult with an expert trained in the care of children and adolescents with T2DM.[18,19] When first-line therapy (eg, metformin) fails, recommendations for intensifying therapy should be generally the same for pediatric and adult populations. The picture is constantly changing, however, as new drugs are introduced, and some drugs that initially appeared to be safe demonstrate adverse effects with wider use. Clinicians should, therefore, remain alert to new developments with regard to treatment of T2DM. Seeking the advice of an expert can help ensure that the treatment goals are appropriately set and that clinicians benefit from cutting-edge treatment information in this rapidly changing area.

The Importance of Family-Centered Diabetes Care

Family structure, support, and education help inform clinical decision-making and negotiations with the patient and family about medical preferences that affect medical decisions, independent of existing clinical recommendations. Because adherence is a major issue in any lifestyle intervention, engaging the family is critical not only to maintain needed changes in lifestyle but also to foster medication adherence.[20–22] The family's ideal role in lifestyle interventions varies, however, depending on the child's age. Behavioral interventions in younger children have shown a favorable effect. With adolescents, however, interventions based on target-age behaviors (eg, including phone or Internet-based interventions as well as face-to-face or peer-enhanced activities) appear to foster better results, at least for weight management.[23]

Success in making lifestyle changes to attain therapeutic goals requires the initial and ongoing education of the patient and the entire family about healthy nutrition and exercise. Any behavior change recommendations must establish realistic goals and take into account the families' health beliefs and behaviors. Understanding the patient and family's perception of the disease (and overweight status) before establishing a management plan is important to dispel misconceptions and promote adherence.[24] Because T2DM disproportionately affects minority populations, there is a need to ensure culturally appropriate, family-centered care along with ongoing education.[25–28] Several observational studies cite the importance of addressing cultural issues within the family.[20–22]

Restrictions in Creating This Document

In developing these guidelines, the following restrictions governed the committee's work:

- Although the importance of diabetes detection and screening of at-risk populations is acknowledged and referenced, the guidelines are restricted to patients meeting the diagnostic criteria for diabetes (eg, this document focuses on treatment postdiagnosis). Specifically, this document and its recommendations do not pertain to patients with impaired fasting plasma glucose (100–125 mg/dL) or impaired glucose tolerance (2-hour oral glucose tolerance test plasma glucose: 140–200 mg/dL) or isolated insulin resistance.
- Although it is noted that the distinction between types 1 and 2 diabetes mellitus in children may be

difficult,[29,30] these recommendations pertain specifically to patients 10 to less than 18 years of age with T2DM (as defined above).

- Although the importance of high-risk care and glycemic control in pregnancy, including pregravid glycemia, is affirmed, the evidence considered and recommendations contained in this document do not pertain to diabetes in pregnancy, including diabetes in pregnant adolescents.
- Recommended screening schedules and management tools for select comorbid conditions (hypertension, dyslipidemia, nephropathy, microalbuminuria, and depression) are provided as resources in the accompanying technical report.[31] These therapeutic recommendations were adapted from other recommended guideline documents with references, without an independent assessment of their supporting evidence.

METHODS

A systematic review was performed and is described in detail in the accompanying technical report.[31] To develop the clinical practice guideline on the management of T2DM in children and adolescents, the AAP convened the Subcommittee on Management of T2DM in Children and Adolescents with the support of the American Diabetes Association, the PES, the AAFP, and the Academy of Nutrition and Dietetics. The subcommittee was co-chaired by 2 pediatric endocrinologists preeminent in their field and included experts in general pediatrics, family medicine, nutrition, Native American health, epidemiology, and medical informatics/guideline methodology. All panel members reviewed the AAP policy on Conflict of Interest and Voluntary Disclosure and declared all potential conflicts (see conflicts statements in the Task Force member list).

These groups partnered to develop an evidence report that served as a major source of information for these practice guideline recommendations.[31] Specific clinical questions addressed in the evidence review were as follows: (1) the effectiveness of treatment modalities for T2DM in children and adolescents, (2) the efficacy of pharmaceutical therapies for treatment of children and adolescents with T2DM, (3) appropriate recommendations for screening for comorbidities typically associated with T2DM in children and adolescents, and (4) treatment recommendations for comorbidities of T2DM in children and adolescents. The accompanying technical report contains more information on comorbidities.[31]

Epidemiologic project staff searched Medline, the Cochrane Collaboration, and Embase. MESH terms used in various combinations in the search included diabetes, mellitus, type 2, type 1, treatment, prevention, diet, pediatric, T2DM, T1DM, NIDDM, metformin, lifestyle, RCT, meta-analysis, child, adolescent, therapeutics, control, adult, obese, gestational, polycystic ovary syndrome, metabolic syndrome, cardiovascular, dyslipidemia, men, and women. In addition, the Boolean operators NOT, AND, OR were included in various combinations. Articles addressing treatment of diabetes mellitus were prospectively limited to those that were published in English between January 1990 and June 2008, included abstracts, and addressed children between the ages of 120 and 215 months with an established diagnosis of T2DM. Studies in adults were considered for inclusion if >10% of the study population was 45 years of age or younger. The Medline search limits included the following: clinical trial; meta-analysis; randomized controlled trial; review; child: 6–12 years; and adolescent: 13–18 years. Additional articles were identified by review of reference lists of relevant articles and ongoing studies recommended by a technical expert advisory group. All articles were reviewed for compliance with the search limitations and appropriateness for inclusion in this document.

Initially, 199 abstracts were identified for possible inclusion, of which 52 were retained for systematic review. Results of the literature review were presented in evidence tables and published in the final evidence report. An additional literature search of Medline and the Cochrane Database of

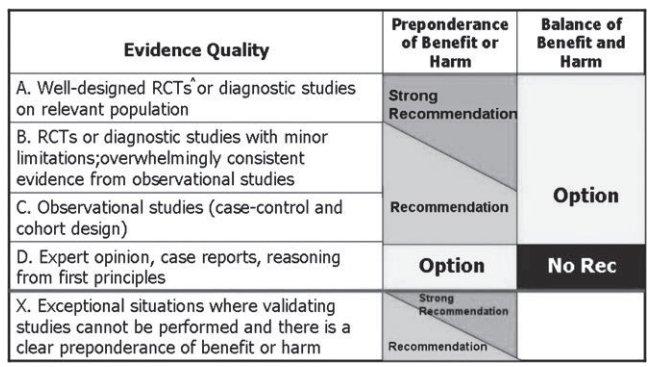


FIGURE 1

Evidence quality. Integrating evidence quality appraisal with an assessment of the anticipated balance between benefits and harms if a policy is carried out leads to designation of a policy as a strong recommendation, recommendation, option, or no recommendation.[32] RCT, randomized controlled trial; Rec, recommendation.

TABLE 1 Definitions and Recommendation Implications

Statement	Definition	Implication
Strong recommendation	A *strong recommendation* in favor of a particular action is made when the anticipated benefits of the recommended intervention clearly exceed the harms (as a strong recommendation against an action is made when the anticipated harms clearly exceed the benefits) and the quality of the supporting evidence is excellent. In some clearly identified circumstances, strong recommendations may be made when high-quality evidence is impossible to obtain and the anticipated benefits strongly outweigh the harms.	Clinicians should follow a strong recommendation unless a clear and compelling rationale for an alternative approach is present.
Recommendation	A *recommendation* in favor of a particular action is made when the anticipated benefits exceed the harms but the quality of evidence is not as strong. Again, in some clearly identified circumstances, recommendations may be made when high-quality evidence is impossible to obtain but the anticipated benefits outweigh the harms.	Clinicians would be prudent to follow a recommendation but should remain alert to new information and sensitive to patient preferences.
Option	*Options* define courses that may be taken when either the quality of evidence is suspect or carefully performed studies have shown little clear advantage to 1 approach over another.	Clinicians should consider the option in their decision-making, and patient preference may have a substantial role.
No recommendation	*No recommendation* indicates that there is a lack of pertinent published evidence and that the anticipated balance of benefits and harms is presently unclear.	Clinicians should be alert to new published evidence that clarifies the balance of benefit versus harm.

It should be noted that, because childhood T2DM is a relatively recent medical phenomenon, there is a paucity of evidence for many or most of the recommendations provided. In some cases, supporting references for a specific recommendation are provided that do not deal specifically with childhood T2DM, such as T1DM, childhood obesity, or childhood "prediabetes," or that were not included in the original comprehensive search. Committee members have made every effort to identify those references that did not affect or alter the level of evidence for specific recommendations.

Systematic Reviews was performed in July 2009 for articles discussing recommendations for screening and treatment of 5 recognized comorbidities of T2DM: cardiovascular disease, dyslipidemia, retinopathy, nephropathy, and peripheral vascular disease. Search criteria were the same as for the search on treatment of T2DM, with the inclusion of the term "type 1 diabetes mellitus." Search terms included, in various combinations, the following: diabetes, mellitus, type 2, type 1, pediatric, T2DM, T1DM, NIDDM, hyperlipidemia, retinopathy, microalbuminuria, comorbidities, screening, RCT, meta-analysis, child, and adolescent. Boolean operators and search limits mirrored those of the primary search.

An additional 336 abstracts were identified for possible inclusion, of which 26 were retained for systematic review. Results of this subsequent literature review were also presented in evidence tables and published in the final evidence report. An epidemiologist appraised the methodologic quality of the research before it was considered by the committee members.

The evidence-based approach to guideline development requires that the evidence in support of each key action statement be identified, appraised, and summarized and that an explicit link between evidence and recommendations be defined. Evidence-based recommendations reflect the quality of evidence and the balance of benefit and harm that is anticipated when the recommendation is followed. The AAP policy statement, "Classifying Recommendations for Clinical Practice Guidelines,"[32] was followed in designating levels of recommendation (see Fig 1 and Table 1).

To ensure that these recommendations can be effectively implemented, the Guidelines Review Group at Yale Center for Medical Informatics provided feedback on a late draft of these recommendations, using the GuideLine Implementability Appraisal.[33] Several potential obstacles to successful implementation were identified and resolved in the final guideline. Evidence was incorporated systematically into 6 key action statements about appropriate management facilitated by BRIDGE-Wiz software (Building Recommendations in a Developer's Guideline Editor; Yale Center for Medical Informatics).

A draft version of this clinical practice guideline underwent extensive peer review by 8 groups within the AAP, the American Diabetes Association, PES, AAFP, and the Academy of Nutrition and Dietetics. Members of the subcommittee were invited to distribute the draft to other representatives and committees within their specialty organizations. The resulting comments were reviewed by the subcommittee and incorporated into the guideline, as appropriate. All AAP guidelines are reviewed every 5 years.

KEY ACTION STATEMENTS

Key Action Statement 1

Clinicians must ensure that insulin therapy is initiated for children and adolescents with T2DM who are ketotic or in diabetic ketoacidosis and in whom the distinction between T1DM and T2DM is unclear; and, in usual cases, should initiate insulin therapy for patients:

a. who have random venous or plasma BG concentrations ≥250 mg/dL; or

b. whose HbA1c is >9%.

(Strong Recommendation: evidence quality X, validating studies cannot be performed, and C, observational studies and expert opinion; preponderance of benefit over harm.)

Action Statement Profile KAS 1

Aggregate evidence quality	X (validating studies cannot be performed)
Benefits	Avoidance of progression of diabetic ketoacidosis (DKA) and worsening metabolic acidosis; resolution of acidosis and hyperglycemia; avoidance of coma and/or death. Quicker restoration of glycemic control, potentially allowing islet β cells to "rest and recover," increasing long-term adherence to treatment; avoiding progression to DKA if T1DM. Avoiding hospitalization. Avoidance of potential risks associated with the use of other agents (eg, abdominal discomfort, bloating, loose stools with metformin; possible cardiovascular risks with sulfonylureas).
Harms/risks/cost	Potential for hypoglycemia, insulin-induced weight gain, cost, patient discomfort from injection, necessity for BG testing, more time required by the health care team for patient training.
Benefits-harms assessment	Preponderance of benefit over harm.
Value judgments	Extensive clinical experience of the expert panel was relied on in making this recommendation.
Role of patient preferences	Minimal.
Exclusions	None.
Intentional vagueness	None.
Strength	Strong recommendation.

The presentation of T2DM in children and adolescents varies according to the disease stage. Early in the disease, before diabetes diagnostic criteria are met, insulin resistance predominates with compensatory high insulin secretion, resulting in normoglycemia. Over time, β cells lose their ability to secrete adequate amounts of insulin to overcome insulin resistance, and hyperglycemia results. Early in this process, blood glucose (BG) concentrations may be normal much of the time and the patient likely will be asymptomatic. At this stage, the disease may only be detected by abnormal BG concentrations identified during screening. As insulin secretion declines further, the patient is likely to develop symptoms of hyperglycemia, occasionally with ketosis or frank ketoacidosis. High glucose concentrations can cause a reversible toxicity to islet β cells that contributes further to insulin deficiency. Of adolescents in whom T2DM is subsequently diagnosed, 5% to 25% present with ketoacidosis.[34]

Diabetic ketoacidosis must be treated with insulin and fluid and electrolyte replacement to prevent worsening metabolic acidosis, coma, and death. Children and adolescents with symptoms of hyperglycemia (polyuria, polydipsia, and polyphagia) who are diagnosed with diabetes mellitus should be evaluated for ketosis (serum or urine ketones) and, if positive, for ketoacidosis (venous pH), even if their phenotype and risk factor status (obesity, acanthosis nigricans, positive family history of T2DM) suggests T2DM. Patients in whom ketoacidosis is diagnosed require immediate treatment with insulin and fluid replacement in an inpatient setting under the supervision of a physician who is experienced in treating this complication.

Youth and adolescents who present with T2DM with poor glycemic control (BG concentrations ≥250 mg/dL or HbA1c >9%) but who lack evidence of ketosis or ketoacidosis may also benefit from initial treatment with insulin, at least on a short-term basis.[34] This allows for quicker restoration of glycemic control and, theoretically, may allow islet β cells to "rest and recover."[35,36] Furthermore, it has been noted that initiation of insulin may increase long-term adherence to treatment in children and adolescents with T2DM by enhancing the patient's perception of the seriousness of the disease.[7,37–40] Many patients with T2DM can be weaned gradually from insulin therapy and subsequently managed with metformin and lifestyle modification.[34]

As noted previously, in some children and adolescents with newly diagnosed diabetes mellitus, it may be difficult to distinguish between type 1 and type 2 disease (eg, an obese child presenting with ketosis).[39,41] These patients are best managed initially with insulin therapy while appropriate tests are performed to differentiate between T1DM and T2DM. The care of children and adolescents who have either newly diagnosed T2DM or undifferentiated-type diabetes and who require initial insulin treatment should be supervised by a physician experienced in treating diabetic patients with insulin.

Key Action Statement 2

In all other instances, clinicians should initiate a lifestyle modification program, including nutrition

and physical activity, and start metformin as first-line therapy for children and adolescents at the time of diagnosis of T2DM. (Strong recommendation: evidence quality B; 1 RCT showing improved outcomes with metformin versus lifestyle; preponderance of benefits over harms.)

Action Statement Profile KAS 2

Aggregate evidence quality	B (1 randomized controlled trial showing improved outcomes with metformin versus lifestyle combined with expert opinion).
Benefit	Lower HbA1c, target HbA1c sustained longer, less early deterioration of BG, less chance of weight gain, improved insulin sensitivity, improved lipid profile.
Harm (of using metformin)	Gastrointestinal adverse effects or potential for lactic acidosis and vitamin B_{12} deficiency, cost of medications, cost to administer, need for additional instruction about medication, self-monitoring blood glucose (SMBG), perceived difficulty of insulin use, possible metabolic deterioration if T1DM is misdiagnosed and treated as T2DM, potential risk of lactic acidosis in the setting of ketosis or significant dehydration. It should be noted that there have been no cases reported of vitamin B_{12} deficiency or lactic acidosis with the use of metformin in children.
Benefits-harms assessment	Preponderance of benefit over harm.
Value judgments	Committee members valued faster achievement of BG control over not medicating children.
Role of patient preferences	Moderate; precise implementation recommendations likely will be dictated by patient preferences regarding healthy nutrition, potential medication adverse reaction, exercise, and physical activity.
Exclusions	Although the recommendation to start metformin applies to all, certain children and adolescents with T2DM will not be able to tolerate metformin. In addition, certain older or more debilitated patients with T2DM may be restricted in the amount of moderate-to-vigorous exercise they can perform safely. Nevertheless, this recommendation applies to the vast majority of children and adolescents with T2DM.
Intentional vagueness	None.
Policy level	Strong recommendation.

Metformin as First-Line Therapy

Because of the low success rate with diet and exercise alone in pediatric patients diagnosed with T2DM, metformin should be initiated along with the promotion of lifestyle changes, unless insulin is needed to reverse glucose toxicity in the case of significant hyperglycemia or ketoacidosis (see Key Action Statement 1). Because gastrointestinal adverse effects are common with metformin therapy, the committee recommends starting the drug at a low dose of 500 mg daily, increasing by 500 mg every 1 to 2 weeks, up to an ideal and maximum dose of 2000 mg daily in divided doses.[41] It should be noted that the main gastrointestinal adverse effects (abdominal pain, bloating, loose stools) present at initiation of metformin often are transient and often disappear completely if medication is continued. Generally, doses higher than 2000 mg daily do not provide additional therapeutic benefit.[34,42,43] In addition, the use of extended-release metformin, especially with evening dosing, may be considered, although data regarding the frequency of adverse effects with this preparation are scarce. Metformin is generally better tolerated when taken with food. It is important to recognize the paucity of credible RCTs in adolescents with T2DM. The evidence to recommend initiating metformin at diagnosis along with lifestyle changes comes from 1 RCT, several observational studies, and consensus recommendations.

Lifestyle modifications (including nutrition interventions and increased physical activity) have long been the cornerstone of therapy for T2DM. Yet, medical practitioners recognize that effecting these changes is both challenging and often accompanied by regression over time to behaviors not conducive to maintaining the target range of BG concentrations. In pediatric patients, lifestyle change is most likely to be successful when a multidisciplinary approach is used and the entire family is involved. (Encouragement of healthy eating and physical exercise are discussed in Key Action Statements 5 and 6.) Unfortunately, efforts at lifestyle change often fail for a variety of reasons, including high rates of loss to follow-up; a high rate of depression in teenagers, which affects adherence; and peer pressure to participate in activities that often center on unhealthy eating.

Expert consensus is that fewer than 10% of pediatric T2DM patients will attain their BG goals through lifestyle interventions alone.[6,35,44] It is possible that the poor long-term success rates observed from lifestyle interventions stem from patients' perception that the intervention is not important because medications are not being prescribed. One might speculate that prescribing medications, particularly insulin therapy, may convey a greater degree of concern for the patient's health and the seriousness of the diagnosis, relative to that conveyed when medications are not needed, and that improved treatment adherence and follow-up may result from the use of medication. Indeed, 2 prospective observational studies revealed that treatment with

lifestyle modification alone is associated with a higher rate of loss to follow-up than that found in patients who receive medication.[45]

Before initiating treatment with metformin, a number of important considerations must be taken into account. First, it is important to determine whether the child with a new diagnosis has T1DM or T2DM, and it is critical to err on the side of caution if there is any uncertainty. The 2009 *Clinical Practice Consensus Guidelines on Type 2 Diabetes in Children and Adolescents* from the International Society for Pediatric and Adolescent Diabetes provides more information on the classification of diabetes in children and adolescents with new diagnoses.[46] If the diagnosis is unclear (as may be the case when an obese child with diabetes presents also with ketosis), the adolescent must be treated with insulin until the T2DM diagnosis is confirmed.[47] Although it is recognized that some children with newly diagnosed T2DM may respond to metformin alone, the committee believes that the presence of either ketosis or ketoacidosis dictates an absolute initial requirement for insulin replacement. (This is addressed in Key Action Statement 1.)

Although there is little debate that a child presenting with significant hyperglycemia and/or ketosis requires insulin, children presenting with more modest levels of hyperglycemia (eg, random BG of 200–249 mg/dL) or asymptomatic T2DM present additional therapeutic challenges to the clinician. In such cases, metformin alone, insulin alone, or metformin with insulin all represent reasonable options. Additional agents are likely to become reasonable options for initial pharmacologic management in the near future. Although metformin and insulin are the only antidiabetic agents currently approved by the US Food and Drug Administration (FDA) for use in children, both thiazolidinediones and incretins are occasionally used in adolescents younger than 18 years.[48]

Metformin is recommended as the initial pharmacologic agent in adolescents presenting with mild hyperglycemia and without ketonuria or severe hyperglycemia. In addition to improving hepatic insulin sensitivity, metformin has a number of practical advantages over insulin:

- Potential weight loss or weight neutrality.[37,48]
- Because of a lower risk of hypoglycemia, less frequent finger-stick BG measurements are required with metformin, compared with insulin therapy or sulfonylureas.[37,42,49–51]
- Improves insulin sensitivity and may normalize menstrual cycles in females with polycystic ovary syndrome. (Because metformin may also improve fertility in patients with polycystic ovary syndrome, contraception is indicated for sexually active patients who wish to avoid pregnancy.)
- Taking pills does not have the discomfort associated with injections.
- Less instruction time is required to start oral medication, making it is easier for busy practitioners to prescribe.
- Adolescents do not always accept injections, so oral medication might enhance adherence.[52]

Potential advantages of insulin over metformin for treatment at diabetes onset include the following:

- Metabolic control may be achieved more rapidly with insulin compared with metformin therapy.[37]
- With appropriate education and targeting the regimen to the individual, adolescents are able to accept and use insulin therapy with improved metabolic outcomes.[53]
- Insulin offers theoretical benefits of improved metabolic control while preserving β-cell function or even reversing β-cell damage.[34,35]
- Initial use of insulin therapy may convey to the patient a sense of seriousness of the disease.[7,53]

Throughout the writing of these guidelines, the authors have been following the progress of the National Institute of Diabetes and Digestive and Kidney Diseases–supported Treatment Options for type 2 Diabetes in Adolescents and Youth (TODAY) trial,[54] designed to compare standard (metformin alone) therapy versus more aggressive therapy as the initial treatment of youth with recent-onset T2DM. Since the completion of these guidelines, results of the TODAY trial have become available and reveal that metformin alone is inadequate in effecting sustained glycemic control in the majority of youth with diabetes. The study also revealed that the addition of rosiglitazone to metformin is superior to metformin alone in preserving glycemic control. Direct application of these findings to clinical practice is problematic, however, because rosiglitazone is not FDA-approved for use in children, and its use, even in adults, is now severely restricted by the FDA because of serious adverse effects reported in adults. Thus, the results suggest that therapy that is more aggressive than metformin monotherapy may be required in these adolescents to prevent loss of glycemic control, but they do not provide specific guidance because it is not known whether the effect of the additional agent was specific to rosiglitazone or would be seen with the addition of other agents. Unfortunately, there are limited data for the use of other currently available oral or injected hypoglycemic agents in this age range, except for insulin. Therefore,

the writing group for these guidelines continues to recommend metformin as first-line therapy in this age group but with close monitoring for glycemic deterioration and the early addition of insulin or another pharmacologic agent if needed.

Lifestyle Modification, Including Nutrition and Physical Activity

Although lifestyle changes are considered indispensable to reaching treatment goals in diabetes, no significant data from RCTs provide information on success rates with such an approach alone.

A potential downside for initiating lifestyle changes alone at T2DM onset is potential loss of patients to follow-up and worse health outcomes. The value of lifestyle modification in the management of adolescents with T2DM is likely forthcoming after a more detailed analysis of the lifestyle intervention arm of the multicenter TODAY trial becomes available.[54] As noted previously, although it was published after this guideline was developed, the TODAY trial indicated that results from the metformin-plus-lifestyle intervention were not significantly different from either metformin alone or the metformin-plus-rosiglitazone intervention in maintaining glycemic control over time.[54]

Summary

As noted previously, metformin is a safe and effective agent for use at the time of diagnosis in conjunction with lifestyle changes. Although observational studies and expert opinion strongly support lifestyle changes as a key component of the regimen in addition to metformin, randomized trials are needed to delineate whether using lifestyle options alone is a reasonable first step in treating any select subgroups of children with T2DM.

Key Action Statement 3

The committee suggests that clinicians monitor HbA1c concentrations every 3 months and intensify treatment if treatment goals for BG and HbA1c concentrations are not being met. (Option: evidence quality D; expert opinion and studies in children with T1DM and in adults with T2DM; preponderance of benefits over harms.)

Action Statement Profile KAS 3

Aggregate evidence quality	D (expert opinion and studies in children with T1DM and in adults with T2DM; no studies have been performed in children and adolescents with T2DM).
Benefit	Diminishing the risk of progression of disease and deterioration resulting in hospitalization; prevention of microvascular complications of T2DM.
Harm	Potential for hypoglycemia from overintensifying treatment to reach HbA1c target goals; cost of frequent testing and medical consultation; possible patient discomfort.
Benefits-harms assessment	Preponderance of benefits over harms.
Value judgments	Recommendation dictated by widely accepted standards of diabetic care.
Role of patient preferences	Minimal; recommendation dictated by widely accepted standards of diabetic care.
Exclusions	None.
Intentional vagueness	Intentional vagueness in the recommendation as far as setting goals and intensifying treatment attributable to limited evidence.
Policy level	Option.

HbA1c provides a measure of glycemic control in patients with diabetes mellitus and allows an estimation of the individual's average BG over the previous 8 to 12 weeks. No RCTs have evaluated the relationship between glycemic control and the risk of developing microvascular and/or macrovascular complications in children and adolescents with T2DM. A number of studies of children with T1DM[55–57] and adults with T2DM have, however, shown a significant relationship between glycemic control (as measured by HbA1c concentration) and the risk of microvascular complications (eg, retinopathy, nephropathy, and neuropathy).[58,59] The relationship between HbA1c concentration and risk of microvascular complications appears to be curvilinear; the lower the HbA1c concentration, the lower the downstream risk of microvascular complications, with the greatest risk reduction seen at the highest HbA1c concentrations.[57]

It is generally recommended that HbA1c concentrations be measured every 3 months.[60] For adults with T1DM, the American Diabetes Association recommends target HbA1c concentrations of less than 7%; the American Association of Clinical Endocrinologists recommends target concentrations of less than 6.5%. Although HbA1c target concentrations for children and adolescents with T1DM are higher,[13] several review articles suggest target HbA1c concentrations of less than 7% for children and adolescents with T2DM.[40,61–63] The committee concurs that, ideally, target HbA1c concentration should be less than 7% but notes that specific goals must be achievable for the individual patient and that this concentration may not be applicable for all patients. For patients in whom a target concentration of less than 7% seems unattainable, individualized goals should be set, with the ultimate goal of reaching guideline target concentrations. In addition, in the absence of hypoglycemia, even lower HbA1c target concentrations can be considered on the basis of an absence of hypoglycemic events and other individual considerations.

When concentrations are found to be above the target, therapy should be intensified whenever possible, with the goal of bringing the concentration to target. Intensification activities may include, but are not limited to, increasing the frequency of clinic visits, engaging in more frequent BG monitoring, adding 1 or more antidiabetic agents, meeting with a registered dietitian and/or diabetes educator, and increasing attention to diet and exercise regimens. Patients whose HbA1c concentrations remain relatively stable may only need to be tested every 6 months. Ideally, real-time HbA1c concentrations should be available at the time of the patient's visit with the clinician to allow the physician and patient and/or parent to discuss intensification of therapy during the visit, if needed.

Key Action Statement 4

The committee suggests that clinicians advise patients to monitor finger-stick BG concentrations in those who

a. are taking insulin or other medications with a risk of hypoglycemia; or
b. are initiating or changing their diabetes treatment regimen; or
c. have not met treatment goals; or
d. have intercurrent illnesses.

(Option: evidence quality D; expert consensus. Preponderance of benefits over harms.)

Glycemic control correlates closely with the frequency of BG monitoring in adolescents with T1DM.[64,65] Although studies evaluating the efficacy of frequent BG monitoring have not been conducted in children and adolescents with T2DM, benefits have been described in insulin-treated adults with T2DM who tested their BG 4 times per day, compared with adults following a less frequent monitoring regimen.[66] These data support the value of BG monitoring in adults treated with insulin, and likely are relevant to youth with T2DM as well, especially those treated with insulin, at the onset of the disease, when treatment goals are not met, and when the treatment regimen is changed. The committee believes that current (2011) ADA recommendations for finger-stick BG monitoring apply to most youth with T2DM[67]:

- Finger-stick BG monitoring should be performed 3 or more times daily for patients using multiple insulin injections or insulin pump therapy.
- For patients using less-frequent insulin injections, noninsulin therapies, or medical nutrition therapy alone, finger-stick BG monitoring may be useful as a guide to the success of therapy.
- To achieve postprandial glucose targets, postprandial finger-stick BG monitoring may be appropriate.

Action Statement Profile KAS 4

Aggregate evidence quality	D (expert consensus).
Benefit	Potential for improved metabolic control, improved potential for prevention of hypoglycemia, decreased long-term complications.
Harm	Patient discomfort, cost of materials.
Benefits-harms assessment	Benefit over harm.
Value judgments	Despite lack of evidence, there were general committee perceptions that patient safety concerns related to insulin use or clinical status outweighed any risks from monitoring.
Role of patient preferences	Moderate to low; recommendation driven primarily by safety concerns.
Exclusions	None.
Intentional vagueness	Intentional vagueness in the recommendation about specific approaches attributable to lack of evidence and the need to individualize treatment.
Policy level	Option.

Recognizing that current practices may not always reflect optimal care, a 2004 survey of practices among members of the PES revealed that 36% of pediatric endocrinologists asked their pediatric patients with T2DM to monitor BG concentrations twice daily; 12% asked patients to do so once daily; 13% asked patients to do so 3 times per day; and 12% asked patients to do so 4 times daily.[61] The questionnaire provided to the pediatric endocrinologists did not ask about the frequency of BG monitoring in relationship to the diabetes regimen, however.

Although normoglycemia may be difficult to achieve in adolescents with T2DM, a fasting BG concentration of 70 to 130 mg/dL is a reasonable target for most. In addition, because postprandial hyperglycemia has been associated with increased risk of cardiovascular events in adults, postprandial BG testing may be valuable in select patients. BG concentrations obtained 2 hours after meals (and paired with pre-meal concentrations) provide an index of glycemic excursion, and may be useful in improving glycemic control, particularly for the patient whose fasting plasma glucose is normal but whose HbA1c is not at target.[68] Recognizing the limited evidence for benefit of FSBG testing in this population, the committee provides suggested guidance for testing frequency, tailored to the medication regimen, as follows:

BG Testing Frequency for Patients With Newly Diagnosed T2DM: Fasting, Premeal, and Bedtime Testing

The committee suggests that all patients with newly diagnosed T2DM, regardless of prescribed treatment plan, should perform finger-stick BG monitoring before meals (including a morning fasting concentration) and

at bedtime until reasonable metabolic control is achieved.[69] Once BG concentrations are at target levels, the frequency of monitoring can be modified depending on the medication used, the regimen's intensity, and the patient's metabolic control. Patients who are prone to marked hyperglycemia or hypoglycemia or who are on a therapeutic regimen associated with increased risk of hypoglycemia will require continued frequent BG testing. Expectations for frequency and timing of BG monitoring should be clearly defined through shared goal-setting between the patient and clinician. The adolescent and family members should be given a written action plan stating the medication regimen, frequency and timing of expected BG monitoring, as well as follow-up instructions.

BG Testing Frequency for Patients on Single Insulin Daily Injections and Oral Agents

Single bedtime long-acting insulin: The simplest insulin regimen consists of a single injection of long-acting insulin at bedtime (basal insulin only). The appropriateness of the insulin dose for patients using this regimen is best defined by the fasting/prebreakfast BG test. For patients on this insulin regimen, the committee suggests daily fasting BG measurements. This regimen is associated with some risk of hypoglycemia (especially overnight or fasting hypoglycemia) and may not provide adequate insulin coverage for mealtime ingestions throughout the day, as reflected by fasting BG concentrations in target, but daytime readings above target. In such cases, treatment with meglitinide (Prandin [Novo Nordisk Pharmaceuticals] or Starlix [Novartis Pharmaceuticals]) or a short-acting insulin before meals (see below) may be beneficial.

Oral agents: Once treatment goals are met, the frequency of monitoring can be decreased; however, the committee recommends some continued BG testing for all youth with T2DM, at a frequency determined within the clinical context (e.g. medication regimen, HbA1c, willingness of the patient, etc.). For example, an infrequent or intermittent monitoring schedule may be adequate when the patient is using exclusively an oral agent associated with a low risk of hypoglycemia and if HbA1c concentrations are in the ideal or non-diabetic range. A more frequent monitoring schedule should be advised during times of illness or if symptoms of hyperglycemia or hypoglycemia develop.

Oral agent plus a single injection of a long-acting insulin: Some youth with T2DM can be managed successfully with a single injection of long-acting insulin in conjunction with an oral agent. Twice a day BG monitoring (fasting plus a second BG concentration — ideally 2-hour post prandial) often is recommended, as long as HbA1c and BG concentrations remain at goal and the patient remains asymptomatic.

BG Testing Frequency for Patients Receiving Multiple Daily Insulin Injections (eg, Basal Bolus Regimens): Premeal and Bedtime Testing

Basal bolus regimens are commonly used in children and youth with T1DM and may be appropriate for some youth with T2DM as well. They are the most labor intensive, providing both basal insulin plus bolus doses of short-acting insulin at meals. Basal insulin is provided through either the use of long-acting, relatively peak-free insulin (by needle) or via an insulin pump. Bolus insulin doses are given at meal-time, using one of the rapid-acting insulin analogs. The bolus dose is calculated by using a correction algorithm for the premeal BG concentration as well as a "carb ratio," in which 1 unit of a rapid-acting insulin analog is given for "X" grams of carbohydrates ingested (see box below). When using this method, the patient must be willing and able to count the number of grams of carbohydrates in the meal and divide by the assigned "carb ratio (X)" to know how many units of insulin should be taken. In addition, the patient must always check BG concentrations before the meal to determine how much additional insulin should be given as a correction dose using an algorithm assigned by the care team if the fasting BG is not in target. Insulin pumps are based on this concept of "basal-bolus" insulin administration and have the capability of calculating a suggested bolus dosage, based on inputted grams of carbohydrates and BG concentrations. Because the BG value determines the amount of insulin to be given at each meal, the recommended testing frequency for patients on this regimen is before every meal.

Box 1 Example of Basal Bolus Insulin Regimen

If an adolescent has a BG of 250 mg/dL, is to consume a meal containing 60 g of carbohydrates, with a carbohydrate ratio of 1:10 and an assigned correction dose of 1:25>125 (with 25 being the insulin sensitivity and 125 mg/dL the target blood glucose level), the mealtime bolus dose of insulin would be as follows:

60 g/10 "carb ratio" =

6 units rapid-acting insulin for meal

plus

(250–125)/25 = 125/25 =

5 units rapid-acting insulin for correction

Thus, total bolus insulin coverage at mealtime is: **11 U** (6 + 5) of rapid-acting insulin.

Key Action Statement 5

The committee suggests that clinicians incorporate the Academy of Nutrition and Dietetics' *Pediatric Weight Management Evidence-Based Nutrition Practice Guidelines* in the nutrition counseling of patients with T2DM both at the time of diagnosis and as part of ongoing management. (Option; evidence quality D; expert opinion; preponderance of benefits over harms. Role of patient preference is dominant.)

Action Statement Profile KAS 5

Aggregate evidence quality	D (expert opinion).
Benefit	Promotes weight loss; improves insulin sensitivity; contributes to glycemic control; prevents worsening of disease; facilitates a sense of well-being; and improves cardiovascular health.
Harm	Costs of nutrition counseling; inadequate reimbursement of clinicians' time; lost opportunity costs vis-a-vis time and resources spent in other counseling activities.
Benefits-harms assessment	Benefit over harm.
Value judgments	There is a broad societal agreement on the benefits of dietary recommendations.
Role of patient preference	Dominant. Patients may have different preferences for how they wish to receive assistance in managing their weight-loss goals. Some patients may prefer a referral to a nutritionist while others might prefer accessing online sources of help. Patient preference should play a significant role in determining an appropriate weight-loss strategy.
Exclusions	None.
Intentional vagueness	Intentional vagueness in the recommendation about specific approaches attributable to lack of evidence and the need to individualize treatment.
Policy level	Option.

Consuming more calories than one uses results in weight gain and is a major contributor to the increasing incidence of T2DM in children and adolescents. Current literature is inconclusive about a single best meal plan for patients with diabetes mellitus, however, and studies specifically addressing the diet of children and adolescents with T2DM are limited. Challenges to making recommendations stem from the small sample size of these studies, limited specificity for children and adolescents, and difficulties in generalizing the data from dietary research studies to the general population.

Although evidence is lacking in children with T2DM, numerous studies have been conducted in overweight children and adolescents, because the great majority of children with T2DM are obese or overweight at diagnosis.[26] The committee suggests that clinicians encourage children and adolescents with T2DM to follow the Academy of Nutrition and Dietetics' recommendations for maintaining healthy weight to promote health and reduce obesity in this population. The committee recommends that clinicians refer patients to a registered dietitian who has expertise in the nutritional needs of youth with T2DM. Clinicians should incorporate the Academy of Nutrition and Dietetics' *Pediatric Weight Management Evidence-Based Nutrition Practice Guidelines*, which describe effective, evidence-based treatment options for weight management, summarized below (A complete list of these recommendations is accessible to health care professionals at: http://www.andevidencelibrary.com/topic.cfm?cat=4102&auth=1.)

According to the Academy of Nutrition and Dietetics' guidelines, when incorporated with lifestyle changes, balanced macronutrient diets at 900 to 1200 kcal per day are associated with both short- and long-term (eg, $\geq$ 1 year) improvements in weight status and body composition in children 6 to 12 years of age.[70] These calorie recommendations are to be incorporated with lifestyle changes, including increased activity and possibly medication. Restrictions of no less than 1200 kcal per day in adolescents 13 to 18 years old result in improved weight status and body composition as well.[71] The Diabetes Prevention Program demonstrated that participants assigned to the intensive lifestyle-intervention arm had a reduction in daily energy intake of 450 kcal and a 58% reduction in progression to diabetes at the 2.8-year follow-up.[71] At the study's end, 50% of the lifestyle-arm participants had achieved the goal weight loss of at least 7% after the 24-week curriculum and 38% showed weight loss of at least 7% at the time of their most recent visit.[72] The Academy of Nutrition and Dietetics recommends that protein-sparing, modified-fast (ketogenic) diets be restricted to children who are >120% of their ideal body weight and who have a serious medical complication that would benefit from rapid weight loss.[71] Specific recommendations are for the intervention to be short-term (typically 10 weeks) and to be conducted under the supervision of a multidisciplinary team specializing in pediatric obesity.

Regardless of the meal plan prescribed, some degree of nutrition education must be provided to maximize adherence and positive results. This education should encourage patients to follow healthy eating patterns, such as consuming 3 meals with planned snacks per day, not eating while watching television or using computers, using smaller plates to make portions appear larger, and leaving small amounts of food on the plate.[73] Common dietary recommendations to reduce calorie intake and to promote weight loss in children include the following: (1) eating regular meals and snacks; (2) reducing portion sizes; (3) choosing calorie-free beverages, except for milk; (4) limiting juice to 1 cup per day; (5) increasing consumption of fruits and vegetables; (6) consuming 3 or 4 servings of low-fat dairy products per day; (7) limiting intake of high-fat foods; (8) limiting frequency and size of snacks; and (9) reducing calories consumed in fast-food meals.[74]

Key Action Statement 6

The committee suggests that clinicians encourage children and adolescents with T2DM to engage in moderate-to-vigorous exercise for at least 60 minutes daily and to limit nonacademic screen time to less than 2 hours per day. (Option: evidence quality D, expert opinion and evidence from studies of metabolic syndrome and obesity; preponderance of benefits over harms. Role of patient preference is dominant.)

Action Statement Profile KAS 6

Aggregate evidence quality	D (expert opinion and evidence from studies of metabolic syndrome and obesity).
Benefit	Promotes weight loss; contributes to glycemic control; prevents worsening of disease; facilitates the ability to perform exercise; improves the person's sense of well-being; and fosters cardiovascular health.
Harm	Cost for patient of counseling, food, and time; costs for clinician in taking away time that could be spent on other activities; inadequate reimbursement for clinician's time.
Benefits-harms assessment	Preponderance of benefit over harm.
Value judgments	Broad consensus.
Role of patient preference	Dominant. Patients may seek various forms of exercise. Patient preference should play a significant role in creating an exercise plan.
Exclusions	Although certain older or more debilitated patients with T2DM may be restricted in the amount of moderate-to-vigorous exercise they can perform safely, this recommendation applies to the vast majority of children and adolescents with T2DM.
Intentional vagueness	Intentional vagueness on the sequence of follow-up contact attributable to the lack of evidence and the need to individualize care.
Policy level	Option.

Recommendations From the Academy of Nutrition and Dietetics

Pediatric Weight Management Evidence-Based Nutrition Practice Guidelines

Recommendation	Strength
Interventions to reduce pediatric obesity should be multicomponent and include diet, physical activity, nutritional counseling, and parent or caregiver participation.	Strong
A nutrition prescription should be formulated as part of the dietary intervention in a multicomponent pediatric weight management program.	Strong
Dietary factors that may be associated with an increased risk of overweight are increased total dietary fat intake and increased intake of calorically sweetened beverages.	Strong
Dietary factors that may be associated with a decreased risk of overweight are increased fruit and vegetable intake.	Strong
A balanced macronutrient diet that contains no fewer than 900 kcal per day is recommended to improve weight status in children aged 6–12 y who are medically monitored.	Strong
A balanced macronutrient diet that contains no fewer than 1200 kcal per day is recommended to improve weight status in adolescents aged 13–18 y who are medically monitored.	Strong
Family diet behaviors that are associated with an increased risk of pediatric obesity are parental restriction of highly palatable foods, consumption of food away from home, increased meal portion size, and skipping breakfast.	Fair

Engaging in Physical Activity

Physical activity is an integral part of weight management for prevention and treatment of T2DM. Although there is a paucity of available data from children and adolescents with T2DM, several well-controlled studies performed in obese children and adolescents at risk of metabolic syndrome and T2DM provide guidelines for physical activity. (See the Resources section for tools on this subject.) A summary of the references supporting the evidence for this guideline can be found in the technical report.[31]

At present, moderate-to-vigorous exercise of at least 60 minutes daily is recommended for reduction of BMI and improved glycemic control in patients with T2DM.[75] "Moderate to

vigorous exercise" is defined as exercise that makes the individual breathe hard and perspire and that raises his or her heart rate. An easy way to define exercise intensity for patients is the "talk test"; during moderate physical activity a person can talk but not sing. During vigorous activity, a person cannot talk without pausing to catch a breath.[76]

Adherence may be improved if clinicians provide the patient with a written prescription to engage in physical activity, including a "dose" describing ideal duration, intensity, and frequency.[75] When prescribing physical exercise, clinicians are encouraged to be sensitive to the needs of children, adolescents, and their families. Routine, organized exercise may be beyond the family's logistical and/or financial means, and some families may not be able to provide structured exercise programs for their children. It is most helpful to recommend an individualized approach that can be incorporated into the daily routine, is tailored to the patients' physical abilities and preferences, and recognizes the families' circumstances.[77] For example, clinicians might recommend only daily walking, which has been shown to improve weight loss and insulin sensitivity in adults with T2DM[78] and may constitute "moderate to vigorous activity" for some children with T2DM. It is also important to recognize that the recommended 60 minutes of exercise do not have to be accomplished in 1 session but can be completed through several, shorter increments (eg, 10–15 minutes). Patients should be encouraged to identify a variety of forms of activity that can be performed both easily and frequently.[77] In addition, providers should be cognizant of the potential need to adjust the medication dosage, especially if the patient is receiving insulin, when initiating an aggressive physical activity program.

Reducing Screen Time

Screen time contributes to a sedentary lifestyle, especially when the child or adolescent eats while watching television or playing computer games. The US Department of Health and Human Services recommends that individuals limit "screen time" spent watching television and/or using computers and handheld devices to less than 2 hours per day unless the use is related to work or homework.[79] Physical activity may be gained either through structured games and sports or through everyday activities, such as walking, ideally with involvement of the parents as good role models.

Increased screen time and food intake and reduced physical activity are associated with obesity. There is good evidence that modifying these factors can help prevent T2DM by reducing the individual's rate of weight gain. The evidence profile in pediatric patients with T2DM is inadequate at this time, however. Pending new data, the committee suggests that clinicians follow the AAP Committee on Nutrition's guideline, *Prevention of Pediatric Overweight and Obesity*. The guideline recommends restricting nonacademic screen time to a maximum of 2 hours per day and discouraging the presence of video screens and television sets in children's bedrooms.[80–82] The American Medical Association's Expert Panel on Childhood Obesity has endorsed this guideline.

Valuable recommendations for enhancing patient health include the following:

- With patients and their families, jointly determining an individualized plan that includes specific goals to reduce sedentary behaviors and increase physical activity.
- Providing a written prescription for engaging in 60-plus minutes of moderate-to-vigorous physical activities per day that includes dose, timing, and duration. It is important for clinicians to be sensitive to the needs of children, adolescents, and their families in encouraging daily physical exercise. Graded duration of exercise is recommended for those youth who cannot initially be active for 60 minutes daily, and the exercise may be accomplished through several, shorter increments (eg, 10–15 minutes).
- Incorporating physical activities into children's and adolescents' daily routines. Physical activity may be gained either through structured games and sports or through everyday activities, such as walking.
- Restricting nonacademic screen time to a maximum of 2 hours per day.
- Discouraging the presence of video screens and television sets in children's bedrooms.

Conversations pertaining to the Key Action Statements should be clearly documented in the patient's medical record.

AREAS FOR FUTURE RESEARCH

As noted previously, evidence for medical interventions in children in general is scant and is especially lacking for interventions directed toward children who have developed diseases not previously seen commonly in youth, such as childhood T2DM. Recent studies such as the Search for Diabetes in Youth Study (SEARCH)—an observational multicenter study in 2096 youth with T2DM funded by the Centers for Disease Control and Prevention and the National Institute of Diabetes and Digestive and Kidney Diseases—now provide a detailed description of childhood diabetes. Subsequent trials will describe the short-term and enduring effects of specific interventions

on the progression of the disease with time.

Although it is likely that children and adolescents with T2DM have an aggressive form of diabetes, as reflected by the age of onset, future research should determine whether the associated comorbidities and complications of diabetes also are more aggressive in pediatric populations than in adults and if they are more or less responsive to therapeutic interventions. Additional research should explore whether early introduction of insulin or the use of particular oral agents will preserve β-cell function in these children, and whether recent technologic advances (such as continuous glucose monitoring and insulin pumps) will benefit this population. Additional issues that require further study include the following:

- To delineate whether using lifestyle options without medication is a reliable first step in treating selected children with T2DM.
- To determine whether BG monitoring should be recommended to all children and youth with T2DM, regardless of therapy used; what the optimal frequency of BG monitoring is for pediatric patients on the basis of treatment regimen; and which subgroups will be able to successfully maintain glycemic goals with less frequent monitoring.
- To explore the efficacy of school- and clinic-based diet and physical activity interventions to prevent and manage pediatric T2DM.
- To explore the association between increased "screen time" and reduced physical activity with respect to T2DM's risk factors.

RESOURCES

Several tools are available online to assist providers in improving patient adherence to lifestyle modifications, including examples of activities to be recommended for patients:

- The American Academy of Pediatrics:
  - www.healthychildren.org
  - www.letsmove.gov
  - Technical Report: Management of Type 2 Diabetes Mellitus in Children and Adolescents.[31]
    - Includes an overview and screening tools for a variety of comorbidities.
  - Gahagan S, Silverstein J; Committee on Native American Child Health and Section on Endocrinology. Clinical report: prevention and treatment of type 2 diabetes mellitus in children, with special emphasis on American Indian and Alaska Native Children. *Pediatrics*. 2003;112 (4):e328–e347. Available at: http://www.pediatrics.org/cgi/content/full/112/4/e328[63]
    - Fig 3 presents a screening tool for microalbumin.
  - Bright Futures: http://brightfutures.aap.org/
  - Daniels SR, Greer FR; Committee on Nutrition. Lipid screening and cardiovascular health in childhood. *Pediatrics*. 2008;122 (1):198–208. Available at:
- The American Diabetes Association: www.diabetes.org
  - Management of dyslipidemia in children and adolescents with diabetes. *Diabetes Care*. 2003;26(7):2194–2197. Available at: http://care.diabetesjournals.org/content/26/7/2194.full
- Academy of Nutrition and Dietetics:
  - http://www.eatright.org/childhoodobesity/
  - http://www.eatright.org/kids/
  - http://www.eatright.org/cps/rde/xchg/ada/hs.xsl/index.html
  - Pediatric Weight Management Evidence-Based Nutrition Practice Guidelines: http://www.adaevidencelibrary.com/topic.cfm?cat=2721
- American Heart Association:
  - American Heart Association *Circulation*. 2006 Dec 12;114(24):2710-2738. Epub 2006 Nov 27. Review.
- Centers for Disease Control and Prevention:
  - http://www.cdc.gov/obesity/childhood/solutions.html
  - BMI and other growth charts can be downloaded and printed from the CDC Web site: http://www.cdc.gov/growthcharts.
  - Center for Epidemiologic Studies Depression Scale (CES-D): http://www.chcr.brown.edu/pcoc/cesdscale.pdf; see attachments
- *Diagnostic and Statistical Manual of Mental Disorders*. 4th ed. Washington, DC: American Psychiatric Association; 1994
- Let's Move Campaign: www.letsmove.gov
- The Reach Institute. *Guidelines for Adolescent Depression in Primary Care (GLAD-PC) Toolkit*, 2007. Contains a listing of the criteria for major depressive disorder as defined by the DSM-IV-TR. Available at: http://www.gladpc.org
- The National Heart, Lung, and Blood Institute (NHLBI) hypertension guidelines: http://www.nhlbi.nih.gov/guidelines/hypertension/child_tbl.htm
- The National Diabetes Education Program and TIP sheets (including tip sheets on youth transitioning to adulthood and adult providers, Staying Active, Eating Healthy, Ups and Downs of Diabetes, etc): www.ndep.nih.gov or www.yourdiabetesinfo.org

- National High Blood Pressure Education Program Working Group on High Blood Pressure in Children and Adolescents, The Fourth Report on the Diagnosis, Evaluation, and Treatment of High Blood Pressure in Children and Adolescents: *Pediatrics*. 2004;114:555–576. Available at: http://pediatrics.aappublications.org/content/114/Supplement_2/555.long
- National Initiative for Children's Healthcare Quality (NICHQ): childhood obesity section: http://www.nichq.org/childhood_obesity/index.html
- The National Institute of Child Health and Human Development (NICHD): www.NICHD.org
- President's Council on Physical Fitness and Sports: http://www.presidentschallenge.org/home_kids.aspx
- US Department of Agriculture's "My Pyramid" Web site:
  - http://www.choosemyplate.gov/
  - http://fnic.nal.usda.gov/life-cycle-nutrition/child-nutrition-and-health

SUBCOMMITTEE ON TYPE 2 DIABETES (OVERSIGHT BY THE STEERING COMMITTEE ON QUALITY IMPROVEMENT AND MANAGEMENT, 2008–2012)

Kenneth Claud Copeland, MD, FAAP: Co-chair—Endocrinology and Pediatric Endocrine Society Liaison (2009: Novo Nordisk, Genentech, Endo [National Advisory Groups]; 2010: Novo Nordisk [National Advisory Group]); published research related to type 2 diabetes

Janet Silverstein, MD, FAAP: Co-chair—Endocrinology and American Diabetes Association Liaison (small grants with Pfizer, Novo Nordisk, and Lilly; grant review committee for Genentech; was on an advisory committee for Sanofi Aventis, and Abbott Laboratories for a 1-time meeting); published research related to type 2 diabetes

Kelly Roberta Moore, MD, FAAP: General Pediatrics, Indian Health, AAP Committee on Native American Child Health Liaison (board member of the Merck Company Foundation Alliance to Reduce Disparities in Diabetes. Their national program office is the University of Michigan's Center for Managing Chronic Disease.)

Greg Edward Prazar, MD, FAAP: General Pediatrics (no conflicts)

Terry Raymer, MD, CDE: Family Medicine, Indian Health Service (no conflicts)

Richard N. Shiffman, MD, FAAP: Partnership for Policy Implementation Informatician, General Pediatrics (no conflicts)

Shelley C. Springer, MD, MBA, FAAP: Epidemiologist (no conflicts)

Meaghan Anderson, MS, RD, LD, CDE: Academy of Nutrition and Dietetics Liaison (formerly a Certified Pump Trainer for Animas)

Stephen J. Spann, MD, MBA, FAAFP: American Academy of Family Physicians Liaison (no conflicts)

Vidhu V. Thaker, MD, FAAP: QuIIN Liaison, General Pediatrics (no conflicts)

CONSULTANT

Susan K. Flinn, MA: Medical Writer (no conflicts)

STAFF

Caryn Davidson, MA

REFERENCES

1. Centers for Disease Control and Prevention. Data and Statistics. Obesity rates among children in the United States. Available at: www.cdc.gov/obesity/childhood/prevalence.html. Accessed August 13, 2012
2. Copeland KC, Chalmers LJ, Brown RD. Type 2 diabetes in children: oxymoron or medical metamorphosis? *Pediatr Ann*. 2005;34(9):686–697
3. Narayan KM, Boyle JP, Thompson TJ, Sorensen SW, Williamson DF. Lifetime risk for diabetes mellitus in the United States. *JAMA*. 2003;290(14):1884–1890
4. Chopra M, Galbraith S, Darnton-Hill I. A global response to a global problem: the epidemic of overnutrition. *Bull World Health Organ*. 2002;80(12):952–958
5. Liese AD, D'Agostino RB, Jr, Hamman RF, et al; SEARCH for Diabetes in Youth Study Group. The burden of diabetes mellitus among US youth: prevalence estimates from the SEARCH for Diabetes in Youth Study. *Pediatrics*. 2006;118(4):1510–1518
6. Silverstein JH, Rosenbloom AL. Type 2 diabetes in children. *Curr Diab Rep*. 2001;1(1):19–27
7. Pinhas-Hamiel O, Zeitler P. Clinical presentation and treatment of type 2 diabetes in children. *Pediatr Diabetes*. 2007;8(suppl 9):16–27
8. Dabelea D, Bell RA, D'Agostino RB Jr, et al; Writing Group for the SEARCH for Diabetes in Youth Study Group. Incidence of diabetes in youth in the United States. *JAMA*. 2007;297(24):2716–2724
9. Mayer-Davis EJ, Bell RA, Dabelea D, et al; SEARCH for Diabetes in Youth Study Group. The many faces of diabetes in American youth: type 1 and type 2 diabetes in five race and ethnic populations: the SEARCH for Diabetes in Youth Study. *Diabetes Care*. 2009;32(suppl 2):S99–S101
10. Copeland KC, Zeitler P, Geffner M, et al; TODAY Study Group. Characteristics of adolescents and youth with recent-onset type 2 diabetes: the TODAY cohort at baseline. *J Clin Endocrinol Metab*. 2011;96(1):159–167
11. Narayan KM, Williams R. Diabetes—a global problem needing global solutions. *Prim Care Diabetes*. 2009;3(1):3–4
12. Wild S, Roglic G, Green A, Sicree R, King H. Global prevalence of diabetes: estimates for the year 2000 and projections for 2030. *Diabetes Care*. 2004;27(5):1047–1053
13. Silverstein J, Klingensmith G, Copeland K, et al; American Diabetes Association. Care of children and adolescents with type 1 diabetes: a statement of the American Diabetes Association. *Diabetes Care*. 2005;28(1):186–212
14. Pinhas-Hamiel O, Zeitler P. Barriers to the treatment of adolescent type 2 diabetes—a survey of provider perceptions. *Pediatr Diabetes*. 2003;4(1):24–28
15. Moore KR, McGowan MK, Donato KA, Kollipara S, Roubideaux Y. Community resources for promoting youth nutrition and physical activity. *Am J Health Educ*. 2009;40(5):298–303
16. Zeitler P, Epstein L, Grey M, et al; The TODAY Study Group. Treatment Options for type 2 diabetes mellitus in Adolescents and Youth: a study of the comparative efficacy of metformin alone or in combination with rosiglitazone or lifestyle intervention in adolescents with type 2 diabetes mellitus. *Pediatr Diabetes*. 2007;8(2):74–87
17. Kane MP, Abu-Baker A, Busch RS. The utility of oral diabetes medications in type 2

diabetes of the young. *Curr Diabetes Rev.* 2005;1(1):83–92

18. De Berardis G, Pellegrini F, Franciosi M, et al. Quality of care and outcomes in type 2 diabetes patientes. *Diabetes Care.* 2004;27 (2):398–406
19. Ziemer DC, Miller CD, Rhee MK, et al. Clinical inertia contributes to poor diabetes control in a primary care setting. *Diabetes Educ.* 2005;31(4):564–571
20. Bradshaw B. The role of the family in managing therapy in minority children with type 2 diabetes mellitus. *J Pediatr Endocrinol Metab.* 2002;15(suppl 1):547–551
21. Pinhas-Hamiel O, Standiford D, Hamiel D, Dolan LM, Cohen R, Zeitler PS. The type 2 family: a setting for development and treatment of adolescent type 2 diabetes mellitus. *Arch Pediatr Adolesc Med.* 1999; 153(10):1063–1067
22. Mulvaney SA, Schlundt DG, Mudasiru E, et al. Parent perceptions of caring for adolescents with type 2 diabetes. *Diabetes Care.* 2006;29(5):993–997
23. Summerbell CD, Ashton V, Campbell KJ, Edmunds L, Kelly S, Waters E. Interventions for treating obesity in children. *Cochrane Database Syst Rev.* 2003;(3):CD001872
24. Skinner AC, Weinberger M, Mulvaney S, Schlundt D, Rothman RL. Accuracy of perceptions of overweight and relation to self-care behaviors among adolescents with type 2 diabetes and their parents. *Diabetes Care.* 2008;31(2):227–229
25. American Diabetes Association. Type 2 diabetes in children and adolescents. *Diabetes Care.* 2000;23(3):381–389
26. Pinhas-Hamiel O, Zeitler P. Type 2 diabetes in adolescents, no longer rare. *Pediatr Rev.* 1998;19(12):434–435
27. Fagot-Campagna A, Pettitt DJ, Engelgau MM, et al. Type 2 diabetes among North American children and adolescents: an epidemiologic review and a public health perspective. *J Pediatr.* 2000;136(5):664–672
28. Rothman RL, Mulvaney S, Elasy TA, et al. Self-management behaviors, racial disparities, and glycemic control among adolescents with type 2 diabetes. *Pediatrics.* 2008;121(4). Available at: www.pediatrics.org/cgi/content/full/121/4/e912
29. Scott CR, Smith JM, Cradock MM, Pihoker C. Characteristics of youth-onset noninsulin-dependent diabetes mellitus and insulin-dependent diabetes mellitus at diagnosis. *Pediatrics.* 1997;100(1):84–91
30. Libman IM, Pietropaolo M, Arslanian SA, LaPorte RE, Becker DJ. Changing prevalence of overweight children and adolescents at onset of insulin-treated diabetes. *Diabetes Care.* 2003;26(10):2871–2875
31. Springer SC, Copeland KC, Silverstein J, et al. Technical report: management of type 2 diabetes mellitus in children and adolescents. *Pediatrics.* 2012, In press
32. American Academy of Pediatrics Steering Committee on Quality Improvement and Management. Classifying recommendations for clinical practice guidelines. *Pediatrics.* 2004;114(3):874–877
33. Shiffman RN, Dixon J, Brandt C, et al. The GuideLine Implementability Appraisal (GLIA): development of an instrument to identify obstacles to guideline implementation. *BMC Med Inform Decis Mak.* 2005;5:23
34. Gungor N, Hannon T, Libman I, Bacha F, Arslanian S. Type 2 diabetes mellitus in youth: the complete picture to date. *Pediatr Clin North Am.* 2005;52(6):1579–1609
35. Daaboul JJ, Siverstein JH. The management of type 2 diabetes in children and adolescents. *Minerva Pediatr.* 2004;56(3):255–264
36. Kadmon PM, Grupposo PA. Glycemic control with metformin or insulin therapy in adolescents with type 2 diabetes mellitus. *J Pediatr Endocrinol.* 2004;17(9):1185–1193
37. Owada M, Nitadori Y, Kitagawa T. Treatment of NIDDM in youth. *Clin Pediatr (Phila).* 1998;37(2):117–121
38. Pinhas-Hamiel O, Zeitler P. Advances in epidemiology and treatment of type 2 diabetes in children. *Adv Pediatr.* 2005;52: 223–259
39. Jones KL, Haghi M. Type 2 diabetes mellitus in children and adolescence: a primer. *Endocrinologist.* 2000;10:389–396
40. Kawahara R, Amemiya T, Yoshino M, et al. Dropout of young non-insulin-dependent diabetics from diabetic care. *Diabetes Res Clin Pract.* 1994;24(3):181–185
41. Kaufman FR. Type 2 diabetes mellitus in children and youth: a new epidemic. *J Pediatr Endocrinol Metab.* 2002;15(suppl 2): 737–744
42. Garber AJ, Duncan TG, Goodman AM, Mills DJ, Rohlf JL. Efficacy of metformin in type II diabetes: results of a double-blind, placebo-controlled, dose-response trial. *Am J Med.* 1997;103(6):491–497
43. Dabelea D, Pettitt DJ, Jones KL, Arslanian SA. Type 2 diabetes mellitus in minority children and adolescents: an emerging problem. *Endocrinol Metabo Clin North Am.* 1999;28(4):709–729
44. Miller JL, Silverstein JH. The management of type 2 diabetes mellitus in children and adolescents. *J Pediatr Endocrinol Metab.* 2005;18(2):111–123
45. Reinehr T, Schober E, Roth CL, Wiegand S, Holl R; DPV-Wiss Study Group. Type 2 diabetes in children and adolescents in a 2-year follow-up: insufficient adherence to diabetes centers. *Horm Res.* 2008;69(2):107–113
46. Rosenbloom AL, Silverstein JH, Amemiya S, Zeitler P, Klingensmith GJ. Type 2 diabetes in children and adolescents. *Pediatr Diabetes.* 2009;10(suppl 12):17–32
47. Zuhri-Yafi MI, Brosnan PG, Hardin DS. Treatment of type 2 diabetes mellitus in children and adolescents. *J Pediatr Endocrinol Metab.* 2002;15(suppl 1):541–546
48. Rapaport R, Silverstein JH, Garzarella L, Rosenbloom AL. Type 1 and type 2 diabetes mellitus in childhood in the United States: practice patterns by pediatric endocrinologists. *J Pediatr Endocrinol Metab.* 2004;17 (6):871–877
49. Glaser N, Jones KL. Non-insulin-dependent diabetes mellitus in children and adolescents. *Adv Pediatr.* 1996;43:359–396
50. Miller JL, Silverstein JH. The treatment of type 2 diabetes mellitus in youth: which therapies? *Treat Endocrinol.* 2006;5(4):201–210
51. Silverstein JH, Rosenbloom AL. Treatment of type 2 diabetes mellitus in children and adolescents. *J Pediatr Endocrinol Metab.* 2000;13(suppl 6):1403–1409
52. Dean H. Treatment of type 2 diabetes in youth: an argument for randomized controlled studies. *Paediatr Child Health (Oxford).* 1999;4(4):265–270
53. Sellers EAC, Dean HJ. Short-term insulin therapy in adolescents with type 2 diabetes mellitus. *J Pediatr Endocrinol Metab.* 2004; 17(11):1561–1564
54. Zeitler P, Hirst K, Pyle L, et al; TODAY Study Group. A clinical trial to maintain glycemic control in youth with type 2 diabetes. *N Engl J Med.* 2012;366(24):2247–2256
55. White NH, Cleary PA, Dahms W, Goldstein D, Malone J, Tamborlane WV; Diabetes Control and Complications Trial (DCCT)/Epidemiology of Diabetes Interventions and Complications (EDIC) Research Group. Beneficial effects of intensive therapy of diabetes during adolescence: outcomes after the conclusion of the Diabetes Control and Complications Trial (DCCT). *J Pediatr.* 2001;139(6):804–812
56. The Diabetes Control and Complications Trial Research Group. The effect of intensive treatment of diabetes on the development and progression of long-term complications in insulin-dependent diabetes mellitus. *N Engl J Med.* 1993;329(14):977–986
57. Orchard TJ, Olson JC, Erbey JR, et al. Insulin resistance-related factors, but not glycemia, predict coronary artery disease in type 1 diabetes: 10-year follow-up data from the Pittsburgh Epidemiology of Diabetes Complications Study. *Diabetes Care.* 2003;26(5):1374–1379

58. UK Prospective Diabetes Study Group. U.K. prospective diabetes study 16. Overview of 6 years' therapy of type II diabetes: a progressive disease. *Diabetes*. 1995;44(11): 1249–1258
59. Shichiri M, Kishikawa H, Ohkubo Y, Wake N. Long-term results of the Kumamoto Study on optimal diabetes control in type 2 diabetic patients. *Diabetes Care*. 2000;23 (suppl 2):B21–B29
60. Baynes JW, Bunn HF, Goldstein D, et al; National Diabetes Data Group. National Diabetes Data Group: report of the expert committee on glucosylated hemoglobin. *Diabetes Care*. 1984;7(6):602–606
61. Dabiri G, Jones K, Krebs J, et al. Benefits of rosiglitazone in children with type 2 diabetes mellitus [abstract]. *Diabetes*. 2005; A457
62. Ponder SW, Sullivan S, McBath G. Type 2 diabetes mellitus in teens. *Diabetes Spectrum*. 2000;13(2):95–119
63. Gahagan S, Silverstein J, and the American Academy of Pediatrics Committee on Native American Child Health. Prevention and treatment of type 2 diabetes mellitus in children, with special emphasis on American Indian and Alaska Native children. *Pediatrics*. 2003;112(4). Available at: www.pediatrics.org/cgi/content/full/112/4/e328
64. Levine BS, Anderson BJ, Butler DA, Antisdel JE, Brackett J, Laffel LM. Predictors of glycemic control and short-term adverse outcomes in youth with type 1 diabetes. *J Pediatr*. 2001;139(2):197–203
65. Haller MJ, Stalvey MS, Silverstein JH. Predictors of control of diabetes: monitoring may be the key. *J Pediatr*. 2004;144(5):660–661
66. Murata GH, Shah JH, Hoffman RM, et al; Diabetes Outcomes in Veterans Study (DOVES). Intensified blood glucose monitoring improves glycemic control in stable, insulin-treated veterans with type 2 diabetes: the Diabetes Outcomes in Veterans Study (DOVES). *Diabetes Care*. 2003;26(6): 1759–1763
67. American Diabetes Association. Standards of medical care in diabetes—2011. *Diabetes Care*. 2011;34(suppl 1):S11–S61
68. Hanefeld M, Fischer S, Julius U, et al. Risk factors for myocardial infarction and death in newly detected NIDDM: the Diabetes Intervention Study, 11-year follow-up. *Diabetologia*. 1996;39(12):1577–1583
69. Franciosi M, Pellegrini F, De Berardis G, et al; QuED Study Group. The impact of blood glucose self-monitoring on metabolic control and quality of life in type 2 diabetic patients: an urgent need for better educational strategies. *Diabetes Care*. 2001;24 (11):1870–1877
70. American Dietetic Association. Recommendations summary: pediatric weight management (PWM) using protein sparing modified fast diets for pediatric weight loss. Available at: www.adaevidencelibrary.com/template.cfm?template=guide_-summary&key=416. Accessed August 13, 2012
71. Knowler WC, Barrett-Connor E, Fowler SE, et al; Diabetes Prevention Program Research Group. Reduction in the incidence of type 2 diabetes with lifestyle intervention or metformin. *N Engl J Med*. 2002;346(6): 393–403
72. Willi SM, Martin K, Datko FM, Brant BP. Treatment of type 2 diabetes in childhood using a very-low-calorie diet. *Diabetes Care*. 2004;27(2):348–353
73. Berry D, Urban A, Grey M. Management of type 2 diabetes in youth (part 2). *J Pediatr Health Care*. 2006;20(2):88–97
74. Loghmani ES. Nutrition therapy for overweight children and adolescents with type 2 diabetes. *Curr Diab Rep*. 2005;5(5):385–390
75. McGavock J, Sellers E, Dean H. Physical activity for the prevention and management of youth-onset type 2 diabetes mellitus: focus on cardiovascular complications. *Diab Vasc Dis Res*. 2007;4(4):305–310
76. Centers for Disease Control and Prevention. Physical activity for everyone: how much physical activity do you need? Atlanta, GA: Centers for Disease Control and Prevention; 2008. Available at: www.cdc.gov/physicalactivity/everyone/guidelines/children.html. Accessed August 13, 2012
77. Pinhas-Hamiel O, Zeitler P. A weighty problem: diagnosis and treatment of type 2 diabetes in adolescents. *Diabetes Spectrum*. 1997;10(4):292–298
78. Yamanouchi K, Shinozaki T, Chikada K, et al. Daily walking combined with diet therapy is a useful means for obese NIDDM patients not only to reduce body weight but also to improve insulin sensitivity. *Diabetes Care*. 1995;18(6):775–778
79. National Heart, Lung, and Blood Institute, US Department of Health and Human Services, National Institutes of Health. Reduce screen time. Available at: www.nhlbi.nih.gov/health/public/heart/obesity/wecan/reduce-screen-time/index.htm. Accessed August 13, 2012
80. Krebs NF, Jacobson MS; American Academy of Pediatrics Committee on Nutrition. Prevention of pediatric overweight and obesity. *Pediatrics*. 2003;112(2):424–430
81. American Academy of Pediatrics Committee on Public Education. American Academy of Pediatrics: children, adolescents, and television. *Pediatrics*. 2001;107(2):423–426
82. American Medical Association. Appendix. Expert Committee recommendations on the assessment, prevention, and treatment of child and adolescent overweight and obesity. Chicago, IL: American Medical Association; January 25, 2007. Available at: www.ama-assn.org/ama1/pub/upload/mm/433/ped_obesity_recs.pdf. Accessed August 13, 2012

ERRATA

Several inaccuracies occurred in the American Academy of Pediatrics "Clinical Practice Guideline: Management of Newly Diagnosed Type 2 Diabetes Mellitus (T2DM) in Children and Adolescents" published in the February 2013 issue of *Pediatrics* (2013;131[2]:364–382).

On page 366 in the table of definitions, "Prediabetes" should be defined as "Fasting plasma glucose ≥100–125 mg/dL or 2-hour glucose concentration during an oral glucose tolerance test of ≥140 but <200 mg/dL or an HbA1c of 5.7% to 6.4%."

On page 378, middle column, under "Reducing Screen Time," the second sentence should read as follows: "The US Department of Health and Human Services reflects the American Academy of Pediatrics policies by recommending that individuals limit "screen time" spent watching television and/or using computers and handheld devices to <2 hours per day unless the use is related to work or homework."[79–81,83]

Also on page 378, middle column, in the second paragraph under "Reducing Screen Time," the fourth sentence should read: "Pending new data, the committee suggests that clinicians follow the policy statement 'Children, Adolescents, and Television' from the AAP Council on Communications and Media (formerly the Committee on Public Education)." The references cited in the next sentence should be 80–83.

Reference 82 should be replaced with the following reference: Barlow SE; Expert Committee. Expert committee recommendations regarding the prevention, assessment, and treatment of child and adolescent overweight and obesity: summary report. *Pediatrics*. 2007;120(suppl 4):S164–S192

Finally, a new reference 83 should be added: American Academy of Pediatrics, Council on Communications and Media. Policy statement: children, adolescents, obesity, and the media. *Pediatrics*. 2011;128(1):201–208

doi:10.1542/peds.2013-0666

Diabetes Clinical Practice Guideline Quick Reference Tools

- Action Statement Summary
  — Management of Newly Diagnosed Type 2 Diabetes Mellitus (T2DM) in Children and Adolescents
- *ICD-10-CM* Coding Quick Reference for Type 2 Diabetes Mellitus
- AAP Patient Education Handout
  — *Type 2 Diabetes: Tips for Healthy Living*

Action Statement Summary

Management of Newly Diagnosed Type 2 Diabetes Mellitus (T2DM) in Children and Adolescents

Key Action Statement 1

Clinicians must ensure that insulin therapy is initiated for children and adolescents with T2DM who are ketotic or in diabetic ketoacidosis and in whom the distinction between T1DM and T2DM is unclear; and, in usual cases, should initiate insulin therapy for patients:

- who have random venous or plasma BG concentrations ≥250 mg/dL; or
- whose HbA1c is >9%.

(Strong Recommendation: evidence quality X, validating studies cannot be performed, and C, observational studies and expert opinion; preponderance of benefit over harm.)

Key Action Statement 2

In all other instances, clinicians should initiate a lifestyle modification program, including nutrition and physical activity, and start metformin as first-line therapy for children and adolescents at the time of diagnosis of T2DM. (Strong recommendation: evidence quality B; 1 RCT showing improved outcomes with metformin versus lifestyle; preponderance of benefits over harms.)

Key Action Statement 3

The committee suggests that clinicians monitor HbA1c concentrations every 3 months and intensify treatment if treatment goals for BG and HbA1c concentrations are not being met. (Option: evidence quality D; expert opinion and studies in children with T1DM and in adults with T2DM; preponderance of benefits over harms.)

Key Action Statement 4

The committee suggests that clinicians advise patients to monitor finger-stick BG concentrations in those who

- are taking insulin or other medications with a risk of hypoglycemia; or
- are initiating or changing their diabetes treatment regimen; or
- have not met treatment goals; or
- have intercurrent illnesses.

(Option: evidence quality D; expert consensus. Preponderance of benefits over harms.)

Key Action Statement 5

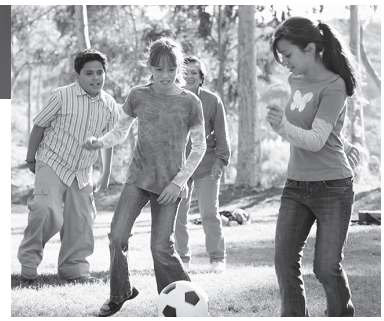
The committee suggests that clinicians incorporate the Academy of Nutrition and Dietetics' *Pediatric Weight Management Evidence-Based Nutrition Practice Guidelines* in the nutrition counseling of patients with T2DM both at the time of diagnosis and as part of ongoing management. (Option; evidence quality D; expert opinion; preponderance of benefits over harms. Role of patient preference is dominant.)

Key Action Statement 6

The committee suggests that clinicians encourage children and adolescents with T2DM to engage in moderate-to-vigorous exercise for at least 60 minutes daily and to limit nonacademic screen time to less than 2 hours per day. (Option: evidence quality D, expert opinion and evidence from studies of metabolic syndrome and obesity; preponderance of benefits over harms. Role of patient preference is dominant.)

Coding Quick Reference for Type 2 Diabetes Mellitus	
ICD-10-CM	
E11.649	Type 2 diabetes mellitus with hypoglycemia without coma
E11.65	Type 2 diabetes mellitus with hyperglycemia
E11.8	Type 2 diabetes mellitus with unspecified complications
E11.9	Type 2 diabetes mellitus without complications
E13.9	Other specified diabetes mellitus without complications
Use codes above (**E11.8–E13.9**). *ICD-10-CM* does not discern between controlled and uncontrolled.	

Type 2 Diabetes: Tips for Healthy Living



Children with type 2 diabetes can live a healthy life. If your child has been diagnosed with type 2 diabetes, your child's doctor will talk with you about the importance of lifestyle and medication in keeping your child's blood glucose (blood sugar) levels under control.

Read on for information from the American Academy of Pediatrics (AAP) about managing blood glucose and creating plans for healthy living.

What is blood glucose?

Glucose is found in the blood and is the body's main source of energy. The food your child eats is broken down by the body into glucose. Glucose is a type of sugar that gives energy to the cells in the body.

The cells need the help of insulin to take the glucose from the blood to the cells. Insulin is made by an organ called the pancreas.

In children with type 2 diabetes, the pancreas does not make enough insulin and the cells don't use the insulin very well.

Why is it important to manage blood glucose levels?

Glucose will build up in the blood if it cannot be used by the cells. High blood glucose levels can damage many parts of the body, such as the eyes, kidneys, nerves, and heart.

Your child's blood glucose levels may need to be checked on a regular schedule to make sure the levels do not get too high. Your child's doctor will tell you what your child's blood glucose level should be. You and your child will need to learn how to use a glucose meter. Blood glucose levels can be quickly and easily measured using a glucose meter. First, a lancet is used to prick the skin; then a drop of blood from your child's finger is placed on a test strip that is inserted into the meter.

Are there medicines for type 2 diabetes?

Insulin in a shot or another medicine by mouth may be prescribed by your child's doctor if needed to help control your child's blood glucose levels. If your child's doctor has prescribed a medicine, it's important that your child take it as directed. Side effects from certain medicines may include bloating or gassiness. Check with your child's doctor if you have questions.

Along with medicines, your child's doctor will suggest changes to your child's diet and encourage your child to be physically active.

Tips for healthy living

A healthy diet and staying active are especially important for children with type 2 diabetes. Your child's blood glucose levels are easier to manage when you child is at a healthy weight.

Create a plan for eating healthy

Talk with your child's doctor and registered dietitian about a meal plan that meets the needs of your child. The following tips can help you select foods that are healthy and contain a high content of nutrients (protein, vitamins, and minerals):

- Eat at least 5 servings of fruits and vegetables each day.
- Include high-fiber, whole-grain foods such as brown rice, whole-grain pasta, corns, peas, and breads and cereals at meals. Sweet potatoes are also a good choice.
- Choose lower-fat or fat-free toppings like grated low-fat parmesan cheese, salsa, herbed cottage cheese, nonfat/low-fat gravy, low-fat sour cream, low-fat salad dressing, or yogurt.
- Select lean meats such as skinless chicken and turkey, fish, lean beef cuts (round, sirloin, chuck, loin, lean ground beef—no more than 15% fat content), and lean pork cuts (tenderloin, chops, ham). Trim off all visible fat. Remove skin from cooked poultry before eating.
- Include healthy oils such as canola or olive oil in your diet. Choose margarine and vegetable oils without trans fats made from canola, corn, sunflower, soybean, or olive oils.
- Use nonstick vegetable sprays when cooking.
- Use fat-free cooking methods such as baking, broiling, grilling, poaching, or steaming when cooking meat, poultry, or fish.
- Serve vegetable- and broth-based soups, or use nonfat (skim) or low-fat (1%) milk or evaporated skim milk when making cream soups.
- Use the Nutrition Facts label on food packages to find foods with less saturated fat per serving. Pay attention to the serving size as you make choices. Remember that the percent daily values on food labels are based on portion sizes and calorie levels for adults.

Create a plan for physical activity

Physical activity, along with proper nutrition, promotes lifelong health. Following are some ideas on how to get fit:

- **Encourage your child to be active at least 1 hour a day.** Active play is the best exercise for younger children! Parents can join their children and have fun while being active too. School-aged child should participate every day in 1 hour or more of moderate to vigorous physical activity that is right for their age, is enjoyable, and involves a variety of activities.
- **Limit television watching and computer use.** The AAP discourages TV and other media use by children younger than 2 years and encourages interactive play. For older children, total entertainment screen time should be limited to less than 1 to 2 hours per day.
- **Keep an activity log.** The use of activity logs can help children and teens keep track of their exercise programs and physical activity. Online tools can be helpful.

- **Get the whole family involved.** It is a great way to spend time together. Also, children who regularly see their parents enjoying sports and physical activity are more likely to do so themselves.
- **Provide a safe environment.** Make sure your child's equipment and chosen site for the sport or activity are safe. Make sure your child's clothing is comfortable and appropriate.

For more information

National Diabetes Education Program

http://ndep.nih.gov

From your doctor

American Academy of Pediatrics
DEDICATED TO THE HEALTH OF ALL CHILDREN™

The American Academy of Pediatrics is an organization of 60,000 primary care pediatricians, pediatric medical subspecialists, and pediatric surgical specialists dedicated to the health, safety, and well-being of infants, children, adolescents, and young adults.

American Academy of Pediatrics
Web site—www.HealthyChildren.org

Early Detection of Developmental Dysplasia of the Hip

- *Clinical Practice Guideline*

AMERICAN ACADEMY OF PEDIATRICS

Committee on Quality Improvement, Subcommittee on Developmental Dysplasia of the Hip

Clinical Practice Guideline: Early Detection of Developmental Dysplasia of the Hip

ABSTRACT. ***Developmental dysplasia of the hip*** **is the preferred term to describe the condition in which the femoral head has an abnormal relationship to the acetabulum. Developmental dysplasia of the hip includes frank dislocation (luxation), partial dislocation (subluxation), instability wherein the femoral head comes in and out of the socket, and an array of radiographic abnormalities that reflect inadequate formation of the acetabulum. Because many of these findings may not be present at birth, the term *developmental* more accurately reflects the biologic features than does the term *congenital*. The disorder is uncommon. The earlier a dislocated hip is detected, the simpler and more effective is the treatment. Despite newborn screening programs, dislocated hips continue to be diagnosed later in infancy and childhood,[1–11] in some instances delaying appropriate therapy and leading to a substantial number of malpractice claims. The objective of this guideline is to reduce the number of dislocated hips detected later in infancy and childhood. The target audience is the primary care provider. The target patient is the healthy newborn up to 18 months of age, excluding those with neuromuscular disorders, myelodysplasia, or arthrogryposis.**

ABBREVIATIONS. DDH, developmental dysplasia of the hip; AVN, avascular necrosis of the hip.

BIOLOGIC FEATURES AND NATURAL HISTORY

Understanding the developmental nature of developmental dysplasia of the hip (DDH) and the subsequent spectrum of hip abnormalities requires a knowledge of the growth and development of the hip joint.[12] Embryologically, the femoral head and acetabulum develop from the same block of primitive mesenchymal cells. A cleft develops to separate them at 7 to 8 weeks' gestation. By 11 weeks' gestation, development of the hip joint is complete. At birth, the femoral head and the acetabulum are primarily cartilaginous. The acetabulum continues to develop postnatally. The growth of the fibrocartilaginous rim (the labrum) that surrounds the bony acetabulum deepens the socket. Development of the femoral head and acetabulum are intimately related, and normal adult hip joints depend on further growth of these structures. Hip dysplasia may occur in utero, perinatally, or during infancy and childhood.

The acronym DDH includes hips that are unstable, subluxated, dislocated (luxated), and/or have malformed acetabula. A hip is *unstable* when the tight fit between the femoral head and the acetabulum is lost and the femoral head is able to move within (subluxated) or outside (dislocated) the confines of the acetabulum. A *dislocation* is a complete loss of contact of the femoral head with the acetabulum. Dislocations are divided into 2 types: teratologic and typical.[12] *Teratologic dislocations* occur early in utero and often are associated with neuromuscular disorders, such as arthrogryposis and myelodysplasia, or with various dysmorphic syndromes. The *typical dislocation* occurs in an otherwise healthy infant and may occur prenatally or postnatally.

During the immediate newborn period, laxity of the hip capsule predominates, and, if clinically significant enough, the femoral head may spontaneously dislocate and relocate. If the hip spontaneously relocates and stabilizes within a few days, subsequent hip development usually is normal. If subluxation or dislocation persists, then structural anatomic changes may develop. A deep concentric position of the femoral head in the acetabulum is necessary for normal development of the hip. When not deeply reduced (subluxated), the labrum may become everted and flattened. Because the femoral head is not reduced into the depth of the socket, the acetabulum does not grow and remodel and, therefore, becomes shallow. If the femoral head moves further out of the socket (dislocation), typically superiorly and laterally, the inferior capsule is pulled upward over the now empty socket. Muscles surrounding the hip, especially the adductors, become contracted, limiting abduction of the hip. The hip capsule constricts; once this capsular constriction narrows to less than the diameter of the femoral head, the hip can no longer be reduced by manual manipulative maneuvers, and operative reduction usually is necessary.

The hip is at risk for dislocation during 4 periods: 1) the 12th gestational week, 2) the 18th gestational week, 3) the final 4 weeks of gestation, and 4) the postnatal period. During the 12th gestational week, the hip is at risk as the fetal lower limb rotates medially. A dislocation at this time is termed teratologic. All elements of the hip joint develop abnor-

The recommendations in this statement do not indicate an exclusive course of treatment or serve as a standard of medical care. Variations, taking into account individual circumstances, may be appropriate.

The Practice Guideline, "Early Detection of Developmental Dysplasia of the Hip," was reviewed by appropriate committees and sections of the American Academy of Pediatrics (AAP) including the Chapter Review Group, a focus group of office-based pediatricians representing each AAP District: Gene R. Adams, MD; Robert M. Corwin, MD; Diane Fuquay, MD; Barbara M. Harley, MD; Thomas J. Herr, MD, Chair; Kenneth E. Matthews, MD; Robert D. Mines, MD; Lawrence C. Pakula, MD; Howard B. Weinblatt, MD; and Delosa A. Young, MD. The Practice Guideline was also reviewed by relevant outside medical organizations as part of the peer review process. PEDIATRICS (ISSN 0031 4005).

mally. The hip muscles develop around the 18th gestational week. Neuromuscular problems at this time, such as myelodysplasia and arthrogryposis, also lead to teratologic dislocations. During the final 4 weeks of pregnancy, mechanical forces have a role. Conditions such as oligohydramnios or breech position predispose to DDH.[13] Breech position occurs in ~3% of births, and DDH occurs more frequently in breech presentations, reportedly in as many as 23%. The frank breech position of hip flexion and knee extension places a newborn or infant at the highest risk. Postnatally, infant positioning such as swaddling, combined with ligamentous laxity, also has a role.

The true incidence of dislocation of the hip can only be presumed. There is no "gold standard" for diagnosis during the newborn period. Physical examination, plane radiography, and ultrasonography all are fraught with false-positive and false-negative results. Arthrography (insertion of contrast medium into the hip joint) and magnetic resonance imaging, although accurate for determining the precise hip anatomy, are inappropriate methods for screening the newborn and infant.

The reported incidence of DDH is influenced by genetic and racial factors, diagnostic criteria, the experience and training of the examiner, and the age of the child at the time of the examination. Wynne-Davies[14] reported an increased risk to subsequent children in the presence of a diagnosed dislocation (6% risk with healthy parents and an affected child, 12% risk with an affected parent, and 36% risk with an affected parent and 1 affected child). DDH is not always detectable at birth, but some newborn screening surveys suggest an incidence as high as 1 in 100 newborns with evidence of instability, and 1 to 1.5 cases of dislocation per 1000 newborns. The incidence of DDH is higher in girls. Girls are especially susceptible to the maternal hormone relaxin, which may contribute to ligamentous laxity with the resultant instability of the hip. The left hip is involved 3 times as commonly as the right hip, perhaps related to the left occiput anterior positioning of most nonbreech newborns. In this position, the left hip resides posteriorly against the mother's spine, potentially limiting abduction.

PHYSICAL EXAMINATION

DDH is an evolving process, and its physical findings on clinical examination change.[12,15,16] The newborn must be relaxed and preferably examined on a firm surface. Considerable patience and skill are required. The physical examination changes as the child grows older. No signs are pathognomonic for a dislocated hip. The examiner must look for asymmetry. Indeed, bilateral dislocations are more difficult to diagnose than unilateral dislocations because symmetry is retained. Asymmetrical thigh or gluteal folds, better observed when the child is prone, apparent limb length discrepancy, and restricted motion, especially abduction, are significant, albeit not pathognomonic signs. With the infant supine and the pelvis stabilized, abduction to 75° and adduction to 30° should occur readily under normal circumstances.

The 2 maneuvers for assessing hip stability in the newborn are the Ortolani and Barlow tests. The Ortolani elicits the sensation of the dislocated hip reducing, and the Barlow detects the unstable hip dislocating from the acetabulum. The Ortolani is performed with the newborn supine and the examiner's index and middle fingers placed along the greater trochanter with the thumb placed along the inner thigh. The hip is flexed to 90° but not more, and the leg is held in neutral rotation. The hip is gently abducted while lifting the leg anteriorly. With this maneuver, a "clunk" is felt as the dislocated femoral head reduces into the acetabulum. This is a positive Ortolani sign. The Barlow provocative test is performed with the newborn positioned supine and the hips flexed to 90°. The leg is then gently adducted while posteriorly directed pressure is placed on the knee. A palpable clunk or sensation of movement is felt as the femoral head exits the acetabulum posteriorly. This is a positive Barlow sign. The Ortolani and Barlow maneuvers are performed 1 hip at a time. Little force is required for the performance of either of these tests. The goal is not to prove that the hip can be dislocated. Forceful and repeated examinations can break the seal between the labrum and the femoral head. These strongly positive signs of Ortolani and Barlow are distinguished from a large array of soft or equivocal physical findings present during the newborn period. High-pitched clicks are commonly elicited with flexion and extension and are inconsequential. A dislocatable hip has a rather distinctive clunk, whereas a subluxable hip is characterized by a feeling of looseness, a sliding movement, but without the true Ortolani and Barlow clunks. Separating true dislocations (clunks) from a feeling of instability and from benign adventitial sounds (clicks) takes practice and expertise. This guideline recognizes the broad range of physical findings present in newborns and infants and the confusion of terminology generated in the literature. By 8 to 12 weeks of age, the capsule laxity decreases, muscle tightness increases, and the Barlow and Ortolani maneuvers are no longer positive regardless of the status of the femoral head. In the 3-month-old infant, limitation of abduction is the most reliable sign associated with DDH. Other features that arouse suspicion include asymmetry of thigh folds, a positive Allis or Galeazzi sign (relative shortness of the femur with the hips and knees flexed), and discrepancy of leg lengths. These physical findings alert the examiner that abnormal relationships of the femoral head to the acetabulum (dislocation and subluxation) *may* be present.

Maldevelopments of the acetabulum alone (acetabular dysplasia) can be determined only by imaging techniques. Abnormal physical findings may be absent in an infant with acetabular dysplasia but no subluxation or dislocation. Indeed, because of the confusion, inconsistencies, and misuse of language in the literature (eg, an Ortolani sign called a click by some and a clunk by others), this guideline uses the following definitions.

- A *positive examination* result for DDH is the Barlow or Ortolani sign. This is the clunk of dislocation or reduction.
- An *equivocal examination* or *warning signs* include an array of physical findings that may be found in children with DDH, in children with another orthopaedic disorder, or in children who are completely healthy. These physical findings include asymmetric thigh or buttock creases, an apparent or true short leg, and limited abduction. These signs, used singly or in combination, serve to raise the pediatrician's index of suspicion and act as a threshold for referral. Newborn soft tissue hip clicks are not predictive of DDH[17] but may be confused with the Ortolani and Barlow clunks by some screening physicians and thereby be a reason for referral.

IMAGING

Radiographs of the pelvis and hips have historically been used to assess an infant with suspected DDH. During the first few months of life when the femoral heads are composed entirely of cartilage, radiographs have limited value. Displacement and instability may be undetectable, and evaluation of acetabular development is influenced by the infant's position at the time the radiograph is performed. By 4 to 6 months of age, radiographs become more reliable, particularly when the ossification center develops in the femoral head. Radiographs are readily available and relatively low in cost.

Real-time ultrasonography has been established as an accurate method for imaging the hip during the first few months of life.[15,18–25] With ultrasonography, the cartilage can be visualized and the hip can be viewed while assessing the stability of the hip and the morphologic features of the acetabulum. In some clinical settings, ultrasonography can provide information comparable to arthrography (direct injection of contrast into the hip joint), without the need for sedation, invasion, contrast medium, or ionizing radiation. Although the availability of equipment for ultrasonography is widespread, accurate results in hip sonography require training and experience. Although expertise in pediatric hip ultrasonography is increasing, this examination may not always be available or obtained conveniently. Ultrasonographic techniques include *static evaluation* of the morphologic features of the hip, as popularized in Europe by Graf,[26] and a *dynamic evaluation*, as developed by Harcke[20] that assesses the hip for stability of the femoral head in the socket, as well as static anatomy. Dynamic ultrasonography yields more useful information. With both techniques, there is considerable interobserver variability, especially during the first 3 weeks of life.[7,27]

Experience with ultrasonography has documented its ability to detect abnormal position, instability, and dysplasia not evident on clinical examination. Ultrasonography during the first 4 weeks of life often reveals the presence of minor degrees of instability and acetabular immaturity. Studies[7,28,29] indicate that nearly all these mild early findings, which will not be apparent on physical examination, resolve spontaneously without treatment. Newborn screening with ultrasonography has required a high frequency of reexamination and results in a large number of hips being unnecessarily treated. One study[23] demonstrates that a screening process with higher false-positive results also yields increased prevention of late cases. Ultrasonographic screening of all infants at 4 to 6 weeks of age would be expensive, requiring considerable resources. This practice is yet to be validated by clinical trial. *Consequently, the use of ultrasonography is recommended as an adjunct to the clinical evaluation*. It is the technique of choice for clarifying a physical finding, assessing a high-risk infant, and monitoring DDH as it is observed or treated. Used in this selective capacity, it can guide treatment and may prevent overtreatment.

PRETERM INFANTS

DDH may be unrecognized in prematurely born infants. When the infant has cardiorespiratory problems, the diagnosis and management are focused on providing appropriate ventilatory and cardiovascular support, and careful examination of the hips may be deferred until a later date. The most complete examination the infant receives may occur at the time of discharge from the hospital, and this single examination may not detect subluxation or dislocation. Despite the medical urgencies surrounding the preterm infant, it is critical to examine the entire child.

METHODS FOR GUIDELINE DEVELOPMENT

Our goal was to develop a practice parameter by using a process that would be based whenever possible on available evidence. The methods used a combination of expert panel, decision modeling, and evidence synthesis[30] (see the Technical Report available on *Pediatrics electronic pages* at www.pediatrics.org). The predominant methods recommended for such evidence synthesis are generally of 2 types: a *data-driven* method and a *model-driven*[31,32] method. In data-driven methods, the analyst finds the best data available and induces a conclusion from these data. A model-driven method, in contrast, begins with an effort to define the context for evidence and then searches for the data as defined by that context. Data-driven methods are useful when the quality of evidence is high. A careful review of the medical literature revealed that the published evidence about DDH did not meet the criteria for high quality. There was a paucity of randomized clinical trials.[8] We decided, therefore, to use the model-driven method.

A decision model was constructed based on the perspective of practicing clinicians and determining the best strategy for screening and diagnosis. The target child was a full-term newborn with no obvious orthopaedic abnormalities. We focused on the various options available to the pediatrician* for the detection of DDH, including screening by physical examination, screening by ultrasonography, and episodic screening during health supervision. Because

*In this guideline, the term *pediatrician* includes the range of pediatric primary care providers, eg, family practitioners and pediatric nurse practitioners.

the detection of a dislocated hip usually results in referral by the pediatrician, and because management of DDH is not in the purview of the pediatrician's care, treatment options are not included. We also included in our model a wide range of options for detecting DDH during the first year of life if the results of the newborn screen are negative.

The outcomes on which we focused were a dislocated hip at 1 year of age as the major morbidity of the disease and avascular necrosis of the hip (AVN) as the primary complication of DDH treatment. AVN is a loss of blood supply to the femoral head resulting in abnormal hip development, distortion of shape, and, in some instances, substantial morbidity. Ideally, a gold standard would be available to define DDH at any point in time. However, as noted, no gold standard exists except, perhaps, arthrography of the hip, which is an inappropriate standard for use in a detection model. Therefore, we defined outcomes in terms of the *process of care*. We reviewed the literature extensively. The purpose of the literature review was to provide the probabilities required by the decision model since there were no randomized clinical trials. The article or chapter title and the abstracts were reviewed by 2 members of the methodology team and members of the subcommittee. Articles not rejected were reviewed, and data were abstracted that would provide evidence for the probabilities required by the decision model. As part of the literature abstraction process, the evidence quality in each article was assessed. A computer-based literature search, hand review of recent publications, or examination of the reference section for other articles ("ancestor articles") identified 623 articles; 241 underwent detailed review, 118 of which provided some data. Of the 100 ancestor articles, only 17 yielded useful articles, suggesting that our accession process was complete. By traditional epidemiologic standards,[33] the quality of the evidence in this set of articles was uniformly low. There were few controlled trials and few studies of the follow-up of infants for whom the results of newborn examinations were negative. When the evidence was poor or lacking entirely, extensive discussions among members of the committee and the expert opinion of outside consultants were used to arrive at a consensus. No votes were taken. Disagreements were discussed, and consensus was achieved.

The available evidence was distilled in 3 ways. First, estimates were made of DDH at birth in infants without risk factors. These estimates constituted the baseline risk. Second, estimates were made of the rates of DDH in the children with risk factors. These numbers guide clinical actions: rates that are too high might indicate referral or different follow-up despite negative physical findings. Third, each screening strategy (pediatrician-based, orthopaedist-based, and ultrasonography-based) was scored for the estimated number of children given a diagnosis of DDH at birth, at mid-term (4–12 months of age), and at late-term (12 months of age and older) and for the estimated number of cases of AVN incurred, assuming that all children given a diagnosis of DDH would be treated. These numbers suggest the best strategy, balancing DDH detection with incurring adverse effects.

The baseline estimate of DDH based on orthopaedic screening was 11.5/1000 infants. Estimates from pediatric screening were 8.6/1000 and from ultrasonography were 25/1000. The 11.5/1000 rate translates into a rate for not-at-risk boys of 4.1/1000 boys and a rate for not-at-risk girls of 19/1000 girls. These numbers derive from the facts that the relative risk—the rate in girls divided by the rate in boys across several studies—is 4.6 and because infants are split evenly between boys and girls, so $.5 \times 4.1/1000 + .5 \times 19/1000 = 11.5/1000$.[34,35] We used these baseline rates for calculating the rates in other risk groups. Because the relative risk of DDH for children with a positive family history (first-degree relatives) is 1.7, the rate for boys with a positive family history is $1.7 \times 4.1 = 6.4/1000$ boys, and for girls with a positive family history, $1.7 \times 19 = 32/1000$ girls. Finally, the relative risk of DDH for breech presentation (of all kinds) is 6.3, so the risk for breech boys is $7.0 \times 4.1 = 29/1000$ boys and for breech girls, $7.0 \times 19 = 133/1000$ girls. These numbers are summarized in Table 1.

These numbers suggest that boys without risk or those with a family history have the lowest risk; girls without risk and boys born in a breech presentation have an intermediate risk; and girls with a positive family history, and especially girls born in a breech presentation, have the highest risks. Guidelines, considering the risk factors, should follow these risk profiles. Reports of newborn screening for DDH have included various screening techniques. In some, the screening clinician was an orthopaedist, in

TABLE 1. Relative and Absolute Risks for Finding a Positive Examination Result at Newborn Screening by Using the Ortolani and Barlow Signs

Newborn Characteristics	Relative Risk of a Positive Examination Result	Absolute Risk of a Positive Examination Result per 1000 Newborns With Risk Factors
All newborns	· · ·	11.5
Boys	1.0	4.1
Girls	4.6	19
Positive family history	1.7	
Boys	· · ·	6.4
Girls	· · ·	32
Breech presentation	7.0	
Boys	· · ·	29
Girls	· · ·	133

TABLE 2. Newborn Strategy*

Outcome	Orthopaedist PE	Pediatrician PE	Ultrasonography
DDH in newborn	12	8.6	25
DDH at ~6 mo of age	.1	.45	.28
DDH at 12 mo of age or more	.16	.33	.1
AVN at 12 mo of age	.06	.1	.1

* PE indicates physical examination. Outcome per 1000 infants initially screened.

others, a pediatrician, and in still others, a physiotherapist. In addition, screening has been performed by ultrasonography. In assessing the expected effect of each strategy, we estimated the newborn DDH rates, the mid-term DDH rates, and the late-term DDH rates for each of the 3 strategies, as shown in Table 2. We also estimated the rate of AVN for DDH treated before 2 months of age (2.5/1000 treated) and after 2 months of age (109/1000 treated). We could not distinguish the AVN rates for children treated between 2 and 12 months of age from those treated later. Table 2 gives these data. The total cases of AVN per strategy are calculated, assuming that all infants with positive examination results are treated.

Table 2 shows that a strategy using pediatricians to screen newborns would give the lowest newborn rate but the highest mid- and late-term DDH rates. To assess how much better an ultrasonography-only screening strategy would be, we could calculate a cost-effectiveness ratio. In this case, the "cost" of ultrasonographic screening is the number of "extra" newborn cases that probably include children who do not need to be treated. (The cost from AVN is the same in the 2 strategies.) By using these cases as the cost and the number of later cases averted as the effect, a ratio is obtained of 71 children treated neonatally because of a positive ultrasonographic screen for each later case averted. Because this number is high, and because the presumption of better late-term efficacy is based on a single study, we do not recommend ultrasonographic screening at this time.

RECOMMENDATIONS AND NOTES TO ALGORITHM (Fig 1)

1. **All newborns are to be screened by physical examination**. The evidence† for this recommendation is good. The expert consensus‡ is strong. Although initial screening by orthopaedists§ would be optimal (Table 2), it is doubtful that if widely practiced, such a strategy would give the same good results as those published from pediatric orthopaedic research centers. **It is recommended that screening be done by a properly trained health care provider** (eg, physician, pediatric nurse practitioner, physician assistant, or physical therapist). (Evidence for this recommendation is strong.) A number of studies performed by properly trained nonphysicians report results indistinguishable from those performed by physicians.[36] The examination after discharge from the neonatal intensive care unit should be performed as a newborn examination with appropriate screening. **Ultrasonography of all newborns is not recommended.** (Evidence is fair; consensus is strong.) Although there is indirect evidence to support the use of ultrasonographic screening of all newborns, it is not advocated because it is operator-dependent, availability is questionable, it increases the rate of treatment, and interobserver variability is high. There are probably some increased costs. We considered a strategy of "no newborn screening." This arm is politically indefensible because screening newborns is inherent in pediatrician's care. The technical report details this limb through decision analysis. Regardless of the screening method used for the newborn, DDH is detected in 1 in 5000 infants at 18 months of age.[3] The evidence and consensus for newborn screening remain strong.

Newborn Physical Examination and Treatment

2. **If a positive Ortolani or Barlow sign is found in the newborn examination, the infant should be referred to an orthopaedist**. Orthopaedic referral is recommended when the Ortolani sign is unequivocally positive (a clunk). Orthopaedic referral is not recommended for any softly positive finding in the examination (eg, hip click without dislocation). The precise time frame for the newborn to be evaluated by the orthopaedist cannot be determined from the literature. However, the literature suggests that the majority of "abnormal" physical findings of hip examinations at birth (clicks and clunks) will resolve by 2 weeks; therefore, consultation and possible initiation of treatment are recommended by that time. The data recommending that all those with a positive Ortolani sign be referred to an orthopaedist are limited, but expert panel consensus, nevertheless, was strong, because pediatricians do not have the training to take full responsibility and because true Ortolani clunks are rare and their management is more appropriately performed by the orthopaedist.

If the results of the physical examination at birth are "equivocally" positive (ie, soft click, mild asymmetry, but neither an Ortolani nor a Barlow sign is present), then a follow-up hip examination by the pediatrician in 2 weeks is recommended. (Evidence is good; consensus is strong.) The available data suggest that most clicks resolve by 2 weeks and that these "benign hip clicks" in the newborn period do

†In this guideline, evidence is listed as good, fair, or poor based on the methodologist's evaluation of the literature quality. (See the Technical Report.)

‡Opinion or consensus is listed as *strong* if opinion of the expert panel was unanimous or *mixed* if there were dissenting points of view.

§In this guideline, the term *orthopaedist* refers to an orthopaedic surgeon with expertise in pediatric orthopaedic conditions.

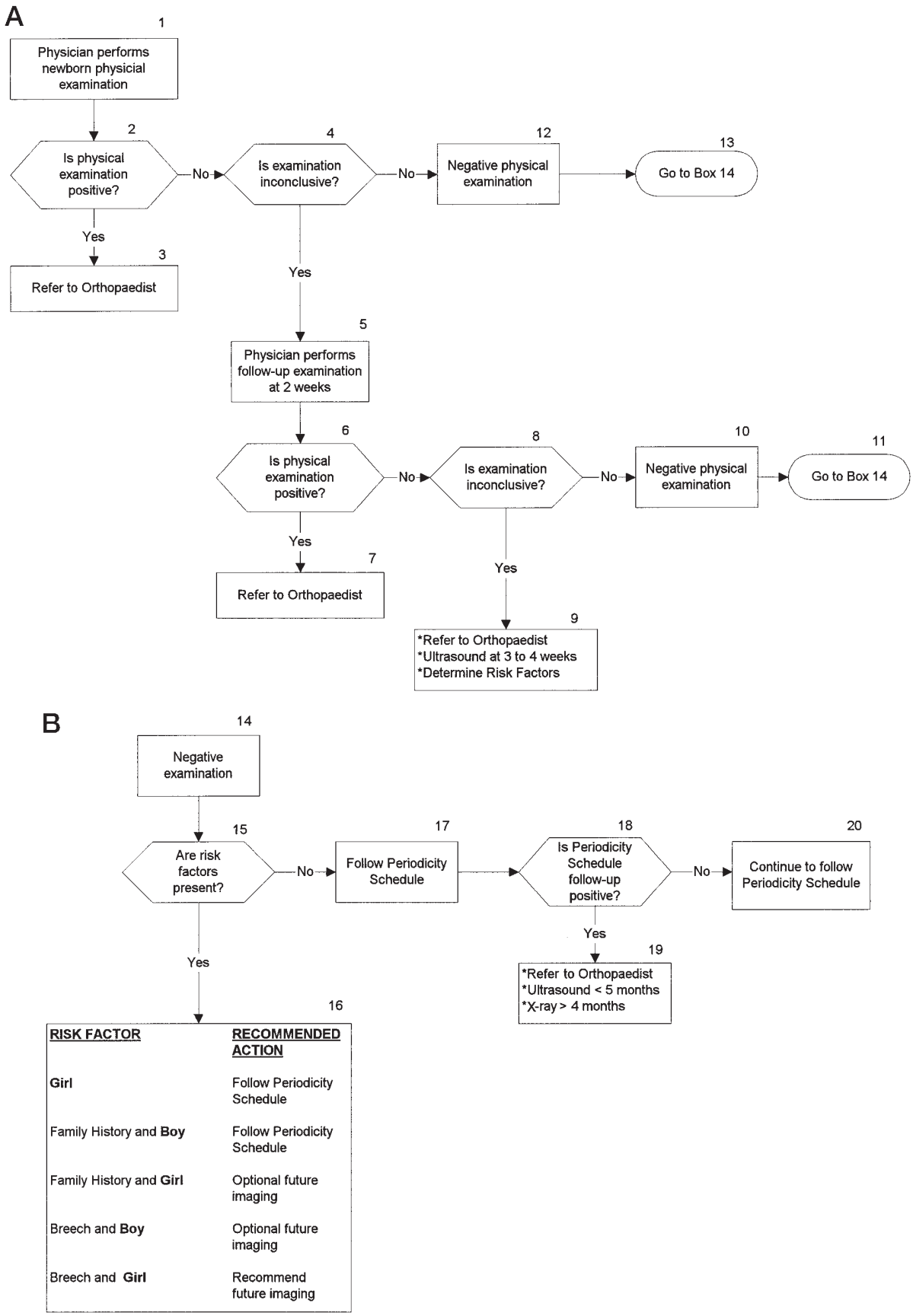


Fig 1. Screening for developmental hip dysplasia—clinical algorithm.

not lead to later hip dysplasia.[9,17,28,37] Thus, for an infant with softly positive signs, the pediatrician should reexamine the hips at 2 weeks before making referrals for orthopaedic care or ultrasonography. We recognize the concern of pediatricians about adherence to follow-up care regimens, but this concern regards all aspects of health maintenance and is not a reason to request ultrasonography or other diagnostic study of the newborn hips.

3. **If the results of the newborn physical examination are positive (ie, presence of an Ortolani or a Barlow sign), ordering an ultrasonographic examination of the newborn is not recommended**. (Evidence is poor; opinion is strong.) Treatment decisions are not influenced by the results of ultrasonography but are based on the results of the physical examination. The treating physician may use a variety of imaging studies during clinical management. **If the results of the newborn physical examination are positive, obtaining a radiograph of the newborn's pelvis and hips is not recommended** (evidence is poor; opinion is strong), because they are of limited value and do not influence treatment decisions.

The use of triple diapers when abnormal physical signs are detected during the newborn period is not recommended. (Evidence is poor; opinion is strong.) Triple diaper use is common practice despite the lack of data on the effectiveness of triple diaper use; and, in instances of frank dislocation, the use of triple diapers may delay the initiation of more appropriate treatment (such as with the Pavlik harness). Often, the primary care pediatrician may not have performed the newborn examination in the hospital. The importance of communication cannot be overemphasized, and triple diapers may aid in follow-up as a reminder that a possible abnormal physical examination finding was present in the newborn.

2-Week Examination

4. **If the results of the physical examination are positive (eg, positive Ortolani or Barlow sign) at 2 weeks, refer to an orthopaedist**. (Evidence is strong; consensus is strong.) Referral is urgent but is not an emergency. Consensus is strong that, as in the newborn, the presence of an Ortolani or Barlow sign at 2 weeks warrants referral to an orthopaedist. An Ortolani sign at 2 weeks may be a new finding or a finding that was not apparent at the time of the newborn examination.

5. **If at the 2-week examination the Ortolani and Barlow signs are absent but physical findings raise suspicions, consider referral to an orthopaedist or request ultrasonography at age 3 to 4 weeks**. Consensus is mixed about the follow-up for softly positive or equivocal findings at 2 weeks of age (eg, adventitial click, thigh asymmetry, and apparent leg length difference). Because it is necessary to confirm the status of the hip joint, the pediatrician can consider referral to an orthopaedist or for ultrasonography if the constellation of physical findings raises a high level of suspicion. However, if the physical findings are minimal, continuing follow-up by the periodicity schedule with focused hip examinations is also an option, provided risk factors are considered. (See "Recommendations" 7 and 8.)

6. **If the results of the physical examination are negative at 2 weeks, follow-up is recommended at the scheduled well-baby periodic examinations**. (Evidence is good; consensus is strong.)

7. **Risk factors**. **If the results of the newborn examination are negative (or equivocally positive), risk factors may be considered**.[13,21,38–41] Risk factors are a study of thresholds to act.[42] Table 1 gives the risk of finding a positive Ortolani or Barlow sign at the time of the initial newborn screening. If this examination is negative, the absolute risk of there being a true dislocated hip is greatly reduced. Nevertheless, the data in Table 1 may influence the pediatrician to perform confirmatory evaluations. Action will vary based on the individual clinician. The following recommendations are made (evidence is strong; opinion is strong):
   - **Girl** (newborn risk of 19/1000). When the results of the newborn examination are negative or equivocally positive, hips should be reevaluated at 2 weeks of age. If negative, continue according to the periodicity schedule; if positive, refer to an orthopaedist or for ultrasonography at 3 weeks of age.
   - **Infants with a positive family history of DDH** (newborn risk for boys of 9.4/1000 and for girls, 44/1000). When the results of the newborn examination in boys are negative or equivocally positive, hips should be reevaluated at 2 weeks of age. If negative, continue according to the periodicity schedule; if positive, refer to an orthopaedist or for ultrasonography at 3 weeks of age. In girls, the absolute risk of 44/1000 may exceed the pediatrician's threshold to act, and imaging with an ultrasonographic examination at 6 weeks of age or a radiograph of the pelvis at 4 months of age is recommended.
   - **Breech presentation** (newborn risk for boys of 26/1000 and for girls, 120/1000). **For negative or equivocally positive newborn examinations, the infant should be reevaluated at regular intervals (according to the periodicity schedule) if the examination results remain negative**. Because an absolute risk of 120/1000 (12%) probably exceeds most pediatricians' threshold to act, imaging with an ultrasonographic examination at 6 weeks of age or with a radiograph of the pelvis and hips at 4 months of age is recommended. In addition, because some reports show a high incidence of hip abnormalities detected at an older age in children born breech, this imaging strategy remains an option for all children born breech, not just girls. These hip abnormalities are, for the most part, inadequate development of the acetabulum. Acetabular dysplasia is best found by a radiographic examination at 6 months of age or older. A

suggestion of poorly formed acetabula may be observed at 6 weeks of age by ultrasonography, but the best study remains a radiograph performed closer to 6 months of age. Ultrasonographic newborn screening of all breech infants will not eliminate the possibility of later acetabular dysplasia.

8. **Periodicity**. **The hips must be examined at every well-baby visit according to the recommended periodicity schedule for well-baby examinations (2–4 days for newborns discharged in less than 48 hours after delivery, by 1 month, 2 months, 4 months, 6 months, 9 months, and 12 months of age)**. If at any time during the follow-up period DDH is suspected because of an abnormal physical examination or by a parental complaint of difficulty diapering or abnormal appearing legs, the pediatrician must confirm that the hips are stable, in the sockets, and developing normally. Confirmation can be made by a focused physical examination when the infant is calm and relaxed, by consultation with another primary care pediatrician, by consultation with an orthopaedist, by ultrasonography if the infant is younger than 5 months of age, or by radiography if the infant is older than 4 months of age. (Between 4 and 6 months of age, ultrasonography and radiography seem to be equally effective diagnostic imaging studies.)

DISCUSSION

DDH is an important term because it accurately reflects the biologic features of the disorder and the susceptibility of the hip to become dislocated at various times. Dislocated hips always will be diagnosed later in infancy and childhood because not every dislocated hip is detectable at birth, and hips continue to dislocate throughout the first year of life. Thus, this guideline requires that the pediatrician follow *a process of care for the detection of DDH*. The process recommended for early detection of DDH includes the following:

- Screen all newborns' hips by physical examination.
- Examine all infants' hips according to a periodicity schedule and follow-up until the child is an established walker.
- Record and document physical findings.
- Be aware of the changing physical examination for DDH.
- If physical findings raise suspicion of DDH, or if parental concerns suggest hip disease, confirmation is required by expert physical examination, referral to an orthopaedist, or by an age-appropriate imaging study.

When this process of care is followed, the number of dislocated hips diagnosed at 1 year of age should be minimized. However, the problem of late detection of dislocated hips will not be eliminated. The results of screening programs have indicated that 1 in 5000 children have a dislocated hip detected at 18 months of age or older.[3]

TECHNICAL REPORT

The Technical Report is available from the American Academy of Pediatrics from several sources. The Technical Report is published in full-text on *Pediatrics electronic pages*. It is also available in a compendium of practice guidelines that contains guidelines and evidence reports together. The objective was to create a recommendation to pediatricians and other primary care providers about their role as screeners for detecting DDH. The patients are a theoretical cohort of newborns. A model-based method using decision analysis was the foundation. Components of the approach include:

- Perspective: primary care provider
- Outcomes: DDH and AVN
- Preferences: expected rates of outcomes
- Model: influence diagram assessed from the subcommittee and from the methodology team with critical feedback from the subcommittee
- Evidence sources: Medline and EMBase (detailed in "Methods" section)
- Evidence quality: assessed on a custom, subjective scale, based primarily on the fit of the evidence in the decision model

The results are detailed in the "Methods" section. Based on the raw evidence and Bayesian hierarchical meta-analysis,[34,35] estimates for the incidence of DDH based on the type of screener (orthopaedist vs pediatrician); the odds ratio for DDH given risk factors of sex, family history, and breech presentation; and estimates for late detection and AVN were determined and are detailed in the "Methods" section and in Tables 1 and 2.

The decision model (reduced based on available evidence) suggests that orthopaedic screening is optimal, but because orthopaedists in the published studies and in practice would differ in pediatric expertise, the supply of pediatric orthopaedists is relatively limited, and the difference between orthopaedists and pediatricians is statistically insignificant, we conclude that pediatric screening is to be recommended. The place for ultrasonography in the screening process remains to be defined because of the limited data available regarding late diagnosis in ultrasonography screening to permit definitive recommendations.

These data could be used by others to refine the conclusion based on costs, parental preferences, or physician style. Areas for research are well defined by our model-based method. All references are in the Technical Report.

RESEARCH QUESTIONS

The quality of the literature suggests many areas for research, because there is a paucity of randomized clinical trials and case-controlled studies. The following is a list of possibilities:

1. Minimum diagnostic abilities of a screener. Although there are data for pediatricians in general, few, if any, studies evaluated the abilities of an individual examiner. What should the minimum

sensitivity and specificity be, and how should they be assessed?
2. Intercurrent screening. There were few studies on systemic processes for screening after the newborn period.[2,43,44] Although several studies assessed postneonatal DDH, the data did not specify how many examinations were performed on each child before the abnormal result was found.
3. Trade-offs. Screening always results in false-positive results, and these patients suffer the adverse effects of therapy. How many unnecessary AVNs are we—families, physicians, and society—willing to tolerate from a screening program for every appropriately treated infant in whom late DDH was averted? This assessment depends on people's values and preferences and is not strictly an epidemiologic issue.
4. Postneonatal DDH after ultrasonographic screening. Although we concluded that ultrasonographic screening did not result in fewer diagnoses of postneonatal DDH, that conclusion was based on only 1 study.[36] Further study is needed.
5. Cost-effectiveness. If ultrasonographic screening reduces the number of postneonatal DDH diagnoses, then there will be a cost trade-off between the resources spent up front to screen everyone with an expensive technology, as in the case of ultrasonography, and the resources spent later to treat an expensive adverse event, as in the case of physical examination-based screening. The level at which the cost per case of postneonatal DDH averted is no longer acceptable is a matter of social preference, not of epidemiology.

ACKNOWLEDGMENTS

We acknowledge and appreciate the help of our methodology team, Richard Hinton, MD, Paola Morello, MD, and Jeanne Santoli, MD, who diligently participated in the literature review and abstracting the articles into evidence tables, and the subcommittee on evidence analysis.

We would also like to thank Robert Sebring, PhD, for assisting in the management of this process; Bonnie Cosner for managing the workflow; and Chris Kwiat, MLS, from the American Academy of Pediatrics Bakwin Library, who performed the literature searches.

REFERENCES

1. Bjerkreim I, Hagen O, Ikonomou N, Kase T, Kristiansen T, Arseth P. Late diagnosis of developmental dislocation of the hip in Norway during the years 1980–1989. *J Pediatr Orthop B*. 1993;2:112–114
2. Clarke N, Clegg J, Al-Chalabi A. Ultrasound screening of hips at risk for CDH: failure to reduce the incidence of late cases. *J Bone Joint Surg Br*. 1989;71:9–12
3. Dezateux C, Godward C. Evaluating the national screening programme for congenital dislocation of the hip. *J Med Screen*. 1995;2:200–206
4. Hadlow V. Neonatal screening for congenital dislocation of the hip: a prospective 21-year survey. *J Bone Joint Surg Br*. 1988;70:740–743
5. Krikler S, Dwyer N. Comparison of results of two approaches to hip screening in infants. *J Bone Joint Surg Br*. 1992;74:701–703
6. Macnicol M. Results of a 25-year screening programme for neonatal hip instability. *J Bone Joint Surg Br*. 1990;72:1057–1060
7. Marks DS, Clegg J, Al-Chalabi AN. Routine ultrasound screening for neonatal hip instability: can it abolish late-presenting congenital dislocation of the hip? *J Bone Joint Surg Br*. 1994;76:534–538
8. Rosendahl K, Markestad T, Lie R. Congenital dislocation of the hip: a prospective study comparing ultrasound and clinical examination. *Acta Paediatr*. 1992;81:177–181
9. Sanfridson J, Redlund-Johnell I, Uden A. Why is congenital dislocation of the hip still missed? Analysis of 96,891 infants screened in Malmo 1956–1987. *Acta Orthop Scand*. 1991;62:87–91
10. Tredwell S, Bell H. Efficacy of neonatal hip examination. *J Pediatr Orthop*. 1981;1:61–65
11. Yngve D, Gross R. Late diagnosis of hip dislocation in infants. *J Pediatr Orthop*. 1990;10:777–779
12. Aronsson DD, Goldberg MJ, Kling TF, Roy DR. Developmental dysplasia of the hip. *Pediatrics*. 1994;94:201–212
13. Hinderaker T, Daltveit AK, Irgens LM, Uden A, Reikeras O. The impact of intra-uterine factors on neonatal hip instability: an analysis of 1,059,479 children in Norway. *Acta Orthop Scand*. 1994;65:239–242
14. Wynne-Davies R. Acetabular dysplasia and familial joint laxity: two etiological factors in congenital dislocation of the hip: a review of 589 patients and their families. *J Bone Joint Surg Br*. 1970;52:704–716
15. De Pellegrin M. Ultrasound screening for congenital dislocation of the hip: results and correlations between clinical and ultrasound findings. *Ital J Orthop Traumatol*. 1991;17:547–553
16. Stoffelen D, Urlus M, Molenaers G, Fabry G. Ultrasound, radiographs, and clinical symptoms in developmental dislocation of the hip: a study of 170 patients. *J Pediatr Orthop B*. 1995;4:194–199
17. Bond CD, Hennrikus WL, Della Maggiore E. Prospective evaluation of newborn soft tissue hip clicks with ultrasound. *J Pediatr Orthop*. 1997; 17:199–201
18. Bialik V, Wiener F, Benderly A. Ultrasonography and screening in developmental displacement of the hip. *J Pediatr Orthop B*. 1992;1:51–54
19. Castelein R, Sauter A. Ultrasound screening for congenital dysplasia of the hip in newborns: its value. *J Pediatr Orthop*. 1988;8:666–670
20. Clarke NMP, Harcke HT, McHugh P, Lee MS, Borns PF, MacEwen GP. Real-time ultrasound in the diagnosis of congenital dislocation and dysplasia of the hip. *J Bone Joint Surg Br*. 1985;67:406–412
21. Garvey M, Donoghue V, Gorman W, O'Brien N, Murphy J. Radiographic screening at four months of infants at risk for congenital hip dislocation. *J Bone Joint Surg Br*. 1992;74:704–707
22. Langer R. Ultrasonic investigation of the hip in newborns in the diagnosis of congenital hip dislocation: classification and results of a screening program. *Skeletal Radiol*. 1987;16:275–279

23. Rosendahl K, Markestad T, Lie RT. Ultrasound screening for developmental dysplasia of the hip in the neonate: the effect on treatment rate and prevalence of late cases. *Pediatrics*. 1994;94:47–52
24. Terjesen T. Ultrasound as the primary imaging method in the diagnosis of hip dysplasia in children aged <2 years. *J Pediatr Orthop B*. 1996;5: 123–128
25. Vedantam R, Bell M. Dynamic ultrasound assessment for monitoring of treatment of congenital dislocation of the hip. *J Pediatr Orthop*. 1995;15: 725–728
26. Graf R. Classification of hip joint dysplasia by means of sonography. *Arch Orthop Trauma Surg*. 1984;102:248–255
27. Berman L, Klenerman L. Ultrasound screening for hip abnormalities: preliminary findings in 1001 neonates. *Br Med J (Clin Res Ed)*. 1986;293: 719–722
28. Castelein R, Sauter A, de Vlieger M, van Linge B. Natural history of ultrasound hip abnormalities in clinically normal newborns. *J Pediatr Orthop*. 1992;12:423–427
29. Clarke N. Sonographic clarification of the problems of neonatal hip stability. *J Pediatr Orthop*. 1986;6:527–532
30. Eddy DM. The confidence profile method: a Bayesian method for assessing health technologies. *Operations Res*. 1989;37:210–228
31. Howard RA, Matheson JE. Influence diagrams. In: Matheson JE, ed. *Readings on the Principles and Applications of Decision Analysis*. Menlo Park, CA: Strategic Decisions Group; 1981:720–762
32. Nease RF, Owen DK. Use of influence diagrams to structure medical decisions. *Med Decis Making*. 1997;17:265–275
33. Guyatt GH, Sackett DL, Sinclair JC, Hayward R, Cook DJ, Cook RJ. Users' guide to the medical literature, IX: a method for grading health care recommendations. *JAMA*. 1995;274:1800–1804
34. Gelman A, Carlin JB, Stern HS, Rubin DB. *Bayesian Data Analysis*. London, UK: Chapman and Hall; 1997
35. Spiegelhalter D, Thomas A, Best N, Gilks W. *BUGS 0.5: Bayesian Inference Using Gibbs Sampling Manual, II*. Cambridge, MA: MRC Biostatistics Unit, Institute of Public Health; 1996. Available at: http://www.mrc-bsu.cam.ac.uk/bugs/software/software.html
36. Fiddian NJ, Gardiner JC. Screening for congenital dislocation of the hip by physiotherapists: results of a ten-year study. *J Bone Joint Surg Br*. 1994;76:458–459
37. Dunn P, Evans R, Thearle M, Griffiths H, Witherow P. Congenital dislocation of the hip: early and late diagnosis and management compared. *Arch Dis Child*. 1992;60:407–414
38. Holen KJ, Tegnander A, Terjesen T, Johansen OJ, Eik-Nes SH. Ultrasonographic evaluation of breech presentation as a risk factor for hip dysplasia. *Acta Paediatr*. 1996;85:225–229
39. Jones D, Powell N. Ultrasound and neonatal hip screening: a prospective study of "high risk" babies. *J Bone Joint Surg Br*. 1990;72:457–459
40. Teanby DN, Paton RW. Ultrasound screening for congenital dislocation of the hip: a limited targeted programme. *J Pediatr Orthop*. 1997;17: 202–204
41. Tonnis D, Storch K, Ulbrich H. Results of newborn screening for CDH with and without sonography and correlation of risk factors. *J Pediatr Orthop*. 1990;10:145–152
42. Pauker SG, Kassirer JP. The threshold approach to clinical decision making. *N Engl J Med*. 1980;302:1109–1117
43. Bower C, Stanley F, Morgan B, Slattery H, Stanton C. Screening for congenital dislocation of the hip by child-health nurses in western Australia. *Med J Aust*. 1989;150:61–65
44. Franchin F, Lacalendola G, Molfetta L, Mascolo V, Quagliarella L. Ultrasound for early diagnosis of hip dysplasia. *Ital J Orthop Traumatol*. 1992;18:261–269

ADDENDUM TO REFERENCES FOR THE DDH GUIDELINE

New information is generated constantly. Specific details of this report must be changed over time.

New articles (additional articles 1–7) have been published since the completion of our literature search and construction of this Guideline. These articles taken alone might seem to contradict some of the Guideline's estimates as detailed in the article and in the Technical Report. However, taken in context with the literature synthesis carried out for the construction of this Guideline, our estimates remain intact and no conclusions are obviated.

ADDITIONAL ARTICLES

1. Bialik V, Bialik GM, Blazer S, Sujov P, Wiener F, Berant M. Developmental dysplasia of the hip: a new approach to incidence. *Pediatrics*. 1999;103:93–99
2. Clegg J, Bache CE, Raut VV. Financial justification for routine ultrasound screening of the neonatal hip. *J Bone Joint Surg*. 1999;81-B:852–857
3. Holen KJ, Tegnander A, Eik-Nes SH, Terjesen T. The use of ultrasound in determining the initiation in treatment in instability of the hips in neonates. *J Bone Joint Surg*. 1999;81-B:846–851
4. Lewis K, Jones DA, Powell N. Ultrasound and neonatal hip screening: the five-year results of a prospective study in high risk babies. *J Pediatr Orthop*. 1999;19:760–762
5. Paton RW, Srinivasan MS, Shah B, Hollis S. Ultrasound screening for hips at risk in developmental dysplasia: is it worth it? *J Bone Joint Surg*. 1999;81-B:255–258
6. Sucato DJ, Johnston CE, Birch JG, Herring JA, Mack P. Outcomes of ultrasonographic hip abnormalities in clinically stable hips. *J Pediatr Orthop*. 1999;19:754–759
7. Williams PR, Jones DA, Bishay M. Avascular necrosis and the aberdeen splint in developmental dysplasia of the hip. *J Bone Joint Surg*. 1999;81-B:1023–1028

Dysplasia of the Hip Clinical Practice Guideline Quick Reference Tools

- Recommendation Summary
  — Early Detection of Developmental Dysplasia of the Hip
- *ICD-10-CM* Coding Quick Reference for Dysplasia of the Hip
- AAP Patient Education Handout
  — *Hip Dysplasia (Developmental Dysplasia of the Hip)*

Recommendation Summary

Early Detection of Developmental Dysplasia of the Hip

Recommendation 1

A. All newborns are to be screened by physical examination. (The evidence for this recommendation is good. The expert consensus is strong.)
B. It is recommended that screening be done by a properly trained health care provider (eg, physician, pediatric nurse practitioner, physician assistant, or physical therapist). (Evidence for this recommendation is strong.)
C. Ultrasonography of all newborns is not recommended. (Evidence is fair; consensus is strong.)

Recommendation 2

A. If a positive Ortolani or Barlow sign is found in the newborn examination, the infant should be referred to an orthopaedist. (The data recommending that all those with a positive Ortolani sign be referred to an orthopaedist are limited, but expert panel consensus, nevertheless, was strong….)
B. If the results of the physical examination at birth are "equivocally" positive (ie, soft click, mild asymmetry, but neither an Ortolani nor a Barlow sign is present), then a follow-up hip examination by the pediatrician in 2 weeks is recommended. (Evidence is good; consensus is strong.)

Recommendation 3

A. If the results of the newborn physical examination are positive (ie, presence of an Ortolani or a Barlow sign), ordering an ultrasonographic examination of the newborn is not recommended. (Evidence is poor; opinion is strong.)
B. If the results of the newborn physical examination are positive, obtaining a radiograph of the newborn's pelvis and hips is not recommended. (Evidence is poor; opinion is strong.)
C. The use of triple diapers when abnormal physical signs are detected during the newborn period is not recommended. (Evidence is poor; opinion is strong.)

Recommendation 4

If the results of the physical examination are positive (eg, positive Ortolani or Barlow sign) at 2 weeks, refer to an orthopaedist. (Evidence is strong; consensus is strong.)

Recommendation 5

If at the 2-week examination the Ortolani and Barlow signs are absent but physical findings raise suspicions, consider referral to an orthopaedist or request ultrasonography at age 3 to 4 weeks.

Recommendation 6

If the results of the physical examination are negative at 2 weeks, follow-up is recommended at the scheduled well-baby periodic examinations. (Evidence is good; consensus is strong.)

Recommendation 7

Risk factors. If the results of the newborn examination are negative (or equivocally positive), risk factors may be considered. The following recommendations are made (evidence is strong; opinion is strong):

A. Girl (newborn risk of 19/1000). When the results of the newborn examination are negative or equivocally positive, hips should be reevaluated at 2 weeks of age. If negative, continue according to the periodicity schedule; if positive, refer to an orthopaedist or for ultrasonography at 3 weeks of age.
B. Infants with a positive family history of DDH (newborn risk for boys of 9.4/1000 and for girls, 44/1000). When the results of the newborn examination in boys are negative or equivocally positive, hips should be reevaluated at 2 weeks of age. If negative, continue according to the periodicity schedule; if positive, refer to an orthopaedist or for ultrasonography at 3 weeks of age. In girls, the absolute risk of 44/1000 may exceed the pediatrician's threshold to act, and imaging with an ultrasonographic examination at 6 weeks of age or a radiograph of the pelvis at 4 months of age is recommended.
C. Breech presentation (newborn risk for boys of 26/1000 and for girls, 120/1000). For negative or equivocally positive newborn examinations, the infant should be reevaluated at regular intervals (according to the periodicity schedule) if the examination results remain negative.

Recommendation 8

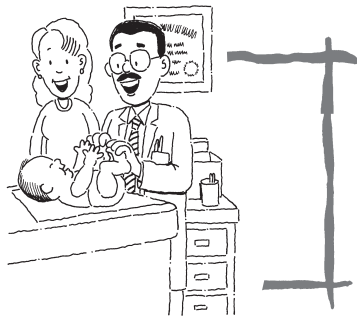
Periodicity. The hips must be examined at every well-baby visit according to the recommended periodicity schedule for well-baby examinations (2–4 days for newborns discharged in less than 48 hours after delivery, by 1 month, 2 months, 4 months, 6 months, 9 months, and 12 months of age).

Coding Quick Reference for Dysplasia of the Hip	
ICD-10-CM	
Q65.0-	Congenital dislocation of hip, unilateral
Q65.1	Congenital dislocation of hip, bilateral
Q65.3-	Congenital partial dislocation of hip, unilateral
Q65.4	Congenital partial dislocation of hip, bilateral
Q65.6	Congenital unstable hip (Congenital dislocatable hip)
Q65.89	Other specified congenital deformities of hip

Symbol "-" requires a fifth character; **1** = right; **2** = left.

Hip Dysplasia

(Developmental Dysplasia of the Hip)



Hip dysplasia (developmental dysplasia of the hip) is a condition in which a child's upper thighbone is dislocated from the hip socket. It can be present at birth or develop during a child's first year of life.

Hip dysplasia is not always detectable at birth or even during early infancy. In spite of careful screening of children for hip dysplasia during regular well-child exams, a number of children with hip dysplasia are not diagnosed until after they are 1 year old.

Hip dysplasia is rare. However, if your baby is diagnosed with the condition, quick treatment is important.

What causes hip dysplasia?

No one is sure why hip dysplasia occurs (or why the left hip dislocates more often than the right hip). One reason may have to do with the hormones a baby is exposed to before birth. While these hormones serve to relax muscles in the pregnant mother's body, in some cases they also may cause a baby's joints to become too relaxed and prone to dislocation. This condition often corrects itself in several days, and the hip develops normally. In some cases, these dislocations cause changes in the hip anatomy that need treatment.

Who is at risk?

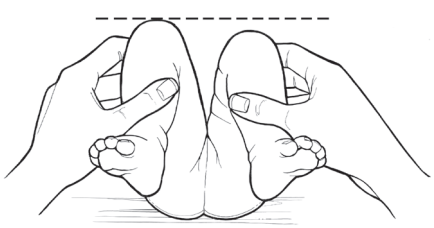
Factors that may increase the risk of hip dysplasia include

- Sex—more frequent in girls
- Family history—more likely when other family members have had hip dysplasia
- Birth position—more common in infants born in the breech position
- Birth order—firstborn children most at risk for hip dysplasia

Detecting hip dysplasia

Your pediatrician will check your newborn for hip dysplasia right after birth and at every well-child exam until your child is walking normally.

During the exam, your child's pediatrician will carefully flex and rotate your child's legs to see if the thighbones are properly positioned in the hip sockets. This does not require a great deal of force and will not hurt your baby.



Your child's pediatrician also will look for other signs that may suggest a problem, including

- Limited range of motion in either leg
- One leg is shorter than the other
- Thigh or buttock creases appear uneven or lopsided

If your child's pediatrician suspects a problem with your child's hip, you may be referred to an orthopedic specialist who has experience treating hip dysplasia.

Treating hip dysplasia

Early treatment is important. The sooner treatment begins, the simpler it will be. In the past parents were told to double or triple diaper their babies to keep the legs in a position where dislocation was unlikely. *This practice is not recommended.* The diapering will not prevent hip dysplasia and will only delay effective treatment. Failure to treat this condition can result in permanent disability.

If your child is diagnosed with hip dysplasia before she is 6 months old, she will most likely be treated with a soft brace (such as the Pavlik harness) that holds the legs flexed and apart to allow the thighbones to be secure in the hip sockets.

Pavlik Harness

The orthopedic consultant will tell you how long and when your baby will need to wear the brace. Your child also will be examined frequently during this time to make sure that the hips remain normal and stable.

In resistant cases or in older children, hip dysplasia may need to be treated with a combination of braces, casts, traction, or surgery. Your child will be admitted to the hospital if surgery is necessary. After surgery, your child will be placed in a hip spica cast for about 3 months. A hip spica cast is a hard cast that immobilizes the hips and keeps them in the correct position. When the cast is removed, your child will need to wear a removable hip brace for several more months.

Remember

If you have any concerns about your child's walking, talk with his pediatrician. If the cause is hip dysplasia, prompt treatment is important.

American Academy of Pediatrics

DEDICATED TO THE HEALTH OF ALL CHILDREN™

The American Academy of Pediatrics is an organization of 60,000 primary care pediatricians, pediatric medical subspecialists, and pediatric surgical specialists dedicated to the health, safety, and well-being of infants, children, adolescents, and young adults.

American Academy of Pediatrics
Web site—www.aap.org

Febrile Seizures: Clinical Practice Guideline for the Long-term Management of the Child With Simple Febrile Seizures

- *Clinical Practice Guideline*

CLINICAL PRACTICE GUIDELINE

Febrile Seizures: Clinical Practice Guideline for the Long-term Management of the Child With Simple Febrile Seizures

Steering Committee on Quality Improvement and Management, Subcommittee on Febrile Seizures

ABSTRACT

Febrile seizures are the most common seizure disorder in childhood, affecting 2% to 5% of children between the ages of 6 and 60 months. Simple febrile seizures are defined as brief (<15-minute) generalized seizures that occur once during a 24-hour period in a febrile child who does not have an intracranial infection, metabolic disturbance, or history of afebrile seizures. This guideline (a revision of the 1999 American Academy of Pediatrics practice parameter [now termed clinical practice guideline] "The Long-term Treatment of the Child With Simple Febrile Seizures") addresses the risks and benefits of both continuous and intermittent anticonvulsant therapy as well as the use of antipyretics in children with simple febrile seizures. It is designed to assist pediatricians by providing an analytic framework for decisions regarding possible therapeutic interventions in this patient population. It is not intended to replace clinical judgment or to establish a protocol for all patients with this disorder. Rarely will these guidelines be the only approach to this problem. *Pediatrics* 2008;121:1281–1286

www.pediatrics.org/cgi/doi/10.1542/peds.2008-0939

doi:10.1542/peds.2008-0939

Key Word
fever

Abbreviation
AAP—American Academy of Pediatrics

The expected outcomes of this practice guideline include:

1. optimizing practitioner understanding of the scientific basis for using or avoiding various proposed treatments for children with simple febrile seizures;
2. improving the health of children with simple febrile seizures by avoiding therapies with high potential for adverse effects and no demonstrated ability to improve children's long-term outcomes;
3. reducing costs by avoiding therapies that will not demonstrably improve children's long-term outcomes; and
4. helping the practitioner educate caregivers about the low risks associated with simple febrile seizures.

The committee determined that with the exception of a high rate of recurrence, no long-term effects of simple febrile seizures have been identified. The risk of developing epilepsy in these patients is extremely low, although slightly higher than that in the general population. No data, however, suggest that prophylactic treatment of children with simple febrile seizures would reduce the risk, because epilepsy likely is the result of genetic predisposition rather than structural damage to the brain caused by recurrent simple febrile seizures. Although antipyretics have been shown to be ineffective in preventing recurrent febrile seizures, there is evidence that continuous anticonvulsant therapy with phenobarbital, primidone, or valproic acid and intermittent therapy with diazepam are effective in reducing febrile-seizure recurrence. The potential toxicities associated with these agents, however, outweigh the relatively minor risks associated with simple febrile seizures. As such, the committee concluded that, on the basis of the risks and benefits of the effective therapies, neither continuous nor intermittent anticonvulsant therapy is recommended for children with 1 or more simple febrile seizures.

INTRODUCTION

Febrile seizures are seizures that occur in febrile children between the ages of 6 and 60 months who do not have an intracranial infection, metabolic disturbance, or history of afebrile seizures. Febrile seizures are subdivided into 2 categories: simple and complex. Simple febrile seizures last for less than 15 minutes, are generalized (without a focal component), and occur once in a 24-hour period, whereas complex febrile seizures are prolonged (>15 minutes), are focal, or occur more than once in 24 hours.[1] Despite the frequency of febrile seizures (2%–5%), there is no unanimity of opinion about management options. This clinical practice guideline addresses potential therapeutic interventions in neurologically normal children with simple febrile seizures. It is not intended for patients with complex febrile seizures and does not pertain to children with previous neurologic insults, known central nervous system abnor-

malities, or a history of afebrile seizures. This clinical practice guideline is a revision of a 1999 American Academy of Pediatrics (AAP) clinical practice parameter, "The Long-term Treatment of the Child With Simple Febrile Seizures."[2]

For a child who has experienced a simple febrile seizure, there are potentially 4 adverse outcomes that theoretically may be altered by an effective therapeutic agent: (1) decline in IQ; (2) increased risk of epilepsy; (3) risk of recurrent febrile seizures; and (4) death. Neither a decline in IQ, academic performance or neurocognitive inattention nor behavioral abnormalities have been shown to be a consequence of recurrent simple febrile seizures.[3] Ellenberg and Nelson[4] studied 431 children who experienced febrile seizures and observed no significant difference in their learning compared with sibling controls. In a similar study by Verity et al,[5] 303 children with febrile seizures were compared with control children. No difference in learning was identified, except in those children who had neurologic abnormalities before their first seizure.

The second concern, increased risk of epilepsy, is more complex. Children with simple febrile seizures have approximately the same risk of developing epilepsy by the age of 7 years as does the general population (ie, 1%).[6] However, children who have had multiple simple febrile seizures, are younger than 12 months at the time of their first febrile seizure, and have a family history of epilepsy are at higher risk, with generalized afebrile seizures developing by 25 years of age in 2.4%.[7] Despite this fact, no study has demonstrated that successful treatment of simple febrile seizures can prevent this later development of epilepsy, and there currently is no evidence that simple febrile seizures cause structural damage to the brain. Indeed, it is most likely that the increased risk of epilepsy in this population is the result of genetic predisposition.

In contrast to the slightly increased risk of developing epilepsy, children with simple febrile seizures have a high rate of recurrence. The risk varies with age. Children younger than 12 months at the time of their first simple febrile seizure have an approximately 50% probability of having recurrent febrile seizures. Children older than 12 months at the time of their first event have an approximately 30% probability of a second febrile seizure; of those who do have a second febrile seizure, 50% have a chance of having at least 1 additional recurrence.[8]

Finally, there is a theoretical risk of a child dying during a simple febrile seizure as a result of documented injury, aspiration, or cardiac arrhythmia, but to the committee's knowledge, it has never been reported.

In summary, with the exception of a high rate of recurrence, no long-term adverse effects of simple febrile seizures have been identified. Because the risks associated with simple febrile seizures, other than recurrence, are so low and because the number of children who have febrile seizures in the first few years of life is so high, to be commensurate, a proposed therapy would need to be exceedingly low in risks and adverse effects, inexpensive, and highly effective.

METHODS

To update the clinical practice guideline on the treatment of children with simple febrile seizures, the AAP reconvened the Subcommittee on Febrile Seizures. The committee was chaired by a child neurologist and consisted of a neuroepidemiologist, 2 additional child neurologists, and a practicing pediatrician. All panel members reviewed and signed the AAP voluntary disclosure and conflict-of-interest form. The guideline was reviewed by members of the AAP Steering Committee on Quality Improvement and Management; members of the AAP Sections on Neurology, Pediatric Emergency Medicine, Developmental and Behavioral Pediatrics, and Epidemiology; members of the AAP Committees on Pediatric Emergency Medicine and Medical Liability and Risk Management; members of the AAP Councils on Children With Disabilities and Community Pediatrics; and members of outside organizations including the Child Neurology Society and the American Academy of Neurology.

A comprehensive review of the evidence-based literature published since 1998 was conducted with the aim of addressing possible therapeutic interventions in the management of children with simple febrile seizures. The review focused on both the efficacy and potential adverse effects of the proposed treatments. Decisions were made on the basis of a systematic grading of the quality of evidence and strength of recommendations.

The AAP established a partnership with the University of Kentucky (Lexington, KY) to develop an evidence report, which served as a major source of information for these practice-guideline recommendations. The specific issues addressed were (1) effectiveness of continuous anticonvulsant therapy in preventing recurrent febrile seizures, (2) effectiveness of intermittent anticonvulsant therapy in preventing recurrent febrile seizures, (3) effectiveness of antipyretics in preventing recurrent febrile seizures, and (4) adverse effects of either continuous or intermittent anticonvulsant therapy.

In the original practice parameter, more than 300 medical journal articles reporting studies of the natural history of simple febrile seizures or the therapy of these seizures were reviewed and abstracted.[2] An additional 65 articles were reviewed and abstracted for the update. Emphasis was placed on articles that differentiated simple febrile seizures from other types of seizures, that carefully matched treatment and control groups, and that described adherence to the drug regimen. Tables were constructed from the 65 articles that best fit these criteria. A more comprehensive review of the literature on which this report is based can be found in a forthcoming technical report (the initial technical report can be accessed at http://aappolicy.aappublications.org/cgi/content/full/pediatrics;103/6/e86). The technical report also will contain dosing information.

The evidence-based approach to guideline development requires that the evidence in support of a recommendation be identified, appraised, and summarized and that an explicit link between evidence and recommendations be defined. Evidence-based recommendations reflect the quality of evidence and the balance of benefit and harm that is

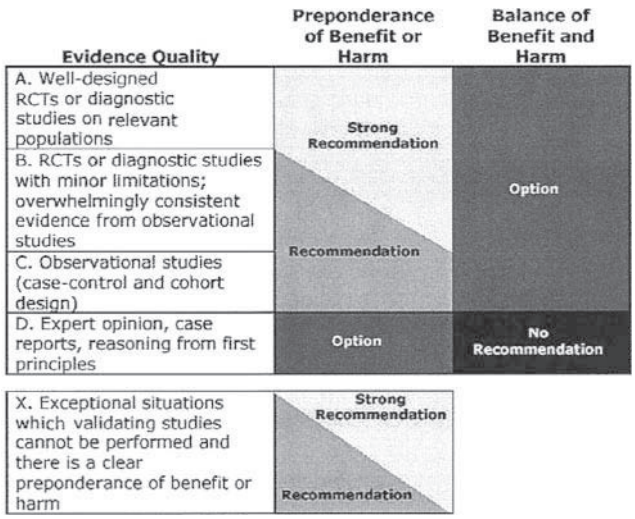


FIGURE 1

Integrating evidence-quality appraisal with an assessment of the anticipated balance between benefits and harms if a policy is conducted leads to designation of a policy as a strong recommendation, recommendation, option, or no recommendation. RCT indicates randomized, controlled trial.

anticipated when the recommendation is followed. The AAP policy statement "Classifying Recommendations for Clinical Practice Guidelines"[9] was followed in designating levels of recommendations (see Fig 1 and Table 1).

RECOMMENDATION

On the basis of the risks and benefits of the effective therapies, neither continuous nor intermittent anticonvulsant therapy is recommended for children with 1 or more simple febrile seizures.

- Aggregate evidence quality: B (randomized, controlled trials and diagnostic studies with minor limitations).
- Benefit: prevention of recurrent febrile seizures, which are not harmful and do not significantly increase the risk for development of future epilepsy.
- Harm: adverse effects including rare fatal hepatotoxicity (especially in children younger than 2 years who are also at greatest risk of febrile seizures), thrombocytopenia, weight loss and gain, gastrointestinal disturbances, and pancreatitis with valproic acid and hyperactivity, irritability, lethargy, sleep disturbances, and hypersensitivity reactions with phenobarbital; lethargy, drowsiness, and ataxia for intermittent diazepam as well as the risk of masking an evolving central nervous system infection.
- Benefits/harms assessment: preponderance of harm over benefit.
- Policy level: recommendation.

BENEFITS AND RISKS OF CONTINUOUS ANTICONVULSANT THERAPY

Phenobarbital

Phenobarbital is effective in preventing the recurrence of simple febrile seizures.[10] In a controlled double-blind study, daily therapy with phenobarbital reduced the rate of subsequent febrile seizures from 25 per 100 subjects per year to 5 per 100 subjects per year.[11] For the agent to be effective, however, it must be given daily and maintained in the therapeutic range. In a study by Farwell et al,[12] for example, children whose phenobarbital levels were in the therapeutic range had a reduction in recurrent seizures, but because noncompliance was so high, an overall benefit with phenobarbital therapy was not identified.

The adverse effects of phenobarbital include hyperactivity, irritability, lethargy, sleep disturbances, and hypersensitivity reactions. The behavioral adverse effects

TABLE 1 **Guideline Definitions for Evidence-Based Statements**

Statement	Definition	Implication
Strong recommendation	A strong recommendation in favor of a particular action is made when the anticipated benefits of the recommended intervention clearly exceed the harms (as a strong recommendation against an action is made when the anticipated harms clearly exceed the benefits) and the quality of the supporting evidence is excellent. In some clearly identified circumstances, strong recommendations may be made when high-quality evidence is impossible to obtain and the anticipated benefits strongly outweigh the harms.	Clinicians should follow a strong recommendation unless a clear and compelling rationale for an alternative approach is present.
Recommendation	A recommendation in favor of a particular action is made when the anticipated benefits exceed the harms but the quality of evidence is not as strong. Again, in some clearly identified circumstances, recommendations may be made when high-quality evidence is impossible to obtain but the anticipated benefits outweigh the harms.	Clinicians would be prudent to follow a recommendation but should remain alert to new information and sensitive to patient preferences.
Option	Options define courses that may be taken when either the quality of evidence is suspect or carefully performed studies have shown little clear advantage to 1 approach over another.	Clinicians should consider the option in their decision-making, and patient preference may have a substantial role.
No recommendation	No recommendation indicates that there is a lack of pertinent published evidence and that the anticipated balance of benefits and harms is presently unclear.	Clinicians should be alert to new published evidence that clarifies the balance of benefit versus harm.

may occur in up to 20% to 40% of patients and may be severe enough to necessitate discontinuation of the drug.[13–16]

Primidone

Primidone, in doses of 15 to 20 mg/kg per day, has also been shown to reduce the recurrence rate of febrile seizures.[17,18] It is of interest that the derived phenobarbital level in a Minigawa and Miura study[17] was below therapeutic (16 μg/mL) in 29 of the 32 children, suggesting that primidone itself may be active in preventing seizure recurrence. As with phenobarbital, adverse effects include behavioral disturbances, irritability, and sleep disturbances.[18]

Valproic Acid

In randomized, controlled studies, only 4% of children taking valproic acid, as opposed to 35% of control subjects, had a subsequent febrile seizure. Therefore, valproic acid seems to be at least as effective in preventing recurrent simple febrile seizures as phenobarbital and significantly more effective than placebo.[19–21]

Drawbacks to therapy with valproic acid include its rare association with fatal hepatotoxicity (especially in children younger than 2 years, who are also at greatest risk of febrile seizures), thrombocytopenia, weight loss and gain, gastrointestinal disturbances, and pancreatitis. In studies in which children received valproic acid to prevent recurrence of febrile seizures, no cases of fatal hepatotoxicity were reported.[15]

Carbamazepine

Carbamazepine has not been shown to be effective in preventing the recurrence of simple febrile seizures. Antony and Hawke[13] compared children who had been treated with therapeutic levels of either phenobarbital or carbamazepine, and 47% of the children in the carbamazepine-treated group had recurrent seizures compared with only 10% of those in the phenobarbital group. In another study, Camfield et al[22] treated children (whose conditions failed to improve with phenobarbital therapy) with carbamazepine. Despite good compliance, 13 of the 16 children treated with carbamazepine had a recurrent febrile seizure within 18 months. It is theoretically possible that these excessively high rates of recurrences might have been attributable to adverse effects of carbamazepine.

Phenytoin

Phenytoin has not been shown to be effective in preventing the recurrence of simple febrile seizures, even when the agent is in the therapeutic range.[23,24] Other anticonvulsants have not been studied for the continuous treatment of simple febrile seizures.

BENEFITS AND RISKS OF INTERMITTENT ANTICONVULSANT THERAPY

Diazepam

A double-blind controlled study of patients with a history of febrile seizures demonstrated that administration of oral diazepam (given at the time of fever) could reduce the recurrence of febrile seizures. Children with a history of febrile seizures were given either oral diazepam (0.33 mg/kg, every 8 hours for 48 hours) or a placebo at the time of fever. The risk of febrile seizures per person-year was decreased 44% with diazepam.[25] In a more recent study, children with a history of febrile seizures were given oral diazepam at the time of fever and then compared with children in an untreated control group. In the oral diazepam group, there was an 11% recurrence rate compared with a 30% recurrence rate in the control group.[26] It should be noted that all children for whom diazepam was considered a failure had been noncompliant with drug administration, in part because of adverse effects of the medication.

There is also literature that demonstrates the feasibility and safety of interrupting a simple febrile seizure lasting less than 5 minutes with rectal diazepam and with both intranasal and buccal midazolam.[27,28] Although these agents are effective in terminating the seizure, it is questionable whether they have any long-term influence on outcome. In a study by Knudsen et al,[29] children were given either rectal diazepam at the time of fever or only at the onset of seizure. Twelve-year follow-up found that the long-term prognosis of the children in the 2 groups did not differ regardless of whether treatment was aimed at preventing seizures or treating them.

A potential drawback to intermittent medication is that a seizure could occur before a fever is noticed. Indeed, in several of these studies, recurrent seizures were likely attributable to failure of method rather than failure of the agent.

Adverse effects of oral and rectal diazepam[26] and both intranasal and buccal midazolam include lethargy, drowsiness, and ataxia. Respiratory depression is extremely rare, even when given by the rectal route.[28,30] Sedation caused by any of the benzodiazepines, whether administered by the oral, rectal, nasal, or buccal route, have the potential of masking an evolving central nervous system infection. If used, the child's health care professional should be contacted.

BENEFITS AND RISKS OF INTERMITTENT ANTIPYRETICS

No studies have demonstrated that antipyretics, in the absence of anticonvulsants, reduce the recurrence risk of simple febrile seizures. Camfield et al[11] treated 79 children who had had a first febrile seizure with either a placebo plus antipyretic instruction (either aspirin or acetaminophen) versus daily phenobarbital plus antipyretic instruction (either aspirin or acetaminophen). Recurrence risk was significantly lower in the phenobarbital-treated group, suggesting that antipyretic instruction, including the use of antipyretics, is ineffective in preventing febrile-seizure recurrence.

Whether antipyretics are given regularly (every 4 hours) or sporadically (contingent on a specific body-temperature elevation) does not influence outcome. Acetaminophen was either given every 4 hours or only for temperature elevations of more than 37.9°C in 104 children. The incidence of febrile episodes did not differ

significantly between the 2 groups, nor did the early recurrence of febrile seizures. The authors determined that administering prophylactic acetaminophen during febrile episodes was ineffective in preventing or reducing fever and in preventing febrile-seizure recurrence.[31]

In a randomized double-blind placebo-controlled trial, acetaminophen was administered along with low-dose oral diazepam.[32] Febrile-seizure recurrence was not reduced, compared with control groups. As with acetaminophen, ibuprofen also has been shown to be ineffective in preventing recurrence of febrile seizures.[33–35]

In general, acetaminophen and ibuprofen are considered to be safe and effective antipyretics for children. However, hepatotoxicity (with acetaminophen) and respiratory failure, metabolic acidosis, renal failure, and coma (with ibuprofen) have been reported in children after overdose or in the presence of risk factors.[36,37]

CONCLUSIONS

The subcommittee has determined that a simple febrile seizure is a benign and common event in children between the ages of 6 and 60 months. Nearly all children have an excellent prognosis. The committee concluded that although there is evidence that both continuous antiepileptic therapy with phenobarbital, primidone, or valproic acid and intermittent therapy with oral diazepam are effective in reducing the risk of recurrence, the potential toxicities associated with antiepileptic drugs outweigh the relatively minor risks associated with simple febrile seizures. As such, long-term therapy is not recommended. In situations in which parental anxiety associated with febrile seizures is severe, intermittent oral diazepam at the onset of febrile illness may be effective in preventing recurrence. Although antipyretics may improve the comfort of the child, they will not prevent febrile seizures.

REFERENCES

1. Nelson KB, Ellenberg JH. Prognosis in children with febrile seizures. *Pediatrics.* 1978;61(5):720–727
2. American Academy of Pediatrics, Committee on Quality Improvement, Subcommittee on Febrile Seizures. The long-term treatment of the child with simple febrile seizures. *Pediatrics.* 1999;103(6 pt 1):1307–1309
3. Chang YC, Guo NW, Huang CC, Wang ST, Tsai JJ. Neurocognitive attention and behavior outcome of school age children with a history of febrile convulsions: a population study. *Epilepsia.* 2000;41(4):412–420
4. Ellenberg JH, Nelson KB. Febrile seizures and later intellectual performance. *Arch Neurol.* 1978;35(1):17–21
5. Verity CM, Butler NR, Golding J. Febrile convulsions in a national cohort followed up from birth. II: medical history and intellectual ability at 5 years of age. *BMJ.* 1985;290(6478):1311–1315
6. Nelson KB, Ellenberg JH. Predictors of epilepsy in children who have experienced febrile seizures. *N Engl J Med.* 1976;295(19):1029–1033
7. Annegers JF, Hauser WA, Shirts SB, Kurland LT. Factors prognostic of unprovoked seizures after febrile convulsions. *N Engl J Med.* 1987;316(9):493–498
8. Berg AT, Shinnar S, Darefsky AS, et al. Predictors of recurrent febrile seizures: a prospective cohort study. *Arch Pediatr Adolesc Med.* 1997;151(4):371–378
9. American Academy of Pediatrics, Steering Committee on Quality Improvement and Management. Classifying recommendations for clinical practice guidelines. *Pediatrics.* 2004;114(3):874–877
10. Wolf SM, Carr A, Davis DC, Davidson S, et al. The value of phenobarbital in the child who has had a single febrile seizure: a controlled prospective study. *Pediatrics.* 1977;59(3):378–385
11. Camfield PR, Camfield CS, Shapiro SH, Cummings C. The first febrile seizure: antipyretic instruction plus either phenobarbital or placebo to prevent recurrence. *J Pediatr.* 1980;97(1):16–21
12. Farwell JR, Lee JY, Hirtz DG, Sulzbacher SI, Ellenberg JH, Nelson KB. Phenobarbital for febrile seizures: effects on intelligence and on seizure recurrence [published correction appears in *N Engl J Med*. 1992;326(2):144]. *N Engl J Med.* 1990;322(6):364–369
13. Antony JH, Hawke SHB. Phenobarbital compared with carbamazepine in prevention of recurrent febrile convulsions. *Am J Dis Child.* 1983;137(9):892–895
14. Knudsen Fu, Vestermark S. Prophylactic diazepam or phenobarbitone in febrile convulsions: a prospective, controlled study. *Arch Dis Child.* 1978;53(8):660–663
15. Lee K, Melchior JC. Sodium valproate versus phenobarbital in the prophylactic treatment of febrile convulsions in childhood. *Eur J Pediatr.* 1981;137(2):151–153
16. Camfield CS, Chaplin S, Doyle AB, Shapiro SH, Cummings C, Camfield PR. Side effects of phenobarbital in toddlers: behavioral and cognitive aspects. *J Pediatr.* 1979;95(3):361–365
17. Minagawa K, Miura H. Phenobarbital, primidone and sodium valproate in the prophylaxis of febrile convulsions. *Brain Dev.* 1981;3(4):385–393
18. Herranz JL, Armijo JA, Arteaga R. Effectiveness and toxicity of phenobarbital, primidone, and sodium valproate in the pre-

vention of febrile convulsions, controlled by plasma levels. *Epilepsia.* 1984;25(1):89–95
19. Wallace SJ, Smith JA. Successful prophylaxis against febrile convulsions with valproic acid or phenobarbitone. *BMJ.* 1980; 280(6211):353–354
20. Mamelle N, Mamelle JC, Plasse JC, Revol M, Gilly R. Prevention of recurrent febrile convulsions: a randomized therapeutic assay—sodium valproate, phenobarbitone and placebo. *Neuropediatrics.* 1984;15(1):37–42
21. Ngwane E, Bower B. Continuous sodium valproate or phenobarbitone in the prevention of "simple" febrile convulsions. *Arch Dis Child.* 1980;55(3):171–174
22. Camfield PR, Camfield CS, Tibbles JA. Carbamazepine does not prevent febrile seizures in phenobarbital failures. *Neurology.* 1982;32(3):288–289
23. Bacon CJ, Hierons AM, Mucklow JC, Webb JK, Rawlins MD, Weightman D. Placebo-controlled study of phenobarbitone and phenytoin in the prophylaxis of febrile convulsions. *Lancet.* 1981;2(8247):600–604
24. Melchior JC, Buchthal F, Lennox Buchthal M. The ineffectiveness of diphenylhydantoin in preventing febrile convulsions in the age of greatest risk, under 3 years. *Epilepsia.* 1971;12(1): 55–62
25. Rosman NP, Colton T, Labazzo J, et al. A controlled trial of diazepam administered during febrile illnesses to prevent recurrence of febrile seizures. *N Engl J Med.* 1993;329(2):79–84
26. Verrotti A, Latini G, di Corcia G, et al. Intermittent oral diazepam prophylaxis in febrile convulsions: its effectiveness for febrile seizure recurrence. *Eur J Pediatr Neurol.* 2004;8(3): 131–134
27. Lahat E, Goldman M, Barr J, Bistritzer T, Berkovitch M. Comparison of intranasal midazolam with intravenous diazepam for treating febrile seizures in children: prospective randomized study. *BMJ.* 2000;321(7253):83–86
28. McIntyre J, Robertson S, Norris E, et al. Safety and efficacy of buccal midazolam versus rectal diazepam for emergency treatment of seizures in children: a randomized controlled trial. *Lancet.* 2005;366(9481):205–210
29. Knudsen FU, Paerregaard A, Andersen R, Andresen J. Long term outcome of prophylaxis for febrile convulsions. *Arch Dis Child.* 1996;74(1):13–18
30. Pellock JM, Shinnar S. Respiratory adverse events associated with diazepam rectal gel. *Neurology.* 2005;64(10):1768–1770
31. Schnaiderman D, Lahat E, Sheefer T, Aladjem M. Antipyretic effectiveness of acetaminophen in febrile seizures: ongoing prophylaxis versus sporadic usage. *Eur J Pediatr.* 1993;152(9): 747–749
32. Uhari M, Rantala H, Vainionpaa L, Kurttila R. Effect of acetaminophen and of low dose intermittent doses of diazepam on prevention of recurrences of febrile seizures. *J Pediatr.* 1995; 126(6):991–995
33. van Stuijvenberg M, Derksen-Lubsen G, Steyerberg EW, Habbema JDF, Moll HA. Randomized, controlled trial of ibuprofen syrup administered during febrile illnesses to prevent febrile seizure recurrences. *Pediatrics.* 1998;102(5). Available at: www.pediatrics.org/cgi/content/full/102/5/e51
34. van Esch A, Van Steensel-Moll HA, Steyerberg EW, Offringa M, Habbema JDF, Derksen-Lubsen G. Antipyretic efficacy of ibuprofen and acetaminophen in children with febrile seizures. *Arch Pediatr Adolesc Med.* 1995;149(6):632–637
35. van Esch A, Steyerberg EW, Moll HA, et al. A study of the efficacy of antipyretic drugs in the prevention of febrile seizure recurrence. *Ambul Child Health.* 2000;6(1):19–26
36. Easley RB, Altemeier WA. Central nervous system manifestations of an ibuprofen overdose reversed by naloxone. *Pediatr Emerg Care.* 2000;16(1):39–41
37. American Academy of Pediatrics, Committee on Drugs. Acetaminophen toxicity in children. *Pediatrics.* 2001;108(4): 1020–1024

Febrile Seizures: Guideline for the Neurodiagnostic Evaluation of the Child With a Simple Febrile Seizure

- *Clinical Practice Guideline*

Clinical Practice Guideline—Febrile Seizures: Guideline for the Neurodiagnostic Evaluation of the Child With a Simple Febrile Seizure

SUBCOMMITTEE ON FEBRILE SEIZURES

KEY WORD
seizure

ABBREVIATIONS
AAP—American Academy of Pediatrics
Hib—*Haemophilus influenzae* type b
EEG—electroencephalogram
CT—computed tomography

The recommendations in this report do not indicate an exclusive course of treatment or serve as a standard of medical care. Variations, taking into account individual circumstances, may be appropriate.

www.pediatrics.org/cgi/doi/10.1542/peds.2010-3318

doi:10.1542/peds.2010-3318

All clinical practice guidelines from the American Academy of Pediatrics automatically expire 5 years after publication unless reaffirmed, revised, or retired at or before that time.

PEDIATRICS (ISSN Numbers: Print, 0031-4005; Online, 1098-4275).

abstract

FREE

OBJECTIVE: To formulate evidence-based recommendations for health care professionals about the diagnosis and evaluation of a simple febrile seizure in infants and young children 6 through 60 months of age and to revise the practice guideline published by the American Academy of Pediatrics (AAP) in 1996.

METHODS: This review included search and analysis of the medical literature published since the last version of the guideline. Physicians with expertise and experience in the fields of neurology and epilepsy, pediatrics, epidemiology, and research methodologies constituted a subcommittee of the AAP Steering Committee on Quality Improvement and Management. The steering committee and other groups within the AAP and organizations outside the AAP reviewed the guideline. The subcommittee member who reviewed the literature for the 1996 AAP practice guidelines searched for articles published since the last guideline through 2009, supplemented by articles submitted by other committee members. Results from the literature search were provided to the subcommittee members for review. Interventions of direct interest included lumbar puncture, electroencephalography, blood studies, and neuroimaging. Multiple issues were raised and discussed iteratively until consensus was reached about recommendations. The strength of evidence supporting each recommendation and the strength of the recommendation were assessed by the committee member most experienced in informatics and epidemiology and graded according to AAP policy.

CONCLUSIONS: Clinicians evaluating infants or young children after a simple febrile seizure should direct their attention toward identifying the cause of the child's fever. Meningitis should be considered in the differential diagnosis for any febrile child, and lumbar puncture should be performed if there are clinical signs or symptoms of concern. For any infant between 6 and 12 months of age who presents with a seizure and fever, a lumbar puncture is an option when the child is considered deficient in *Haemophilus influenzae* type b (Hib) or *Streptococcus pneumoniae* immunizations (ie, has not received scheduled immunizations as recommended), or when immunization status cannot be determined, because of an increased risk of bacterial meningitis. A lumbar puncture is an option for children who are pretreated with antibiotics. In general, a simple febrile seizure does not usually require further evaluation, specifically electroencephalography, blood studies, or neuroimaging. *Pediatrics* 2011;127:389–394

DEFINITION OF THE PROBLEM

This practice guideline provides recommendations for the neurodiagnostic evaluation of neurologically healthy infants and children 6 through 60 months of age who have had a simple febrile seizure and present for evaluation within 12 hours of the event. It replaces the 1996 practice parameter.[1] This practice guideline is not intended for patients who have had complex febrile seizures (prolonged, focal, and/or recurrent), and it does not pertain to children with previous neurologic insults, known central nervous system abnormalities, or history of afebrile seizures.

TARGET AUDIENCE AND PRACTICE SETTING

This practice guideline is intended for use by pediatricians, family physicians, child neurologists, neurologists, emergency physicians, nurse practitioners, and other health care providers who evaluate children for febrile seizures.

BACKGROUND

A febrile seizure is a seizure accompanied by fever (temperature $\geq$ 100.4°F or 38°C[2] by any method), without central nervous system infection, that occurs in infants and children 6 through 60 months of age. Febrile seizures occur in 2% to 5% of all children and, as such, make up the most common convulsive event in children younger than 60 months. In 1976, Nelson and Ellenberg,[3] using data from the National Collaborative Perinatal Project, further defined febrile seizures as being either simple or complex. Simple febrile seizures were defined as primary generalized seizures that lasted for less than 15 minutes and did not recur within 24 hours. Complex febrile seizures were defined as focal, prolonged ($\geq$15 minutes), and/or recurrent within 24 hours. Children who had simple febrile seizures had no evidence of increased mortality, hemiplegia, or mental retardation. During follow-up evaluation, the risk of epilepsy after a simple febrile seizure was shown to be only slightly higher than that of the general population, whereas the chief risk associated with simple febrile seizures was recurrence in one-third of the children. The authors concluded that simple febrile seizures are benign events with excellent prognoses, a conclusion reaffirmed in the 1980 consensus statement from the National Institutes of Health.[3,4]

The expected outcomes of this practice guideline include the following:

1. Optimize clinician understanding of the scientific basis for the neurodiagnostic evaluation of children with simple febrile seizures.
2. Aid the clinician in decision-making by using a structured framework.
3. Optimize evaluation of the child who has had a simple febrile seizure by detecting underlying diseases, minimizing morbidity, and reassuring anxious parents and children.
4. Reduce the costs of physician and emergency department visits, hospitalizations, and unnecessary testing.
5. Educate the clinician to understand that a simple febrile seizure usually does not require further evaluation, specifically electroencephalography, blood studies, or neuroimaging.

METHODOLOGY

To update the clinical practice guideline on the neurodiagnostic evaluation of children with simple febrile seizures,[1] the American Academy of Pediatrics (AAP) reconvened the Subcommittee on Febrile Seizures. The committee was chaired by a child neurologist and consisted of a neuroepidemiologist, 3 additional child neurologists, and a practicing pediatrician. All panel members reviewed and signed the AAP voluntary disclosure and conflict-of-interest form. No conflicts were reported. Participation in the guideline process was voluntary and not paid. The guideline was reviewed by members of the AAP Steering Committee on Quality Improvement and Management; members of the AAP Section on Administration and Practice Management, Section on Developmental and Behavioral Pediatrics, Section on Epidemiology, Section on Infectious Diseases, Section on Neurology, Section on Neurologic Surgery, Section on Pediatric Emergency Medicine, Committee on Pediatric Emergency Medicine, Committee on Practice and Ambulatory Medicine, Committee on Child Health Financing, Committee on Infectious Diseases, Committee on Medical Liability and Risk Management, Council on Children With Disabilities, and Council on Community Pediatrics; and members of outside organizations including the Child Neurology Society, the American Academy of Neurology, the American College of Emergency Physicians, and members of the Pediatric Committee of the Emergency Nurses Association.

A comprehensive review of the evidence-based literature published from 1996 to February 2009 was conducted to discover articles that addressed the diagnosis and evaluation of children with simple febrile seizures. Preference was given to population-based studies, but given the scarcity of such studies, data from hospital-based studies, groups of young children with febrile illness, and comparable groups were reviewed. Decisions were made on the basis of a systematic grading of the quality of evidence and strength of recommendations.

In the original practice parameter,[1] 203 medical journal articles were reviewed and abstracted. An additional 372 articles were reviewed and abstracted for this update. Emphasis was placed on articles that differentiated simple febrile seizures from other types of seizures. Tables were constructed from the 70 articles that best fit these criteria.

The evidence-based approach to guideline development requires that the evidence in support of a recommendation be identified, appraised, and summarized and that an explicit link between

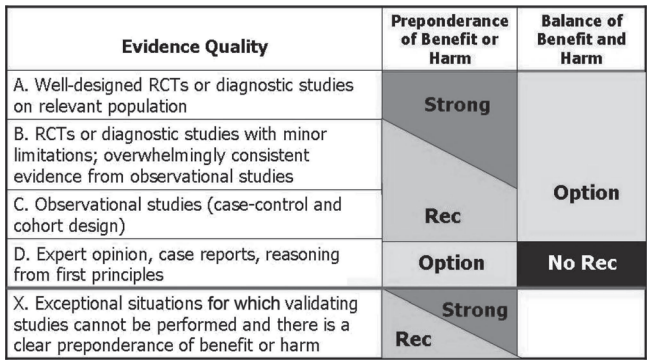


FIGURE 1
Integrating evidence quality appraisal with an assessment of the anticipated balance between benefits and harms if a policy is carried out leads to designation of a policy as a strong recommendation, recommendation, option, or no recommendation. RCT indicates randomized controlled trial; Rec, recommendation.

evidence and recommendations be defined. Evidence-based recommendations reflect the quality of evidence and the balance of benefit and harm that is anticipated when the recommendation is followed. The AAP policy statement "Classifying Recommendations for Clinical Practice Guidelines"[5] was followed in designating levels of recommendations (see Fig 1).

KEY ACTION STATEMENTS

Action Statement 1

Action Statement 1a

A lumbar puncture should be performed in any child who presents with a seizure and a fever and has meningeal signs and symptoms (eg, neck stiffness, Kernig and/or Brudzinski signs) or in any child whose history or examination suggests the presence of meningitis or intracranial infection.

- Aggregate evidence level: B (overwhelming evidence from observational studies).
- Benefits: Meningeal signs and symptoms strongly suggest meningitis, which, if bacterial in etiology, will likely be fatal if left untreated.
- Harms/risks/costs: Lumbar puncture is an invasive and often painful procedure and can be costly.
- Benefits/harms assessment: Preponderance of benefit over harm.
- Value judgments: Observational data and clinical principles were used in making this judgment.
- Role of patient preferences: Although parents may not wish to have their child undergo a lumbar puncture, health care providers should explain that if meningitis is not diagnosed and treated, it could be fatal.
- Exclusions: None.
- Intentional vagueness: None.
- Policy level: Strong recommendation.

Action Statement 1b

In any infant between 6 and 12 months of age who presents with a seizure and fever, a lumbar puncture is an option when the child is considered deficient in *Haemophilus influenzae* type b (Hib) or *Streptococcus pneumoniae* immunizations (ie, has not received scheduled immunizations as recommended) or when immunization status cannot be determined because of an increased risk of bacterial meningitis.

- Aggregate evidence level: D (expert opinion, case reports).
- Benefits: Meningeal signs and symptoms strongly suggest meningitis, which, if bacterial in etiology, will likely be fatal or cause significant long-term disability if left untreated.
- Harms/risks/costs: Lumbar puncture is an invasive and often painful procedure and can be costly.
- Benefits/harms assessment: Preponderance of benefit over harm.
- Value judgments: Data on the incidence of bacterial meningitis from before and after the existence of immunizations against Hib and *S pneumoniae* were used in making this recommendation.
- Role of patient preferences: Although parents may not wish their child to undergo a lumbar puncture, health care providers should explain that in the absence of complete immunizations, their child may be at risk of having fatal bacterial meningitis.
- Exclusions: This recommendation applies only to children 6 to 12 months of age. The subcommittee felt that clinicians would recognize symptoms of meningitis in children older than 12 months.
- Intentional vagueness: None.
- Policy level: Option.

Action Statement 1c

A lumbar puncture is an option in the child who presents with a seizure and fever and is pretreated with antibiotics, because antibiotic treatment can mask the signs and symptoms of meningitis.

- Aggregate evidence level: D (reasoning from clinical experience, case series).
- Benefits: Antibiotics may mask meningeal signs and symptoms but may be insufficient to eradicate meningitis; a diagnosis of meningitis, if bacterial in etiology, will likely be fatal if left untreated.
- Harms/risks/costs: Lumbar puncture is an invasive and often painful procedure and can be costly.

- Benefits/harms assessment: Preponderance of benefit over harm.
- Value judgments: Clinical experience and case series were used in making this judgment while recognizing that extensive data from studies are lacking.
- Role of patient preferences: Although parents may not wish to have their child undergo a lumbar puncture, medical providers should explain that in the presence of pretreatment with antibiotics, the signs and symptoms of meningitis may be masked. Meningitis, if untreated, can be fatal.
- Exclusions: None.
- Intentional vagueness: Data are insufficient to define the specific treatment duration necessary to mask signs and symptoms. The committee determined that the decision to perform a lumbar puncture will depend on the type and duration of antibiotics administered before the seizure and should be left to the individual clinician.
- Policy level: Option.

The committee recognizes the diversity of past and present opinions regarding the need for lumbar punctures in children younger than 12 months with a simple febrile seizure. Since the publication of the previous practice parameter,[1] however, there has been widespread immunization in the United States for 2 of the most common causes of bacterial meningitis in this age range: Hib and *S pneumoniae*. Although compliance with all scheduled immunizations as recommended does not completely eliminate the possibility of bacterial meningitis from the differential diagnosis, current data no longer support routine lumbar puncture in well-appearing, fully immunized children who present with a simple febrile seizure.[6–8] Moreover, although approximately 25% of young children with meningitis have seizures as the presenting sign of the disease, some are either obtunded or comatose when evaluated by a physician for the seizure, and the remainder most often have obvious clinical signs of meningitis (focal seizures, recurrent seizures, petechial rash, or nuchal rigidity).[9–11] Once a decision has been made to perform a lumbar puncture, then blood culture and serum glucose testing should be performed concurrently to increase the sensitivity for detecting bacteria and to determine if there is hypoglycorrhachia characteristic of bacterial meningitis, respectively.

Recent studies that evaluated the outcome of children with simple febrile seizures have included populations with a high prevalence of immunization.[7,8] Data for unimmunized or partially immunized children are lacking. Therefore, lumbar puncture is an option for young children who are considered deficient in immunizations or those in whom immunization status cannot be determined. There are also no definitive data on the outcome of children who present with a simple febrile seizure while already on antibiotics. The authors were unable to find a definition of "pretreated" in the literature, so they consulted with the AAP Committee on Infectious Diseases. Although there is no formal definition, pretreatment can be considered to include systemic antibiotic therapy by any route given within the days before the seizure. Whether pretreatment will affect the presentation and course of bacterial meningitis cannot be predicted but will depend, in part, on the antibiotic administered, the dose, the route of administration, the drug's cerebrospinal fluid penetration, and the organism causing the meningitis. Lumbar puncture is an option in any child pretreated with antibiotics before a simple febrile seizure.

Action Statement 2

An electroencephalogram (EEG) should not be performed in the evaluation of a neurologically healthy child with a simple febrile seizure.

- Aggregate evidence level: B (overwhelming evidence from observational studies).
- Benefits: One study showed a possible association with paroxysmal EEGs and a higher rate of afebrile seizures.[12]
- Harms/risks/costs: EEGs are costly and may increase parental anxiety.
- Benefits/harms assessment: Preponderance of harm over benefit.
- Value judgments: Observational data were used for this judgment.
- Role of patient preferences: Although an EEG might have limited prognostic utility in this situation, parents should be educated that the study will not alter outcome.
- Exclusions: None.
- Intentional vagueness: None.
- Policy level: Strong recommendation.

There is no evidence that EEG readings performed either at the time of presentation after a simple febrile seizure or within the following month are predictive of either recurrence of febrile seizures or the development of afebrile seizures/epilepsy within the next 2 years.[13,14] There is a single study that found that a paroxysmal EEG was associated with a higher rate of afebrile seizures.[12] There is no evidence that interventions based on this test would alter outcome.

Action Statement 3

The following tests should not be performed routinely for the sole purpose of identifying the cause of a simple febrile seizure: measurement of serum electrolytes, calcium, phosphorus, magnesium, or blood glucose or complete blood cell count.

- Aggregate evidence level: B (overwhelming evidence from observational studies).
- Benefits: A complete blood cell count may identify children at risk for bacte-

remia; however, the incidence of bacteremia in febrile children younger than 24 months is the same with or without febrile seizures.

- Harms/risks/costs: Laboratory tests may be invasive and costly and provide no real benefit.
- Benefits/harms assessment: Preponderance of harm over benefit.
- Value judgments: Observational data were used for this judgment.
- Role of patient preferences: Although parents may want blood tests performed to explain the seizure, they should be reassured that blood tests should be directed toward identifying the source of their child's fever.
- Exclusions: None.
- Intentional vagueness: None.
- Policy level: Strong recommendation.

There is no evidence to suggest that routine blood studies are of benefit in the evaluation of the child with a simple febrile seizure.[15–18] Although some children with febrile seizures have abnormal serum electrolyte values, their condition should be identifiable by obtaining appropriate histories and performing careful physical examinations. It should be noted that as a group, children with febrile seizures have relatively low serum sodium concentrations. As such, physicians and caregivers should avoid overhydration with hypotonic fluids.[18] Complete blood cell counts may be useful as a means of identifying young children at risk of bacteremia. It should be noted, however, that the incidence of bacteremia in children younger than 24 months with or without febrile seizures is the same. When fever is present, the decision regarding the need for laboratory testing should be directed toward identifying the source of the fever rather than as part of the routine evaluation of the seizure itself.

Action Statement 4

Neuroimaging should not be performed in the routine evaluation of the child with a simple febrile seizure.

- Aggregate evidence level: B (overwhelming evidence from observational studies).
- Benefits: Neuroimaging might provide earlier detection of fixed structural lesions, such as dysplasia, or very rarely, abscess or tumor.
- Harms/risks/costs: Neuroimaging tests are costly, computed tomography (CT) exposes children to radiation, and MRI may require sedation.
- Benefits/harms assessment: Preponderance of harm over benefit.
- Value judgments: Observational data were used for this judgment.
- Role of patient preferences: Although parents may want neuroimaging performed to explain the seizure, they should be reassured that the tests carry risks and will not alter outcome for their child.
- Exclusions: None.
- Intentional vagueness: None.
- Policy level: Strong recommendation.

The literature does not support the use of skull films in evaluation of the child with a febrile seizure.[15,19] No data have been published that either support or negate the need for CT or MRI in the evaluation of children with simple febrile seizures. Data, however, show that CT scanning is associated with radiation exposure that may escalate future cancer risk. MRI is associated with risks from required sedation and high cost.[20,21] Extrapolation of data from the literature on the use of CT in neurologically healthy children who have generalized epilepsy has shown that clinically important intracranial structural abnormalities in this patient population are uncommon.[22,23]

CONCLUSIONS

Clinicians evaluating infants or young children after a simple febrile seizure should direct their attention toward identifying the cause of the child's fever. Meningitis should be considered in the differential diagnosis for any febrile child, and lumbar puncture should be performed if the child is ill-appearing or if there are clinical signs or symptoms of concern. A lumbar puncture is an option in a child 6 to 12 months of age who is deficient in Hib and *S pneumoniae* immunizations or for whom immunization status is unknown. A lumbar puncture is an option in children who have been pretreated with antibiotics. In general, a simple febrile seizure does not usually require further evaluation, specifically EEGs, blood studies, or neuroimaging.

SUBCOMMITTEE ON FEBRILE SEIZURES, 2002–2010

Patricia K. Duffner, MD (neurology, no conflicts)
Peter H. Berman, MD (neurology, no conflicts)
Robert J. Baumann, MD (neuroepidemiology, no conflicts)
Paul Graham Fisher, MD (neurology, no conflicts)
John L. Green, MD (general pediatrics, no conflicts)
Sanford Schneider, MD (neurology, no conflicts)

STAFF

Caryn Davidson, MA

OVERSIGHT BY THE STEERING COMMITTEE ON QUALITY IMPROVEMENT AND MANAGEMENT, 2009–2011

REFERENCES

1. American Academy of Pediatrics, Provisional Committee on Quality Improvement and Subcommittee on Febrile Seizures. Practice parameter: the neurodiagnostic evaluation of a child with a first simple febrile seizure. *Pediatrics*. 1996;97(5):769–772; discussion 773–775
2. Michael Marcy S, Kohl KS, Dagan R, et al; Brighton Collaboration Fever Working Group. Fever as an adverse event following immunization: case definition and guidelines of data collection, analysis, and presentation. *Vaccine*. 2004;22(5–6):551–556
3. Nelson KB, Ellenberg JH. Predictors of epilepsy in children who have experienced febrile seizures. *N Engl J Med*. 1976;295(19):1029–1033
4. Consensus statement: febrile seizures—long-term management of children with fever-associated seizures. *Pediatrics*. 1980;66(6):1009–1012
5. American Academy of Pediatrics, Steering Committee on Quality Improvement and Management. Classifying recommendations for clinical practice guidelines. *Pediatrics*. 2004;114(3):874–877
6. Trainor JL, Hampers LC, Krug SE, Listernick R. Children with first-time simple febrile seizures are at low risk of serious bacterial illness. *Acad Emerg Med*. 2001;8(8):781–787
7. Shaked O, Peña BM, Linares MY, Baker RL. Simple febrile seizures: are the AAP guidelines regarding lumbar puncture being followed? *Pediatr Emerg Care*. 2009;25(1):8–11
8. Kimia AA, Capraro AJ, Hummel D, Johnston P, Harper MB. Utility of lumbar puncture for first simple febrile seizure among children 6 to 18 months of age. *Pediatrics*. 2009;123(1):6–12
9. Warden CR, Zibulewsky J, Mace S, Gold C, Gausche-Hill M. Evaluation and management of febrile seizures in the out-of-hospital and emergency department settings. *Ann Emerg Med*. 2003;41(2):215–222
10. Rutter N, Smales OR. Role of routine investigations in children presenting with their first febrile convulsion. *Arch Dis Child*. 1977;52(3):188–191
11. Green SM, Rothrock SG, Clem KJ, Zurcher RF, Mellick L. Can seizures be the sole manifestation of meningitis in febrile children? *Pediatrics*. 1993;92(4):527–534
12. Kuturec M, Emoto SE, Sofijanov N, et al. Febrile seizures: is the EEG a useful predictor of recurrences? *Clin Pediatr (Phila)*. 1997;36(1):31–36
13. Frantzen E, Lennox-Buchthal M, Nygaard A. Longitudinal EEG and clinical study of children with febrile convulsions. *Electroencephalogr Clin Neurophysiol*. 1968;24(3):197–212
14. Thorn I. The significance of electroencephalography in febrile convulsions. In: Akimoto H, Kazamatsuri H, Seino M, Ward A, eds. *Advances in Epileptology: XIIIth International Epilepsy Symposium*. New York, NY: Raven Press; 1982:93–95
15. Jaffe M, Bar-Joseph G, Tirosh E. Fever and convulsions: indications for laboratory investigations. *Pediatrics*. 1981;67(5):729–731
16. Gerber MA, Berliner BC. The child with a "simple" febrile seizure: appropriate diagnostic evaluation. *Am J Dis Child*. 1981;135(5):431–443
17. Heijbel J, Blom S, Bergfors PG. Simple febrile convulsions: a prospective incidence study and an evaluation of investigations initially needed. *Neuropadiatrie*. 1980;11(1):45–56
18. Thoman JE, Duffner PK, Shucard JL. Do serum sodium levels predict febrile seizure recurrence within 24 hours? *Pediatr Neurol*. 2004;31(5):342–344
19. Nealis GT, McFadden SW, Ames RA, Ouellette EM. Routine skull roentgenograms in the management of simple febrile seizures. *J Pediatr*. 1977;90(4):595–596
20. Stein SC, Hurst RW, Sonnad SS. Meta-analysis of cranial CT scans in children: a mathematical model to predict radiation-induced tumors associated with radiation exposure that may escalate future cancer risk. *Pediatr Neurosurg*. 2008;44(6):448–457
21. Brenner DJ, Hall EJ. Computed tomography: an increasing source of radiation exposure. *N Engl J Med*. 2007;357(22):2277–2284
22. Yang PJ, Berger PE, Cohen ME, Duffner PK. Computed tomography and childhood seizure disorders. *Neurology*. 1979;29(8):1084–1088
23. Bachman DS, Hodges FJ, Freeman JM. Computerized axial tomography in chronic seizure disorders of childhood. *Pediatrics*. 1976;58(6):828–832

Febrile Seizures Clinical Practice Guidelines Quick Reference Tools

- Recommendation Summaries
  - — Febrile Seizures: Clinical Practice Guideline for the Long-term Management of the Child With Simple Febrile Seizures
  - — Febrile Seizures: Guideline for the Neurodiagnostic Evaluation of the Child With a Simple Febrile Seizure
- *ICD-10-CM* Coding Quick Reference for Febrile Seizures
- AAP Patient Education Handout
  - — *Febrile Seizures*

Recommendation Summaries

Febrile Seizures: Clinical Practice Guideline for the Long-term Management of the Child With Simple Febrile Seizures

On the basis of the risks and benefits of the effective therapies, neither continuous nor intermittent anticonvulsant therapy is recommended for children with 1 or more simple febrile seizures.

- Aggregate evidence quality: B (randomized, controlled trials and diagnostic studies with minor limitations).
- Benefit: prevention of recurrent febrile seizures, which are not harmful and do not significantly increase the risk for development of future epilepsy.
- Harm: adverse effects including rare fatal hepatotoxicity (especially in children younger than 2 years who are also at greatest risk of febrile seizures), thrombocytopenia, weight loss and gain, gastrointestinal disturbances, and pancreatitis with valproic acid and hyperactivity, irritability, lethargy, sleep disturbances, and hypersensitivity reactions with phenobarbital; lethargy, drowsiness, and ataxia for intermittent diazepam as well as the risk of masking an evolving central nervous system infection.
- Benefits/harms assessment: preponderance of harm over benefit.
- Policy level: recommendation.

Febrile Seizures: Guideline for the Neurodiagnostic Evaluation of the Child With a Simple Febrile Seizure

Action Statement 1a

A lumbar puncture should be performed in any child who presents with a seizure and a fever and has meningeal signs and symptoms (eg, neck stiffness, Kernig and/or Brudzinski signs) or in any child whose history or examination suggests the presence of meningitis or intracranial infection.

Action Statement 1b

In any infant between 6 and 12 months of age who presents with a seizure and fever, a lumbar puncture is an option when the child is considered deficient in *Haemophilus influenzae* type b (Hib) or *Streptococcus pneumoniae* immunizations (ie, has not received scheduled immunizations as recommended) or when immunization status cannot be determined because of an increased risk of bacterial meningitis.

Action Statement 1c

A lumbar puncture is an option in the child who presents with a seizure and fever and is pretreated with antibiotics, because antibiotic treatment can mask the signs and symptoms of meningitis.

Action Statement 2

An electroencephalogram (EEG) should not be performed in the evaluation of a neurologically healthy child with a simple febrile seizure.

Action Statement 3

The following tests should not be performed routinely for the sole purpose of identifying the cause of a simple febrile seizure: measurement of serum electrolytes, calcium, phosphorus, magnesium, or blood glucose or complete blood cell count.

Action Statement 4

Neuroimaging should not be performed in the routine evaluation of the child with a simple febrile seizure.

Coding Quick Reference for Febrile Seizures
ICD-10-CM
R56.00 Simple febrile convulsions
R56.01 Complex febrile convulsions

Febrile Seizures

In some children, fevers can trigger seizures. Febrile seizures occur in 2% to 5% of all children between the ages of 6 months and 5 years. Seizures, sometimes called "fits" or "spells," are frightening, but they usually are harmless. Read on for information from the American Academy of Pediatrics that will help you understand febrile seizures and what happens if your child has one.

What is a febrile seizure?

A febrile seizure usually happens during the first few hours of a fever. The child may look strange for a few moments, then stiffen, twitch, and roll his eyes. He will be unresponsive for a short time, his breathing will be disturbed, and his skin may appear a little darker than usual. After the seizure, the child quickly returns to normal. Seizures usually last less than 1 minute but, although uncommon, can last for up to 15 minutes.

Febrile seizures rarely happen more than once within a 24-hour period. Other kinds of seizures (ones that are not caused by fever) last longer, can affect only one part of the body, and may occur repeatedly.

What do I do if my child has a febrile seizure?

If your child has a febrile seizure, act immediately to prevent injury.

- Place her on the floor or bed away from any hard or sharp objects.
- Turn her head to the side so that any saliva or vomit can drain from her mouth.
- Do not put anything into her mouth; she will not swallow her tongue.
- Call your child's doctor.
- If the seizure does not stop after 5 minutes, call 911 or your local emergency number.

Will my child have more seizures?

Febrile seizures tend to run in families. The risk of having seizures with other episodes of fever depends on the age of your child. Children younger than 1 year of age at the time of their first seizure have about a 50% chance of having another febrile seizure. Children older than 1 year of age at the time of their first seizure have only a 30% chance of having a second febrile seizure.

Will my child get epilepsy?

Epilepsy is a term used for multiple and recurrent seizures. Epileptic seizures are not caused by fever. Children with a history of febrile seizures are at only a slightly higher risk of developing epilepsy by age 7 than children who have not had febrile seizures.

Are febrile seizures dangerous?

While febrile seizures may be very scary, they are harmless to the child. Febrile seizures do not cause brain damage, nervous system problems, paralysis, intellectual disability (formerly called mental retardation), or death.

How are febrile seizures treated?

If your child has a febrile seizure, call your child's doctor right away. He or she will want to examine your child in order to determine the cause of your child's fever. It is more important to determine and treat the cause of the fever rather than the seizure. A spinal tap may be done to be sure your child does not have a serious infection like meningitis, especially if your child is younger than 1 year of age.

In general, doctors do not recommend treatment of a simple febrile seizure with preventive medicines. However, this should be discussed with your child's doctor. In cases of prolonged or repeated seizures, the recommendation may be different.

Medicines like acetaminophen and ibuprofen can help lower a fever, but they do not prevent febrile seizures. Your child's doctor will talk with you about the best ways to take care of your child's fever.

If your child has had a febrile seizure, do not fear the worst. These types of seizures are not dangerous to your child and do not cause long-term health problems. If you have concerns about this issue or anything related to your child's health, talk with your child's doctor.

From your doctor

American Academy of Pediatrics

DEDICATED TO THE HEALTH OF ALL CHILDREN™

The American Academy of Pediatrics is an organization of 60,000 primary care pediatricians, pediatric medical subspecialists, and pediatric surgical specialists dedicated to the health, safety, and well-being of infants, children, adolescents, and young adults.

American Academy of Pediatrics
Web site— www.HealthyChildren.org

Clinical Practice Guideline for Screening and Management of High Blood Pressure in Children and Adolescents

- *Clinical Practice Guideline*
  - *PPI: AAP Partnership for Policy Implementation*
    See Appendix 1 for more information.

CLINICAL PRACTICE GUIDELINE Guidance for the Clinician in Rendering Pediatric Care

American Academy of Pediatrics

DEDICATED TO THE HEALTH OF ALL CHILDREN™

Clinical Practice Guideline for Screening and Management of High Blood Pressure in Children and Adolescents

Joseph T. Flynn, MD, MS, FAAP,[a] David C. Kaelber, MD, PhD, MPH, FAAP, FACP, FACMI,[b] Carissa M. Baker-Smith, MD, MS, MPH, FAAP, FAHA,[c] Douglas Blowey, MD,[d] Aaron E. Carroll, MD, MS, FAAP,[e] Stephen R. Daniels, MD, PhD, FAAP,[f] Sarah D. de Ferranti, MD, MPH, FAAP,[g] Janis M. Dionne, MD, FRCPC,[h] Bonita Falkner, MD,[i] Susan K. Flinn, MA,[j] Samuel S. Gidding, MD,[k] Celeste Goodwin,[l] Michael G. Leu, MD, MS, MHS, FAAP,[m] Makia E. Powers, MD, MPH, FAAP,[n] Corinna Rea, MD, MPH, FAAP,[o] Joshua Samuels, MD, MPH, FAAP,[p] Madeline Simasek, MD, MSCP, FAAP,[q] Vidhu V. Thaker, MD, FAAP,[r] Elaine M. Urbina, MD, MS, FAAP,[s] SUBCOMMITTEE ON SCREENING AND MANAGEMENT OF HIGH BLOOD PRESSURE IN CHILDREN

These pediatric hypertension guidelines are an update to the 2004 "Fourth Report on the Diagnosis, Evaluation, and Treatment of High Blood Pressure in Children and Adolescents." Significant changes in these guidelines include (1) the replacement of the term "prehypertension" with the term "elevated blood pressure," (2) new normative pediatric blood pressure (BP) tables based on normal-weight children, (3) a simplified screening table for identifying BPs needing further evaluation, (4) a simplified BP classification in adolescents ≥13 years of age that aligns with the forthcoming American Heart Association and American College of Cardiology adult BP guidelines, (5) a more limited recommendation to perform screening BP measurements only at preventive care visits, (6) streamlined recommendations on the initial evaluation and management of abnormal BPs, (7) an expanded role for ambulatory BP monitoring in the diagnosis and management of pediatric hypertension, and (8) revised recommendations on when to perform echocardiography in the evaluation of newly diagnosed hypertensive pediatric patients (generally only before medication initiation), along with a revised definition of left ventricular hypertrophy. These guidelines include 30 Key Action Statements and 27 additional recommendations derived from a comprehensive review of almost 15 000 published articles between January 2004 and July 2016. Each Key Action Statement includes level of evidence, benefit-harm relationship, and strength of recommendation. This clinical practice guideline, endorsed by the American Heart Association, is intended to foster a patient- and family-centered approach to care, reduce unnecessary and costly medical interventions, improve patient diagnoses and outcomes, support implementation, and provide direction for future research.

abstract

FREE

[a]Dr. Robert O. Hickman Endowed Chair in Pediatric Nephrology, Division of Nephrology, Department of Pediatrics, University of Washington and Seattle Children's Hospital, Seattle, Washington; [b]Departments of Pediatrics, Internal Medicine, Population and Quantitative Health Sciences, Center for Clinical Informatics Research and Education, Case Western Reserve University and MetroHealth System, Cleveland, Ohio; [c]Division of Pediatric Cardiology, School of Medicine, University of Maryland, Baltimore, Maryland; [d]Children's Mercy Hospital, University of Missouri-Kansas City and Children's Mercy Integrated Care Solutions, Kansas City, Missouri; [e]Department of Pediatrics, School of Medicine, Indiana University, Bloomington, Indiana; [f]Department of Pediatrics, School of Medicine, University of Colorado-Denver and Pediatrician in Chief, Children's Hospital Colorado, Aurora, Colorado; [g]Director, Preventive Cardiology Clinic, Boston Children's Hospital, Department of Pediatrics, Harvard Medical School, Boston, Massachusetts; [h]Division of Nephrology, Department of Pediatrics, University of British Columbia and British Columbia Children's Hospital, Vancouver, British Columbia, Canada; Departments of [i]Medicine and Pediatrics, Sidney Kimmel Medical College, Thomas Jefferson University, Philadelphia, Pennsylvania; [j]Consultant, American Academy of Pediatrics, Washington, District of Columbia; [k]Cardiology Division Head, Nemours Cardiac Center, Alfred I. duPont Hospital for Children, Wilmington, Delaware; [l]National Pediatric Blood Pressure Awareness Foundation, Prairieville, Louisiana; Departments of [m]Pediatrics and Biomedical Informatics and Medical Education, University of Washington, University of Washington Medicine and Information Technology Services, and Seattle Children's Hospital,

To cite: Flynn JT, Kaelber DC, Baker-Smith CM, et al. Clinical Practice Guideline for Screening and Management of High Blood Pressure in Children and Adolescents. *Pediatrics*. 2017;140(3):e20171904

1. INTRODUCTION

1. Scope of the Clinical Practice Guideline

Interest in childhood hypertension (HTN) has increased since the 2004 publication of the "Fourth Report on the Diagnosis, Evaluation, and Treatment of High Blood Pressure in Children and Adolescents" (Fourth Report).[1] Recognizing ongoing evidence gaps and the need for an updated, thorough review of the relevant literature, the American Academy of Pediatrics (AAP) and its Council on Quality Improvement and Patient Safety developed this practice guideline to provide an update on topics relevant to the diagnosis, evaluation, and management of pediatric HTN. It is primarily directed at clinicians caring for children and adolescents in the outpatient setting. This guideline is endorsed by the American Heart Association.

When it was not possible to identify sufficient evidence, recommendations are based on the consensus opinion of the expert members of the Screening and Management of High Blood Pressure in Children Clinical Practice Guideline Subcommittee (henceforth, "the subcommittee"). The subcommittee intends to regularly update this guideline as new evidence becomes available. Implementation tools for this guideline are available on the AAP Web site (https://www.aap.org/en-us/about-the-aap/Committees-Councils-Sections/coqips/Pages/Implementation-Guide.aspx).

1.1 Methodology

The subcommittee was co-chaired by a pediatric nephrologist and a general pediatrician and consisted of 17 members, including a parent representative. All subcommittee members were asked to disclose relevant financial or proprietary conflicts of interest for members or their family members at the start of and throughout the guideline preparation process. Potential conflicts of interest were addressed and resolved by the AAP. A detailed list of subcommittee members and affiliations can be found in the Consortium section at the end of this article. A listing of subcommittee members with conflicts of interest will be included in the forthcoming technical report.

The subcommittee epidemiologist created a detailed content outline, which was reviewed and approved by the subcommittee. The outline contained a list of primary and secondary topics generated to guide a thorough literature search and meet the goal of providing an up-to-date systemic review of the literature pertaining to the diagnosis, management, and treatment of pediatric HTN as well as the prevalence of pediatric HTN and its associated comorbidities.

Of the topics covered in the outline, ~80% were researched by using a Patient, Intervention/Indicator, Comparison, Outcome, and Time (PICOT) format to address the following key questions:

1. How should systemic HTN (eg, primary HTN, renovascular HTN, white coat hypertension [WCH], and masked hypertension [MH]) in children be diagnosed, and what is the optimal approach to diagnosing HTN in children and adolescents?
2. What is the recommended workup for pediatric HTN? How do we best identify the underlying etiologies of secondary HTN in children?
3. What is the optimal goal systolic blood pressure (SBP) and/or diastolic blood pressure (DBP) for children and adolescents?
4. In children 0 to 18 years of age, how does treatment with lifestyle versus antihypertensive agents influence indirect measures of cardiovascular disease (CVD) risk, such as carotid intimamedia thickness (cIMT), flow-mediated dilation (FMD), left ventricular hypertrophy (LVH), and other markers of vascular dysfunction?

To address these key questions, a systematic search and review of literature was performed. The initial search included articles published between the publication of the Fourth Report (January 2004) and August 2015. The process used to conduct the systematic review was consistent with the recommendations of the Institute of Medicine for systematic reviews.[2]

For the topics not researched by using the PICOT format, separate searches were conducted. Not all topics (eg, economic aspects of pediatric HTN) were appropriate for the PICOT format. A third and final search was conducted at the time the Key Action Statements (KASs) were generated to identify any additional relevant articles published between August 2015 and July 2016. (See Table 1 for a complete list of KASs.)

A detailed description of the methodology used to conduct the literature search and systematic review for this clinical practice guideline will be included in the forthcoming technical report. In brief, reference selection involved a multistep process. First, 2 subcommittee members reviewed the titles and abstracts of references identified for each key question. The epidemiologist provided a deciding vote when required. Next, 2 subcommittee members and the epidemiologist conducted full-text reviews of the selected articles. Although many subcommittee members have extensively published articles on topics covered in this guideline, articles were not preferentially selected on the basis of authorship.

Articles selected at this stage were mapped back to the relevant main topic in the outline. Subcommittee members were then assigned to

TABLE 1 Summary of KASs for Screening and Management of High BP in Children and Adolescents

KAS	Evidence Quality, Strength of Recommendation
1. BP should be measured annually in children and adolescents ≥3 y of age.	C, moderate
2. BP should be checked in all children and adolescents ≥3 y of age at every health care encounter if they have obesity, are taking medications known to increase BP, have renal disease, a history of aortic arch obstruction or coarctation, or diabetes.	C, moderate
3. Trained health care professionals in the office setting should make a diagnosis of HTN if a child or adolescent has auscultatory-confirmed BP readings ≥95th percentile at 3 different visits.	C, moderate
4. Organizations with EHRs used in an office setting should consider including flags for abnormal BP values, both when the values are being entered and when they are being viewed.	C, weak
5. Oscillometric devices may be used for BP screening in children and adolescents. When doing so, providers should use a device that has been validated in the pediatric age group. If elevated BP is suspected on the basis of oscillometric readings, confirmatory measurements should be obtained by auscultation.	B, strong
6. ABPM should be performed for confirmation of HTN in children and adolescents with office BP measurements in the elevated BP category for 1 year or more or with stage 1 HTN over 3 clinic visits.	C, moderate
7. Routine performance of ABPM should be strongly considered in children and adolescents with high-risk conditions (see Table 12) to assess HTN severity and determine if abnormal circadian BP patterns are present, which may indicate increased risk for target organ damage.	B, moderate
8. ABPM should be performed by using a standardized approach (see Table 13) with monitors that have been validated in a pediatric population, and studies should be interpreted by using pediatric normative data.	C, moderate
9. Children and adolescents with suspected WCH should undergo ABPM. Diagnosis is based on the presence of mean SBP and DBP <95th percentile and SBP and DBP load <25%.	B, strong
10. Home BP monitoring should not be used to diagnose HTN, MH, or WCH but may be a useful adjunct to office and ambulatory BP measurement after HTN has been diagnosed.	C, moderate
11. Children and adolescents ≥6 y of age do not require an extensive evaluation for secondary causes of HTN if they have a positive family history of HTN, are overweight or obese, and/or do not have history or physical examination findings (Table 14) suggestive of a secondary cause of HTN.	C, moderate
12. Children and adolescents who have undergone coarctation repair should undergo ABPM for the detection of HTN (including MH).	B, strong
13. In children and adolescents being evaluated for high BP, the provider should obtain a perinatal history, appropriate nutritional history, physical activity history, psychosocial history, and family history and perform a physical examination to identify findings suggestive of secondary causes of HTN.	B, strong
14. Clinicians should not perform electrocardiography in hypertensive children and adolescents being evaluated for LVH.	B, strong
15-1. It is recommended that echocardiography be performed to assess for cardiac target organ damage (LV mass, geometry, and function) at the time of consideration of pharmacologic treatment of HTN.	C, moderate
15-2. LVH should be defined as LV mass >51 g/m$^{2.7}$ (boys and girls) for children and adolescents older than age 8 y and defined by LV mass >115 g/BSA for boys and LV mass >95 g/BSA for girls.	
15-3. Repeat echocardiography may be performed to monitor improvement or progression of target organ damage at 6- to 12-mo intervals. Indications to repeat echocardiography include persistent HTN despite treatment, concentric LV hypertrophy, or reduced LV ejection fraction.	
15-4. In patients without LV target organ injury at initial echocardiographic assessment, repeat echocardiography at yearly intervals may be considered in those with stage 2 HTN, secondary HTN, or chronic stage 1 HTN incompletely treated (noncompliance or drug resistance) to assess for the development of worsening LV target organ injury.	
16. Doppler renal ultrasonography may be used as a noninvasive screening study for the evaluation of possible RAS in normal-wt children and adolescents ≥8 y of age who are suspected of having renovascular HTN and who will cooperate with the procedure.	C, moderate
17. In children and adolescents suspected of having RAS, either CTA or MRA may be performed as noninvasive imaging studies. Nuclear renography is less useful in pediatrics and should generally be avoided.	D, weak
18. Routine testing for MA is not recommended for children and adolescents with primary HTN.	C, moderate
19. In children and adolescents diagnosed with HTN, the treatment goal with nonpharmacologic and pharmacologic therapy should be a reduction in SBP and DBP to <90th percentile and <130/80 mm Hg in adolescents ≥ 13 years old.	C, moderate
20. At the time of diagnosis of elevated BP or HTN in a child or adolescent, clinicians should provide advice on the DASH diet and recommend moderate to vigorous physical activity at least 3 to 5 d per week (30–60 min per session) to help reduce BP.	C, weak
21. In hypertensive children and adolescents who have failed lifestyle modifications (particularly those who have LV hypertrophy on echocardiography, symptomatic HTN, or stage 2 HTN without a clearly modifiable factor [eg, obesity]), clinicians should initiate pharmacologic treatment with an ACE inhibitor, ARB, long-acting calcium channel blocker, or thiazide diuretic.	B, moderate
22. ABPM may be used to assess treatment effectiveness in children and adolescents with HTN, especially when clinic and/or home BP measurements indicate insufficient BP response to treatment.	B, moderate
23-1. Children and adolescents with CKD should be evaluated for HTN at each medical encounter.	B, strong
23-2. Children or adolescents with both CKD and HTN should be treated to lower 24-hr MAP <50th percentile by ABPM.	
23-3. Regardless of apparent control of BP with office measures, children and adolescents with CKD and a history of HTN should have BP assessed by ABPM at least yearly to screen for MH.	
24. Children and adolescents with CKD and HTN should be evaluated for proteinuria.	B, strong
25. Children and adolescents with CKD, HTN, and proteinuria should be treated with an ACE inhibitor or ARB.	B, strong

TABLE 1 Continued

KAS	Evidence Quality, Strength of Recommendation
26. Children and adolescents with T1DM or T2DM should be evaluated for HTN at each medical encounter and treated if BP ≥95th percentile or >130/80 mm Hg in adolescents ≥13 y of age.	C, moderate
27. In children and adolescents with acute severe HTN and life-threatening symptoms, immediate treatment with short-acting antihypertensive medication should be initiated, and BP should be reduced by no more than 25% of the planned reduction over the first 8 h.	Expert opinion, D, weak
28. Children and adolescents with HTN may participate in competitive sports once hypertensive target organ effects and cardiovascular risk have been assessed.	C, moderate
29. Children and adolescents with HTN should receive treatment to lower BP below stage 2 thresholds before participation in competitive sports.	C, moderate
30. Adolescents with elevated BP or HTN (whether they are receiving antihypertensive treatment) should typically have their care transitioned to an appropriate adult care provider by 22 y of age (recognizing that there may be individual cases in which this upper age limit is exceeded, particularly in the case of youth with special health care needs). There should be a transfer of information regarding HTN etiology and past manifestations and complications of the patient's HTN.	X, strong

writing teams that evaluated the evidence quality for selected topics and generated appropriate KASs in accordance with an AAP grading matrix (see Fig 1 and the detailed discussion in the forthcoming technical report).[3] Special working groups were created to address 2 specific topics for which evidence was lacking and expert opinion was required to generate KASs, "Definition of HTN" and "Definition of LVH." References for any topics not covered by the key questions were selected on the basis of additional literature searches and reviewed by the epidemiologist and subcommittee members assigned to the topic. When applicable, searches were conducted by using the PICOT format .

In addition to the 30 KASs listed above, this guideline also contains 27 additional recommendations that are based on the consensus expert opinion of the subcommittee members. These recommendations, along with their locations in the document, are listed in Table 2.

2. EPIDEMIOLOGY AND CLINICAL SIGNIFICANCE

2.1 Prevalence of HTN in Children

Information on the prevalence of high blood pressure (BP) in children is largely derived from data from the NHANES and typically is based on a single BP measurement session. These surveys, conducted since 1988, indicate that there has been an increase in the prevalence of childhood high BP, including both HTN and elevated BP.[4,5] High BP is consistently greater in boys (15%–19%) than in girls (7%–12%). The prevalence of high BP is higher among Hispanic and non-Hispanic African American children compared with non-Hispanic white children, with higher rates among adolescents than among younger children.[6]

However, in a clinical setting and with repeated BP measurements, the prevalence of confirmed HTN is lower in part because of inherent BP variability as well as an adjustment to the experience of having BP measured (also known as the accommodation effect). Therefore, the actual prevalence of clinical HTN in children and adolescents is ~3.5%.[7,8] The prevalence of persistently elevated BP (formerly termed "prehypertension," including BP values from the 90th to 94th percentiles or between 120/80 and 130/80 mm Hg in adolescents) is also ~2.2% to 3.5%, with higher rates among children and adolescents who have overweight and obesity.[7,9]

Data on BP tracking from childhood to adulthood demonstrate that higher BP in childhood correlates with higher BP in adulthood and the onset of HTN in young adulthood. The strength of the tracking relationship is stronger in older children and adolescents.[10] Trajectory data on BP (including repeat measurements from early childhood into midadulthood) confirm the association of elevated BP in adolescence with HTN in early adulthood[11] and that normal BP in childhood is associated with a lack of HTN in midadulthood.[11]

2.2 Awareness, Treatment, and Control of HTN in Children

Of the 32.6% of US adults who have HTN, almost half (17.2%) are not aware they have HTN; even among those who are aware of their condition, only approximately half (54.1%) have controlled BP.[12] Unfortunately, there are no large studies in which researchers have systematically studied BP awareness or control in youth, although an analysis of prescribing patterns from a nationwide prescription drug provider found an increase in the number of prescriptions written for high BP in youth from 2004 to 2007.[13]

The SEARCH for Diabetes in Youth study found that only 7.4% of youth with type 1 diabetes mellitus (T1DM) and 31.9% of youth with type 2 diabetes mellitus (T2DM) demonstrated knowledge of their BP status.[14] Even after becoming aware of the diagnosis, only 57.1% of patients with T1DM and 40.6% of patients with T2DM achieved good BP control.[14] The HEALTHY Primary Prevention Trial of Risk Factors for

TABLE 2 Additional Consensus Opinion Recommendations and Text Locations

Recommendation	CPG Section(s)
1. Follow the revised classification scheme in Table 3 for childhood BP levels, including the use of the term "elevated BP," the new definition of stage 2 HTN, and the use of similar BP levels as adults for adolescents ≥13 y of age.	3.1
2. Use simplified BP tables (Table 4) to screen for BP values that may require further evaluation by a clinician.	3.2a
3. Use reference data on neonatal BP from ref 80 to identify elevated BP values in neonates up to 44 wk postmenstrual age and BP curves from the 1987 Second Task Force report to identify elevated BP values in infants 1–12 mo of age.	3.3
4. Use the standardized technique for measuring BP by auscultation described in Table 7 and Fig 2 (including appropriate cuff size, extremity, and patient positioning) to obtain accurate BP values.	4.1
5. If the initial BP at an office visit is elevated, as described in Fig 3, obtain 2 additional BP measurements at the same visit and average them; use the averaged auscultatory BP measurement to determine the patient's BP category.	4.1
6. Oscillometric devices are used to measure BP in infants and toddlers until they are able to cooperate with auscultatory BP. Follow the same rules for BP measurement technique and cuff size as for older children.	4.1a
7. Measure BP at every health care encounter in children <3 y of age if they have an underlying condition listed in Table 9 that increases their risk for HTN.	4.2
8. After a patient's BP has been categorized, follow Table 11 for when to obtain repeat BP readings, institute lifestyle changes, or proceed to a workup for HTN.	4.3
9. When an oscillometric BP reading is elevated, obtain repeat readings, discard the first reading, and average subsequent readings to approximate auscultatory BP.	4.5
10. Wrist and forearm BP measurements should not be used in children and adolescents for the diagnosis or management of HTN.	4.6
11. Use ABPM to evaluate high-risk patients (those with obesity, CKD, or repaired aortic coarctation) for potential MH.	4.7a, 4.8
12. Routine use of BP readings obtained in the school setting is not recommended for diagnosis of HTN in children and adolescents.	4.10
13. Use the history and physical examination to identify possible underlying causes of HTN, such as heart disease, kidney disease, renovascular disease, endocrine HTN (Table 15), drug-induced HTN (Table 8), and OSAS-associated HTN (Table 18).	5.2–5.4, 5.7, 9.2
14. Suspect monogenic HTN in patients with a family history of early-onset HTN, hypokalemia, suppressed plasma renin, or an elevated ARR.	5.8
15. Obtain laboratory studies listed in Table 10 to evaluate for underlying secondary causes of HTN when indicated.	6.4
16. Routine use of vascular imaging, such as carotid intimal-media measurements or PWV measurements, is not recommended in the evaluation of HTN in children and adolescents.	6.7
17. Suspect renovascular HTN in selected children and adolescents with stage 2 HTN, significant diastolic HTN, discrepant kidney sizes on ultrasound, hypokalemia on screening laboratories, or an epigastric and/or upper abdominal bruit on physical examination.	6.8a
18. Routine measurement of serum UA is not recommended for children and adolescents with elevated BP.	6.9
19. Offer intensive weight-loss programs to hypertensive children and adolescents with obesity; consider using MI as an adjunct to the treatment of obesity.	7.2c
20. Follow-up children and adolescents treated with antihypertensive medications every 4–6 wk until BP is controlled, then extend the interval. Follow-up every 3–6 mo is appropriate for patients treated with lifestyle modification only.	7.3c
21. Evaluate and treat children and adolescents with apparent treatment-resistant HTN in a similar manner to that recommended for adults with resistant HTN.	7.4
22. Treat hypertensive children and adolescents with dyslipidemia according to current, existing pediatric lipid guidelines.	9.1
23. Use ABPM to evaluate for potential HTN in children and adolescents with known or suspected OSAS.	9.2
24. Racial, ethnic, and sex differences need not be considered in the evaluation and management of children and adolescents with HTN.	10
25. Use ABPM to evaluate BP in pediatric heart- and kidney-transplant recipients.	11.3

Type 2 Diabetes in Middle-School Youth, which examined a school-based intervention designed to reduce cardiovascular (CV) risk among middle school students, found the prevalence of stage 1 or 2 HTN to be ~9.5%.[15] There was no significant reduction in HTN in the control group after the intervention; the intervention group saw a reduction in the prevalence of HTN of ~1%, leaving 8.5% with BP still above the ideal range.

Researchers in a number of small, single-center studies have evaluated BP control in children and adolescents with HTN. One study found that lifestyle change and medications produced adequate BP control in 46 of 65 youth (70%) with HTN.[16] Another study in which researchers used ambulatory blood pressure monitoring (ABPM) to assess BP control among a group of 38 children (of whom 84% had chronic kidney disease [CKD]) found that only 13 children (34%) achieved adequate BP control even among those who received more than 1 drug.[17] A similar study found that additional drugs did increase rates of BP control in children with CKD, however.[18]

2.3 Prevalence of HTN Among Children With Various Chronic Conditions

It is well recognized that HTN rates are higher in children with certain chronic conditions, including children with obesity, sleep-disordered breathing (SDB), CKD, and those born preterm. These are described below.

2.3a Children With Obesity

HTN prevalence ranges from 3.8% to 24.8% in youth with overweight and obesity. Rates of HTN increase in a graded fashion with increasing adiposity.[19–24] Similar relationships are seen between HTN and increasing waist circumference.[4,25,26] Systematic reviews of 63 studies on BMI[27] and 61 studies on various measures

TABLE 2 Continued

Recommendation	CPG Section(s)
26. Reasonable strategies for HTN prevention include the maintenance of a normal BMI, consuming a DASH-type diet, avoidance of excessive sodium consumption, and regular vigorous physical activity.	13.2
27. Provide education about HTN to patients and their parents to improve patient involvement in their care and better achieve therapeutic goals.	15.2, 15.3

Based on the expert opinion of the subcommittee members (level of evidence = D; strength of recommendations = weak). CPG, clinical practice guideline.

of abdominal adiposity[28] have shown associations between these conditions and HTN. Obesity is also associated with a lack of circadian variability of BP,[29,30] with up to 50% of children who have obesity not experiencing the expected nocturnal BP dip.[31–33]

Studies have shown that childhood obesity is also related to the development of future HTN.[22] Elevated BMI as early as infancy is associated with higher future BP.[34] This risk appears to increase with obesity severity; there is a fourfold increase in BP among those with severe obesity (BMI >99th percentile) versus a twofold increase in those with obesity (BMI 95th–98th percentiles) compared with normal-weight children and adolescents.[35]

Collectively, the results of these cross-sectional and longitudinal studies firmly establish an increasing prevalence of HTN with increasing BMI percentile. The study results also underscore the importance of monitoring BP in all children with overweight and/or obesity at every clinical encounter.

Obesity in children with HTN may be accompanied by additional cardiometabolic risk factors (eg, dyslipidemia and disordered glucose metabolism)[36,37] that may have their own effects on BP or may represent comorbid conditions arising from the same adverse lifestyle behaviors.[25,38] Some argue that the presence of multiple risk factors, including obesity and HTN, leads to far greater increases in CV risk than is explained by the individual risk factors alone. Although this phenomenon has been hard to demonstrate definitively, the Strong Heart Study did show that American Indian adolescents with multiple cardiometabolic risk factors had a higher prevalence of LVH (43.2% vs 11.7%), left atrial dilation (63.1% vs 21.9%; $P < .001$), and reduced LV systolic and diastolic function compared with those without multiple cardiometabolic risk factors.[39] Notably, both obesity and HTN were drivers of these CV abnormalities, with obesity being a stronger determinant of cardiac abnormalities than HTN (odds ratio, 4.17 vs 1.03).

2.3b Children With SDB

SDB occurs on a spectrum that includes (1) primary snoring, (2) sleep fragmentation, and (3) obstructive sleep apnea syndrome (OSAS). Researchers in numerous studies have identified an association between SDB and HTN in the pediatric population.[40–42] Studies suggest that children who sleep 7 hours or less per night are at increased risk for HTN.[43] Small studies of youth with sleep disorders have found the prevalence of high BP to range between 3.6% and 14%.[40,41] The more severe the OSAS, the more likely a child is to have HTN.[44,45] Even inadequate duration of sleep and poor-quality sleep have been associated with elevated BP.[43]

2.3c Children With CKD

There are well-established pathophysiologic links between childhood HTN and CKD. Certain forms of CKD can lead to HTN, and untreated HTN can lead to CKD in adults, although evidence for the latter in pediatric patients is lacking. Among children and adolescents with CKD, ~50% are known to be hypertensive.[46–48] In children and adolescents with end-stage renal disease (either those on dialysis or after transplant), ~48% to 79% are hypertensive, with 20% to 70% having uncontrolled HTN.[49–53] Almost 20% of pediatric HTN may be attributable to CKD.[54]

2.3d Children With History of Prematurity

Abnormal birth history—including preterm birth and low birth weight—has been identified as a risk factor for HTN and other CVD in adults[55]; only low birth weight has been associated with elevated BP in the pediatric age range.[56] One retrospective cohort study showed a prevalence of HTN of 7.3% among 3 year olds who were born preterm.[57] Researchers in another retrospective case series noted a high prevalence of HTN in older children with a history of preterm birth.[58] It also appears that preterm birth may result in abnormal circadian BP patterns in childhood.[59] These data are intriguing but limited. Further study is needed to determine how often preterm birth results in childhood HTN.

2.4 Importance of Diagnosing HTN in Children and Adolescents

Numerous studies have shown that elevated BP in childhood increases the risk for adult HTN and metabolic syndrome.[10,60–62] Youth with higher BP levels in childhood are also more likely to have persistent HTN as adults.[60,63] One recent study found that adolescents with elevated BP progressed to HTN at a rate of 7% per year, and elevated BMI predicted sustained BP elevations.[64] In addition, young patients with HTN are likely to experience accelerated vascular aging. Both autopsy[65] and imaging studies[66] have demonstrated BP-related CV damage in youth. These intermediate markers of CVD (eg, increased LV mass,[67] cIMT,[68] and

pulse wave velocity [PWV][69]) are known to predict CV events in adults, making it crucial to diagnose and treat HTN early.

Eighty million US adults (1 in 3) have HTN, which is a major contributor to CVD.[12] Key contributors to CV health have been identified by the American Heart Association (AHA) as "Life's Simple 7," including 4 ideal health behaviors (not smoking, normal BMI, physical activity at goal levels, and a healthy diet) and 3 ideal health factors (untreated, normal total cholesterol; normal fasting blood glucose; and normal untreated BP, defined in childhood as ≤90th percentile or <120/80 mm Hg). Notably, elevated BP is the least common abnormal health factor in children and adolescents[70]; 89% of youth (ages 12–19 years) are in the ideal BP category.[6]

Given the prevalence of known key contributors in youth (ie, tobacco exposure, obesity, inactivity, and nonideal diet[12,71]), adult CVD likely has its origins in childhood. One-third of US adolescents report having tried a cigarette in the past 30 days.[72] Almost half (40%–48%) of teenagers have elevated BMI, and the rates of severe obesity (BMI >99th percentile) continue to climb, particularly in girls and adolescents.[73–75] Physical activity measured by accelerometry shows less than half of school-aged boys and only one-third of school-aged girls meet the goal for ideal physical activity levels.[72] More than 80% of youth 12 to 19 years of age have a poor diet (as defined by AHA metrics for ideal CV health); only ~10% eat adequate fruits and vegetables, and only ~15% consume <1500 mg per day of sodium, both of which are key dietary determinants of HTN.[76]

Finally, measuring BP at routine well-child visits enables the early detection of primary HTN as well as the detection of asymptomatic HTN secondary to another underlying disorder. Early detection of HTN is vital given the greater relative prevalence of secondary causes of HTN in children compared with adults.

TABLE 3 Updated Definitions of BP Categories and Stages

For Children Aged 1–13 y	For Children Aged ≥13 y
Normal BP: <90th percentile	Normal BP: <120/<80 mm Hg
Elevated BP: ≥90th percentile to <95th percentile or 120/80 mm Hg to <95th percentile (whichever is lower)	Elevated BP: 120/<80 to 129/<80 mm Hg
Stage 1 HTN: ≥95th percentile to <95th percentile + 12 mmHg, or 130/80 to 139/89 mm Hg (whichever is lower)	Stage 1 HTN: 130/80 to 139/89 mm Hg
Stage 2 HTN: ≥95th percentile + 12 mm Hg, or ≥140/90 mm Hg (whichever is lower)	Stage 2 HTN: ≥140/90 mm Hg

3. DEFINITION OF HTN

3.1 Definition of HTN (1–18 Years of Age)

Given the lack of outcome data, the current definition of HTN in children and adolescents is based on the normative distribution of BP in healthy children.[1] Because it is a major determinant of BP in growing children, height has been incorporated into the normative data since the publication of the 1996 Working Group Report.[1] BP levels should be interpreted on the basis of sex, age, and height to avoid misclassification of children who are either extremely tall or extremely short. It should be noted that the normative data were collected by using an auscultatory technique,[1] which may provide different values than measurement obtained by using oscillometric devices or from ABPM.

In the Fourth Report, "normal blood pressure" was defined as SBP and DBP values <90th percentile (on the basis of age, sex, and height percentiles). For the preadolescent, "prehypertension" was defined as SBP and/or DBP ≥90th percentile and <95th percentile (on the basis of age, sex, and height tables). For adolescents, "prehypertension" was defined as BP ≥120/80 mm Hg to <95th percentile, or ≥90th and <95th percentile, whichever was lower. HTN was defined as average clinic measured SBP and/or DBP ≥95th percentile (on the basis of age, sex, and height percentiles) and was further classified as stage 1 or stage 2 HTN.

There are still no data to identify a specific level of BP in childhood that leads to adverse CV outcomes in adulthood. Therefore, the subcommittee decided to maintain a statistical definition for childhood HTN. The staging criteria have been revised for stage 1 and stage 2 HTN for ease of implementation compared with the Fourth Report. For children ≥13 years of age, this staging scheme will seamlessly interface with the 2017 AHA and American College of Cardiology (ACC) adult HTN guideline.* Additionally, the term "prehypertension" has been replaced by the term "elevated blood pressure," to be consistent with the AHA and ACC guideline and convey the importance of lifestyle measures to prevent the development of HTN (see Table 3).

3.2 New BP Tables

New normative BP tables based on normal-weight children are included with these guidelines (see Tables 4 and 5). Similar to the tables in the

*Whelton PK, Carey RM, Aranow WS, et al. ACC/AHA/APPA/ABC/ACPM/AGS/APhA/ASH/ASPC/NMA/PCNA Guideline for the prevention, detection, evaluation and managament of high blood pressure in adults: A report of the American College of Cardiology/American Heart Association Task Force on Clinical Practice Guidelines. *Hypertension.* 2017, In press.

Fourth Report,[1] they include SBP and DBP values arranged by age, sex, and height (and height percentile). These values are based on auscultatory measurements obtained from ~50 000 children and adolescents. A new feature in these tables is that the BP values are categorized according to the scheme presented in Table 3 as normal (50th percentile), elevated BP (>90th percentile), stage 1 HTN (≥95th percentile), and stage 2 HTN (≥95th percentile + 12 mm Hg). Additionally, actual heights in centimeters and inches are provided.

Unlike the tables in the Fourth Report,[1] the BP values in these tables do not include children and adolescents with overweight and obesity (ie, those with a BMI ≥85th percentile); therefore, they represent normative BP values for normal-weight youth. The decision to create these new tables was based on evidence of the strong association of both overweight and obesity with elevated BP and HTN. Including patients with overweight and obesity in normative BP tables was thought to create bias. The practical effect of this change is that the BP values in Tables 4 and 5 are several millimeters of mercury lower than in the similar tables in the Fourth Report.[1] These tables are based on the same population data excluding participants with overweight and obesity, and the same methods used in the Fourth Report.[1] The methods and results have been published elsewhere.[77] For researchers and others interested in the equations used to calculate the tables' BP values, detailed methodology and the Statistical Analysis System (SAS) code can be found at: http://sites.google.com/a/channing.harvard.edu/bernardrosner/pediatric-blood-press/childhood-blood-pressure.

There are slight differences between the actual percentile-based values in these tables and the cut-points in Table 3, particularly for teenagers ≥13 years of age. Clinicians should understand that the scheme in Table 3 was chosen to align with the new adult guideline and facilitate the management of older adolescents with high BP. The percentile-based values in Tables 4 and 5 are provided to aid researchers and others interested in a more precise classification of BP.

3.2a. Simplified BP Table

This guideline includes a new, simplified table for initial BP screening (see Table 6) based on the 90th percentile BP for age and sex for children at the 5th percentile of height, which gives the values in the table a negative predictive value of >99%.[78] This simplified table is designed as a screening tool only for the identification of children and adolescents who need further evaluation of their BP starting with repeat BP measurements. It should not be used to diagnose elevated BP or HTN by itself. To diagnose elevated BP or HTN, it is important to locate the actual cutoffs in the complete BP tables because the SBP and DBP cutoffs may be as much as 9 mm Hg higher depending on a child's age and length or height. A typical-use case for this simplified table is for nursing staff to quickly identify BP that may need further evaluation by a clinician. For adolescents ≥13 years of age, a threshold of 120/80 mm Hg is used in the simplified table regardless of sex to align with adult guidelines for the detection of elevated BP.

3.3 Definition of HTN in the Neonate and Infant (0–1 Year of Age)

Although a reasonably strict definition of HTN has been developed for older children, it is more difficult to define HTN in neonates given the well-known changes in BP that occur during the first few weeks of life.[79] These BP changes can be significant in preterm infants, in whom BP depends on a variety of factors, including postmenstrual age, birth weight, and maternal conditions.[80] In an attempt to develop a more standardized approach to the HTN definition in preterm and term neonates, Dionne et al[79] compiled available data on neonatal BP and generated a summary table of BP values, including values for the 95th and 99th percentiles for infants from 26 to 44 weeks' postmenstrual age. The authors proposed that by using these values, a similar approach to that used to identify older children with elevated BP can be followed in neonates, even in those who are born preterm.

At present, no alternative data have been developed, and no outcome data are available on the consequences of high BP in this population; thus, it is reasonable to use these compiled BP values in the assessment of elevated BP in newborn infants. Of note, the 1987 "Report of the Second Task Force on Blood Pressure Control in Children" published curves of normative BP values in older infants up to 1 year of age.[81] These normative values should continue to be used given the lack of more contemporary data for this age group.

4. MEASUREMENT OF BP

4.1 BP Measurement Technique

BP in childhood may vary considerably between visits and even during the same visit. There are many potential etiologies for isolated elevated BP in children and adolescents, including such factors as anxiety and recent caffeine intake.[82] BP generally decreases with repeated measurements during a single visit,[83] although the variability may not be large enough to affect BP classification.[84] BP measurements can also vary across visits[64,85]; one study in adolescents found that only 56% of the sample had the same HTN stage on 3 different occasions.[8] Therefore, it is important to obtain multiple measurements over time before diagnosing HTN.

TABLE 4 BP Levels for Boys by Age and Height Percentile

Age (y)	BP Percentile	SBP (mm Hg)							DBP (mm Hg)						
		Height Percentile or Measured Height							Height Percentile or Measured Height						
		5%	10%	25%	50%	75%	90%	95%	5%	10%	25%	50%	75%	90%	95%
1	Height (in)	30.4	30.8	31.6	32.4	33.3	34.1	34.6	30.4	30.8	31.6	32.4	33.3	34.1	34.6
	Height (cm)	77.2	78.3	80.2	82.4	84.6	86.7	87.9	77.2	78.3	80.2	82.4	84.6	86.7	87.9
	50th	85	85	86	86	87	88	88	40	40	40	41	41	42	42
	90th	98	99	99	100	100	101	101	52	52	53	53	54	54	54
	95th	102	102	103	103	104	105	105	54	54	55	55	56	57	57
	95th + 12 mm Hg	114	114	115	115	116	117	117	66	66	67	67	68	69	69
2	Height (in)	33.9	34.4	35.3	36.3	37.3	38.2	38.8	33.9	34.4	35.3	36.3	37.3	38.2	38.8
	Height (cm)	86.1	87.4	89.6	92.1	94.7	97.1	98.5	86.1	87.4	89.6	92.1	94.7	97.1	98.5
	50th	87	87	88	89	89	90	91	43	43	44	44	45	46	46
	90th	100	100	101	102	103	103	104	55	55	56	56	57	58	58
	95th	104	105	105	106	107	107	108	57	58	58	59	60	61	61
	95th + 12 mm Hg	116	117	117	118	119	119	120	69	70	70	71	72	73	73
3	Height (in)	36.4	37	37.9	39	40.1	41.1	41.7	36.4	37	37.9	39	40.1	41.1	41.7
	Height (cm)	92.5	93.9	96.3	99	101.8	104.3	105.8	92.5	93.9	96.3	99	101.8	104.3	105.8
	50th	88	89	89	90	91	92	92	45	46	46	47	48	49	49
	90th	101	102	102	103	104	105	105	58	58	59	59	60	61	61
	95th	106	106	107	107	108	109	109	60	61	61	62	63	64	64
	95th + 12 mm Hg	118	118	119	119	120	121	121	72	73	73	74	75	76	76
4	Height (in)	38.8	39.4	40.5	41.7	42.9	43.9	44.5	38.8	39.4	40.5	41.7	42.9	43.9	44.5
	Height (cm)	98.5	100.2	102.9	105.9	108.9	111.5	113.2	98.5	100.2	102.9	105.9	108.9	111.5	113.2
	50th	90	90	91	92	93	94	94	48	49	49	50	51	52	52
	90th	102	103	104	105	105	106	107	60	61	62	62	63	64	64
	95th	107	107	108	108	109	110	110	63	64	65	66	67	67	68
	95th + 12 mm Hg	119	119	120	120	121	122	122	75	76	77	78	79	79	80
5	Height (in)	41.1	41.8	43.0	44.3	45.5	46.7	47.4	41.1	41.8	43.0	44.3	45.5	46.7	47.4
	Height (cm)	104.4	106.2	109.1	112.4	115.7	118.6	120.3	104.4	106.2	109.1	112.4	115.7	118.6	120.3
	50th	91	92	93	94	95	96	96	51	51	52	53	54	55	55
	90th	103	104	105	106	107	108	108	63	64	65	65	66	67	67
	95th	107	108	109	109	110	111	112	66	67	68	69	70	70	71
	95th + 12 mm Hg	119	120	121	121	122	123	124	78	79	80	81	82	82	83
6	Height (in)	43.4	44.2	45.4	46.8	48.2	49.4	50.2	43.4	44.2	45.4	46.8	48.2	49.4	50.2
	Height (cm)	110.3	112.2	115.3	118.9	122.4	125.6	127.5	110.3	112.2	115.3	118.9	122.4	125.6	127.5
	50th	93	93	94	95	96	97	98	54	54	55	56	57	57	58
	90th	105	105	106	107	109	110	110	66	66	67	68	68	69	69
	95th	108	109	110	111	112	113	114	69	70	70	71	72	72	73
	95th + 12 mm Hg	120	121	122	123	124	125	126	81	82	82	83	84	84	85
7	Height (in)	45.7	46.5	47.8	49.3	50.8	52.1	52.9	45.7	46.5	47.8	49.3	50.8	52.1	52.9
	Height (cm)	116.1	118	121.4	125.1	128.9	132.4	134.5	116.1	118	121.4	125.1	128.9	132.4	134.5
	50th	94	94	95	97	98	98	99	56	56	57	58	58	59	59
	90th	106	107	108	109	110	111	111	68	68	69	70	70	71	71
	95th	110	110	111	112	114	115	116	71	71	72	73	73	74	74
	95th + 12 mm Hg	122	122	123	124	126	127	128	83	83	84	85	85	86	86

TABLE 4 Continued

Age (y)	BP Percentile	SBP (mm Hg)							DBP (mm Hg)						
		Height Percentile or Measured Height							Height Percentile or Measured Height						
		5%	10%	25%	50%	75%	90%	95%	5%	10%	25%	50%	75%	90%	95%
8	Height (in)	47.8	48.6	50	51.6	53.2	54.6	55.5	47.8	48.6	50	51.6	53.2	54.6	55.5
	Height (cm)	121.4	123.5	127	131	135.1	138.8	141	121.4	123.5	127	131	135.1	138.8	141
	50th	95	96	97	98	99	99	100	57	57	58	59	59	60	60
	90th	107	108	109	110	111	112	112	69	70	70	71	72	72	73
	95th	111	112	112	114	115	116	117	72	73	73	74	75	75	75
	95th + 12 mm Hg	123	124	124	126	127	128	129	84	85	85	86	87	87	87
9	Height (in)	49.6	50.5	52	53.7	55.4	56.9	57.9	49.6	50.5	52	53.7	55.4	56.9	57.9
	Height (cm)	126	128.3	132.1	136.3	140.7	144.7	147.1	126	128.3	132.1	136.3	140.7	144.7	147.1
	50th	96	97	98	99	100	101	101	57	58	59	60	61	62	62
	90th	107	108	109	110	112	113	114	70	71	72	73	74	74	74
	95th	112	112	113	115	116	118	119	74	74	75	76	76	77	77
	95th + 12 mm Hg	124	124	125	127	128	130	131	86	86	87	88	88	89	89
10	Height (in)	51.3	52.2	53.8	55.6	57.4	59.1	60.1	51.3	52.2	53.8	55.6	57.4	59.1	60.1
	Height (cm)	130.2	132.7	136.7	141.3	145.9	150.1	152.7	130.2	132.7	136.7	141.3	145.9	150.1	152.7
	50th	97	98	99	100	101	102	103	59	60	61	62	63	63	64
	90th	108	109	111	112	113	115	116	72	73	74	74	75	75	76
	95th	112	113	114	116	118	120	121	76	76	77	77	78	78	78
	95th + 12 mm Hg	124	125	126	128	130	132	133	88	88	89	89	90	90	90
11	Height (in)	53	54	55.7	57.6	59.6	61.3	62.4	53	54	55.7	57.6	59.6	61.3	62.4
	Height (cm)	134.7	137.3	141.5	146.4	151.3	155.8	158.6	134.7	137.3	141.5	146.4	151.3	155.8	158.6
	50th	99	99	101	102	103	104	106	61	61	62	63	63	63	63
	90th	110	111	112	114	116	117	118	74	74	75	75	75	76	76
	95th	114	114	116	118	120	123	124	77	78	78	78	78	78	78
	95th + 12 mm Hg	126	126	128	130	132	135	136	89	90	90	90	90	90	90
12	Height (in)	55.2	56.3	58.1	60.1	62.2	64	65.2	55.2	56.3	58.1	60.1	62.2	64	65.2
	Height (cm)	140.3	143	147.5	152.7	157.9	162.6	165.5	140.3	143	147.5	152.7	157.9	162.6	165.5
	50th	101	101	102	104	106	108	109	61	62	62	62	62	63	63
	90th	113	114	115	117	119	121	122	75	75	75	75	75	76	76
	95th	116	117	118	121	124	126	128	78	78	78	78	78	79	79
	95th + 12 mm Hg	128	129	130	133	136	138	140	90	90	90	90	90	91	91
13	Height (in)	57.9	59.1	61	63.1	65.2	67.1	68.3	57.9	59.1	61	63.1	65.2	67.1	68.3
	Height (cm)	147	150	154.9	160.3	165.7	170.5	173.4	147	150	154.9	160.3	165.7	170.5	173.4
	50th	103	104	105	108	110	111	112	61	60	61	62	63	64	65
	90th	115	116	118	121	124	126	126	74	74	74	75	76	77	77
	95th	119	120	122	125	128	130	131	78	78	78	78	80	81	81
	95th + 12 mm Hg	131	132	134	137	140	142	143	90	90	90	90	92	93	93
14	Height (in)	60.6	61.8	63.8	65.9	68.0	69.8	70.9	60.6	61.8	63.8	65.9	68.0	69.8	70.9
	Height (cm)	153.8	156.9	162	167.5	172.7	177.4	180.1	153.8	156.9	162	167.5	172.7	177.4	180.1
	50th	105	106	109	111	112	113	113	60	60	62	64	65	66	67
	90th	119	120	123	126	127	128	129	74	74	75	77	78	79	80
	95th	123	125	127	130	132	133	134	77	78	79	81	82	83	84
	95th + 12 mm Hg	135	137	139	142	144	145	146	89	90	91	93	94	95	96

TABLE 4 Continued

Age (y)	BP Percentile	SBP (mm Hg)							DBP (mm Hg)						
		Height Percentile or Measured Height							Height Percentile or Measured Height						
		5%	10%	25%	50%	75%	90%	95%	5%	10%	25%	50%	75%	90%	95%
15	Height (in)	62.6	63.8	65.7	67.8	69.8	71.5	72.5	62.6	63.8	65.7	67.8	69.8	71.5	72.5
	Height (cm)	159	162	166.9	172.2	177.2	181.6	184.2	159	162	166.9	172.2	177.2	181.6	184.2
	50th	108	110	112	113	114	114	114	61	62	64	65	66	67	68
	90th	123	124	126	128	129	130	130	75	76	78	79	80	81	81
	95th	127	129	131	132	134	135	135	78	79	81	83	84	85	85
	95th + 12 mm Hg	139	141	143	144	146	147	147	90	91	93	95	96	97	97
16	Height (in)	63.8	64.9	66.8	68.8	70.7	72.4	73.4	63.8	64.9	66.8	68.8	70.7	72.4	73.4
	Height (cm)	162.1	165	169.6	174.6	179.5	183.8	186.4	162.1	165	169.6	174.6	179.5	183.8	186.4
	50th	111	112	114	115	115	116	116	63	64	66	67	68	69	69
	90th	126	127	128	129	131	131	132	77	78	79	80	81	82	82
	95th	130	131	133	134	135	136	137	80	81	83	84	85	86	86
	95th + 12 mm Hg	142	143	145	146	147	148	149	92	93	95	96	97	98	98
17	Height (in)	64.5	65.5	67.3	69.2	71.1	72.8	73.8	64.5	65.5	67.3	69.2	71.1	72.8	73.8
	Height (cm)	163.8	166.5	170.9	175.8	180.7	184.9	187.5	163.8	166.5	170.9	175.8	180.7	184.9	187.5
	50th	114	115	116	117	117	118	118	65	66	67	68	69	70	70
	90th	128	129	130	131	132	133	134	78	79	80	81	82	82	83
	95th	132	133	134	135	137	138	138	81	82	84	85	86	86	87
	95th + 12 mm Hg	144	145	146	147	149	150	150	93	94	96	97	98	98	99

Use percentile values to stage BP readings according to the scheme in Table 3 (elevated BP: ≥90th percentile; stage 1 HTN: ≥95th percentile; and stage 2 HTN: ≥95th percentile + 12 mm Hg). The 50th, 90th, and 95th percentiles were derived by using quantile regression on the basis of normal-weight children (BMI <85th percentile).[77]

TABLE 5 BP Levels for Girls by Age and Height Percentile

Age (y)	BP Percentile	SBP (mm Hg)							DBP (mm Hg)						
		Height Percentile or Measured Height							Height Percentile or Measured Height						
		5%	10%	25%	50%	75%	90%	95%	5%	10%	25%	50%	75%	90%	95%
1	Height (in)	29.7	30.2	30.9	31.8	32.7	33.4	33.9	29.7	30.2	30.9	31.8	32.7	33.4	33.9
	Height (cm)	75.4	76.6	78.6	80.8	83	84.9	86.1	75.4	76.6	78.6	80.8	83	84.9	86.1
	50th	84	85	86	86	87	88	88	41	42	42	43	44	45	46
	90th	98	99	99	100	101	102	102	54	55	56	56	57	58	58
	95th	101	102	102	103	104	105	105	59	59	60	60	61	62	62
	95th + 12 mm Hg	113	114	114	115	116	117	117	71	71	72	72	73	74	74
2	Height (in)	33.4	34	34.9	35.9	36.9	37.8	38.4	33.4	34	34.9	35.9	36.9	37.8	38.4
	Height (cm)	84.9	86.3	88.6	91.1	93.7	96	97.4	84.9	86.3	88.6	91.1	93.7	96	97.4
	50th	87	87	88	89	90	91	91	45	46	47	48	49	50	51
	90th	101	101	102	103	104	105	106	58	58	59	60	61	62	62
	95th	104	105	106	106	107	108	109	62	63	63	64	65	66	66
	95th + 12 mm Hg	116	117	118	118	119	120	121	74	75	75	76	77	78	78
3	Height (in)	35.8	36.4	37.3	38.4	39.6	40.6	41.2	35.8	36.4	37.3	38.4	39.6	40.6	41.2
	Height (cm)	91	92.4	94.9	97.6	100.5	103.1	104.6	91	92.4	94.9	97.6	100.5	103.1	104.6
	50th	88	89	89	90	91	92	93	48	48	49	50	51	53	53
	90th	102	103	104	104	105	106	107	60	61	61	62	63	64	65
	95th	106	106	107	108	109	110	110	64	65	65	66	67	68	69
	95th + 12 mm Hg	118	118	119	120	121	122	122	76	77	77	78	79	80	81
4	Height (in)	38.3	38.9	39.9	41.1	42.4	43.5	44.2	38.3	38.9	39.9	41.1	42.4	43.5	44.2
	Height (cm)	97.2	98.8	101.4	104.5	107.6	110.5	112.2	97.2	98.8	101.4	104.5	107.6	110.5	112.2
	50th	89	90	91	92	93	94	94	50	51	51	53	54	55	55
	90th	103	104	105	106	107	108	108	62	63	64	65	66	67	67
	95th	107	108	109	109	110	111	112	66	67	68	69	70	70	71
	95th + 12 mm Hg	119	120	121	121	122	123	124	78	79	80	81	82	82	83
5	Height (in)	40.8	41.5	42.6	43.9	45.2	46.5	47.3	40.8	41.5	42.6	43.9	45.2	46.5	47.3
	Height (cm)	103.6	105.3	108.2	111.5	114.9	118.1	120	103.6	105.3	108.2	111.5	114.9	118.1	120
	50th	90	91	92	93	94	95	96	52	52	53	55	56	57	57
	90th	104	105	106	107	108	109	110	64	65	66	67	68	69	70
	95th	108	109	109	110	111	112	113	68	69	70	71	72	73	73
	95th + 12 mm Hg	120	121	121	122	123	124	125	80	81	82	83	84	85	85
6	Height (in)	43.3	44	45.2	46.6	48.1	49.4	50.3	43.3	44	45.2	46.6	48.1	49.4	50.3
	Height (cm)	110	111.8	114.9	118.4	122.1	125.6	127.7	110	111.8	114.9	118.4	122.1	125.6	127.7
	50th	92	92	93	94	96	97	97	54	54	55	56	57	58	59
	90th	105	106	107	108	109	110	111	67	67	68	69	70	71	71
	95th	109	109	110	111	112	113	114	70	71	72	72	73	74	74
	95th + 12 mm Hg	121	121	122	123	124	125	126	82	83	84	84	85	86	86
7	Height (in)	45.6	46.4	47.7	49.2	50.7	52.1	53	45.6	46.4	47.7	49.2	50.7	52.1	53
	Height (cm)	115.9	117.8	121.1	124.9	128.8	132.5	134.7	115.9	117.8	121.1	124.9	128.8	132.5	134.7
	50th	92	93	94	95	97	98	99	55	55	56	57	58	59	60
	90th	106	106	107	109	110	111	112	68	68	69	70	71	72	72
	95th	109	110	111	112	113	114	115	72	72	73	73	74	74	75
	95th + 12 mm Hg	121	122	123	124	125	126	127	84	84	85	85	86	86	87

TABLE 5 Continued

Age (y)	BP Percentile	SBP (mm Hg)							DBP (mm Hg)						
		Height Percentile or Measured Height							Height Percentile or Measured Height						
		5%	10%	25%	50%	75%	90%	95%	5%	10%	25%	50%	75%	90%	95%
8	Height (in)	47.6	48.4	49.8	51.4	53	54.5	55.5	47.6	48.4	49.8	51.4	53	54.5	55.5
	Height (cm)	121	123	126.5	130.6	134.7	138.5	140.9	121	123	126.5	130.6	134.7	138.5	140.9
	50th	93	94	95	97	98	99	100	56	56	57	59	60	61	61
	90th	107	107	108	110	111	112	113	69	70	71	72	72	73	73
	95th	110	111	112	113	115	116	117	72	73	74	74	75	75	75
	95th + 12 mm Hg	122	123	124	125	127	128	129	84	85	86	86	87	87	87
9	Height (in)	49.3	50.2	51.7	53.4	55.1	56.7	57.7	49.3	50.2	51.7	53.4	55.1	56.7	57.7
	Height (cm)	125.3	127.6	131.3	135.6	140.1	144.1	146.6	125.3	127.6	131.3	135.6	140.1	144.1	146.6
	50th	95	95	97	98	99	100	101	57	58	59	60	60	61	61
	90th	108	108	109	111	112	113	114	71	71	72	73	73	73	73
	95th	112	112	113	114	116	117	118	74	74	75	75	75	75	75
	95th + 12 mm Hg	124	124	125	126	128	129	130	86	86	87	87	87	87	87
10	Height (in)	51.1	52	53.7	55.5	57.4	59.1	60.2	51.1	52	53.7	55.5	57.4	59.1	60.2
	Height (cm)	129.7	132.2	136.3	141	145.8	150.2	152.8	129.7	132.2	136.3	141	145.8	150.2	152.8
	50th	96	97	98	99	101	102	103	58	59	59	60	61	61	62
	90th	109	110	111	112	113	115	116	72	73	73	73	73	73	73
	95th	113	114	114	116	117	119	120	75	75	76	76	76	76	76
	95th + 12 mm Hg	125	126	126	128	129	131	132	87	87	88	88	88	88	88
11	Height (in)	53.4	54.5	56.2	58.2	60.2	61.9	63	53.4	54.5	56.2	58.2	60.2	61.9	63
	Height (cm)	135.6	138.3	142.8	147.8	152.8	157.3	160	135.6	138.3	142.8	147.8	152.8	157.3	160
	50th	98	99	101	102	104	105	106	60	60	60	61	62	63	64
	90th	111	112	113	114	116	118	120	74	74	74	74	74	75	75
	95th	115	116	117	118	120	123	124	76	77	77	77	77	77	77
	95th + 12 mm Hg	127	128	129	130	132	135	136	88	89	89	89	89	89	89
12	Height (in)	56.2	57.3	59	60.9	62.8	64.5	65.5	56.2	57.3	59	60.9	62.8	64.5	65.5
	Height (cm)	142.8	145.5	149.9	154.8	159.6	163.8	166.4	142.8	145.5	149.9	154.8	159.6	163.8	166.4
	50th	102	102	104	105	107	108	108	61	61	61	62	64	65	65
	90th	114	115	116	118	120	122	122	75	75	75	75	76	76	76
	95th	118	119	120	122	124	125	126	78	78	78	78	79	79	79
	95th + 12 mm Hg	130	131	132	134	136	137	138	90	90	90	90	91	91	91
13	Height (in)	58.3	59.3	60.9	62.7	64.5	66.1	67	58.3	59.3	60.9	62.7	64.5	66.1	67
	Height (cm)	148.1	150.6	154.7	159.2	163.7	167.8	170.2	148.1	150.6	154.7	159.2	163.7	167.8	170.2
	50th	104	105	106	107	108	108	109	62	62	63	64	65	65	66
	90th	116	117	119	121	122	123	123	75	75	75	76	76	76	76
	95th	121	122	123	124	126	126	127	79	79	79	79	80	80	81
	95th + 12 mm Hg	133	134	135	136	138	138	139	91	91	91	91	92	92	93
14	Height (in)	59.3	60.2	61.8	63.5	65.2	66.8	67.7	59.3	60.2	61.8	63.5	65.2	66.8	67.7
	Height (cm)	150.6	153	156.9	161.3	165.7	169.7	172.1	150.6	153	156.9	161.3	165.7	169.7	172.1
	50th	105	106	107	108	109	109	109	63	63	64	65	66	66	66
	90th	118	118	120	122	123	123	123	76	76	76	76	77	77	77
	95th	123	123	124	125	126	127	127	80	80	80	80	81	81	82
	95th + 12 mm Hg	135	135	136	137	138	139	139	92	92	92	92	93	93	94

TABLE 5 Continued

Age (y)	BP Percentile	SBP (mm Hg)							DBP (mm Hg)						
		Height Percentile or Measured Height							Height Percentile or Measured Height						
		5%	10%	25%	50%	75%	90%	95%	5%	10%	25%	50%	75%	90%	95%
15	Height (in)	59.7	60.6	62.2	63.9	65.6	67.2	68.1	59.7	60.6	62.2	63.9	65.6	67.2	68.1
	Height (cm)	151.7	154	157.9	162.3	166.7	170.6	173	151.7	154	157.9	162.3	166.7	170.6	173
	50th	105	106	107	108	109	109	109	64	64	64	65	66	67	67
	90th	118	119	121	122	123	123	124	76	76	76	77	77	78	78
	95th	124	124	125	126	127	127	128	80	80	80	81	82	82	82
	95th + 12 mm Hg	136	136	137	138	139	139	140	92	92	92	93	94	94	94
16	Height (in)	59.9	60.8	62.4	64.1	65.8	67.3	68.3	59.9	60.8	62.4	64.1	65.8	67.3	68.3
	Height (cm)	152.1	154.5	158.4	162.8	167.1	171.1	173.4	152.1	154.5	158.4	162.8	167.1	171.1	173.4
	50th	106	107	108	109	109	110	110	64	64	65	66	66	67	67
	90th	119	120	122	123	124	124	124	76	76	76	77	78	78	78
	95th	124	125	125	127	127	128	128	80	80	80	81	82	82	82
	95th + 12 mm Hg	136	137	137	139	139	140	140	92	92	92	93	94	94	94
17	Height (in)	60.0	60.9	62.5	64.2	65.9	67.4	68.4	60.0	60.9	62.5	64.2	65.9	67.4	68.4
	Height (cm)	152.4	154.7	158.7	163.0	167.4	171.3	173.7	152.4	154.7	158.7	163.0	167.4	171.3	173.7
	50th	107	108	109	110	110	110	111	64	64	65	66	66	66	67
	90th	120	121	123	124	124	125	125	76	76	77	77	78	78	78
	95th	125	125	126	127	128	128	128	80	80	80	81	82	82	82
	95th + 12 mm Hg	137	137	138	139	140	140	140	92	92	92	93	94	94	94

Use percentile values to stage BP readings according to the scheme in Table 3 (elevated BP: ≥90th percentile; stage 1 HTN: ≥95th percentile; and stage 2 HTN: ≥95th percentile + 12 mm Hg). The 50th, 90th, and 95th percentiles were derived by using quantile regression on the basis of normal-weight children (BMI <85th percentile).[77]

The initial BP measurement may be oscillometric (on a calibrated machine that has been validated for use in the pediatric population) or auscultatory (by using a mercury or aneroid sphygmomanometer[86,87]). (Validation status for oscillometric BP devices, including whether they are validated in the pediatric age group, can be checked at www.dableducational.org.) BP should be measured in the right arm by using standard measurement practices unless the child has atypical aortic arch anatomy, such as right aortic arch and aortic coarctation or left aortic arch with aberrant right subclavian artery (see Table 7). Other important aspects of proper BP measurement are illustrated in an AAP video available at http://youtu.be/JLzkNBpqwi0. Care should be taken that providers follow an accurate and consistent measurement technique.[88,89]

An appropriately sized cuff should be used for accurate BP measurement.[83] Researchers in 3 studies in the United Kingdom and 1 in Brazil documented the lack of availability of an appropriately sized cuff in both the inpatient and outpatient settings.[91–94] Pediatric offices should have access to a wide range of cuff sizes, including a thigh cuff for use in children and adolescents with severe obesity. For children in whom the appropriate cuff size is difficult to determine, the midarm circumference (measured as the midpoint between the acromion of the scapula and olecranon of the elbow, with the shoulder in a neutral position and the elbow flexed to 90°[86,95,96]) should be obtained for an accurate determination of the correct cuff size (see Fig 2 and Table 7).[95]

If the initial BP is elevated (≥90th percentile), providers should perform 2 additional oscillometric or auscultatory BP measurements at the same visit and average them. If using auscultation, this averaged measurement is used to determine the child's BP category (ie, normal,

TABLE 6 Screening BP Values Requiring Further Evaluation

Age, y	BP, mm Hg			
	Boys		Girls	
	Systolic	DBP	Systolic	DBP
1	98	52	98	54
2	100	55	101	58
3	101	58	102	60
4	102	60	103	62
5	103	63	104	64
6	105	66	105	67
7	106	68	106	68
8	107	69	107	69
9	107	70	108	71
10	108	72	109	72
11	110	74	111	74
12	113	75	114	75
≥13	120	80	120	80

elevated BP, stage 1 HTN, or stage 2 HTN). If the averaged oscillometric reading is ≥90th percentile, 2 auscultatory measurements should be taken and averaged to define the BP category (see Fig 3).

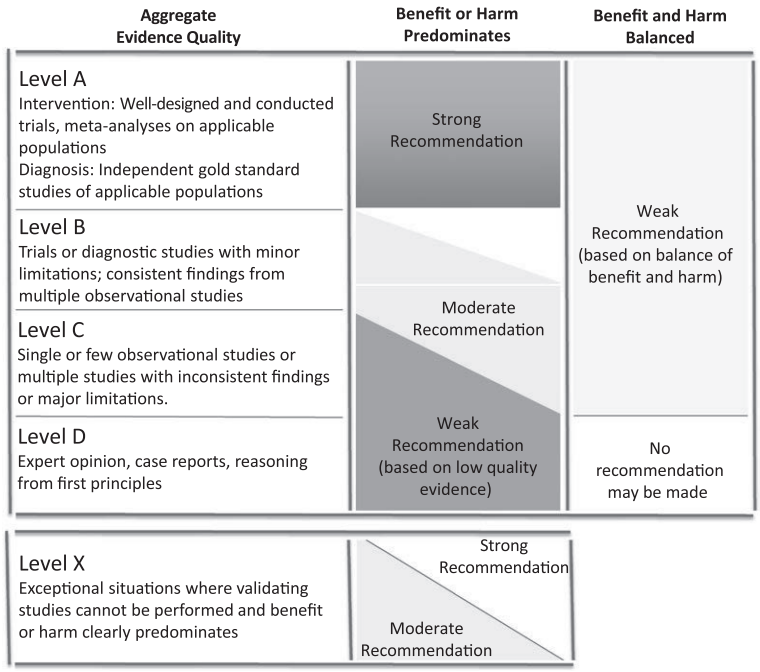


FIGURE 1
AAP grading matrix.

4.1a Measurement of BP in the Neonate

Multiple methods are available for the measurement of BP in hospitalized neonates, including direct intra-arterial measurements using indwelling catheters as well as indirect measurements using the oscillometric technique. In the office, however, the oscillometric technique typically is used at least until the infant is able to cooperate with manual BP determination (which also depends on the ability of the individual measuring the BP to obtain auscultatory BP in infants and toddlers). Normative values for neonatal and infant BP have generally been determined in the right upper arm with the infant supine, and a similar approach should be followed in the outpatient setting.

As with older children, proper cuff size is important in obtaining accurate BP readings in neonates. The cuff bladder length should encircle 80% to 100% of the arm circumference; a cuff bladder with a width-to-arm circumference ratio of 0.45 to 0.55 is recommended.[79,97,98] Offices that will be obtaining BP measurements in neonates need to have a variety of cuff sizes available. In addition, the oscillometric device used should be validated in neonates and programmed to have an initial inflation value appropriate for infants (generally ≤120 mm Hg). Auscultation becomes technically feasible once the infant's upper arm is large enough for the smallest cuff available for auscultatory devices. Measurements are best taken when the infant is in a calm state; multiple readings may be needed if the first

TABLE 7 Best BP Measurement Practices

1. The child should be seated in a quiet room for 3–5 min before measurement, with the back supported and feet uncrossed on the floor.
2. BP should be measured in the right arm for consistency, for comparison with standard tables, and to avoid a falsely low reading from the left arm in the case of coarctation of the aorta. The arm should be at heart level,[90] supported, and uncovered above the cuff. The patient and observer should not speak while the measurement is being taken.
3. The correct cuff size should be used. The bladder length should be 80%–100% of the circumference of the arm, and the width should be at least 40%.
4. For an auscultatory BP, the bell of the stethoscope should be placed over the brachial artery in the antecubital fossa, and the lower end of the cuff should be 2–3 cm above the antecubital fossa. The cuff should be inflated to 20–30 mm Hg above the point at which the radial pulse disappears. Overinflation should be avoided. The cuff should be deflated at a rate of 2–3 mm Hg per second. The first (phase I Korotkoff) and last (phase V Korotkoff) audible sounds should be taken as SBP and DBP. If the Korotkoff sounds are heard to 0 mm Hg, the point at which the sound is muffled (phase IV Korotkoff) should be taken as the DBP, or the measurement repeated with less pressure applied over the brachial artery. The measurement should be read to the nearest 2 mm Hg.
5. To measure BP in the legs, the patient should be in the prone position, if possible. An appropriately sized cuff should be placed midthigh and the stethoscope placed over the popliteal artery. The SBP in the legs is usually 10%–20% higher than the brachial artery pressure.

Adapted from Pickering TG, Hall JE, Appel LJ, et al. Recommendations for blood pressure measurement in humans and experimental animals: part 1: blood pressure measurement in humans: a statement for professionals from the Subcommittee of Professional and Public Education of the American Heart Association Council on High Blood Pressure Research. *Circulation*. 2005;111(5):697–716.

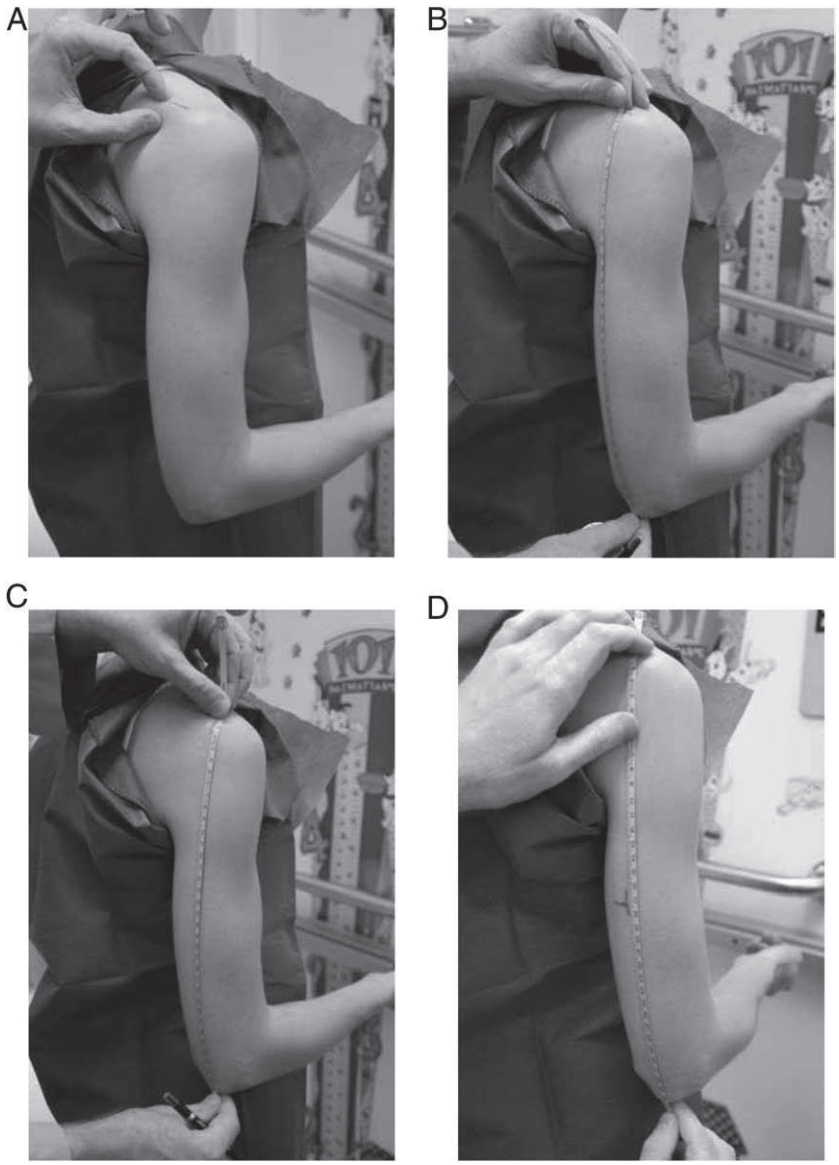


FIGURE 2
Determination of proper BP cuff size.[95] A, Marking spine extending from acromion process. B, Correct tape placement for upper arm length. C, Incorrect tape placement for upper arm length. D, Marking upper arm length midpoint.

reading is elevated, similar to the technique recommended for older children.[99,100]

4.2 BP Measurement Frequency

It remains unclear what age is optimal to begin routine BP measurement in children, although available data suggest that prevention and intervention efforts should begin at a young age.[10,60,101–106] The subcommittee believes that the recommendation to measure BP in the ambulatory setting beginning at 3 years of age should remain unchanged.[1] For otherwise healthy children, however, BP need only be measured annually rather than during every health care encounter.

Some children should have BP measured at every health encounter, specifically those with obesity (BMI ≥95 percentile),[5,27,107–109] renal disease,[46] diabetes,[110,111] aortic arch obstruction or coarctation, or those who are taking medications known to increase BP (see Table 8 and the "Secondary Causes: Medication-related" section of this guideline).[112,113]

Children younger than 3 years should have BP measurements taken at well-child care visits if they are at increased risk for developing HTN (see Table 9).[1]

Key Action Statement 1

BP should be measured annually in children and adolescents ≥3 years of age (grade C, moderate recommendation).

Key Action Statement 2

BP should be checked in all children and adolescents ≥3 years of age at every health care encounter if they have obesity, are taking medications known to increase BP, have renal disease, a history of aortic arch obstruction or coarctation, or diabetes (see Table 9) (grade C, moderate recommendation).

4.3 Patient Management on the Basis of Office BP

4.3a Normal BP

If BP is normal or normalizes after repeat readings (ie, BP <90th percentile), then no additional action is needed. Practitioners should measure the BP at the next routine well-child care visit.

4.3b Elevated BP

1. If the BP reading is at the elevated BP level (Table 3), lifestyle interventions should be recommended (ie, healthy diet, sleep, and physical activity); the measurement should be repeated in 6 months by auscultation. Nutrition and/or weight management referral should be considered as appropriate;
2. If BP remains at the elevated BP level after 6 months, upper and lower extremity BP should be checked (right arm, left arm, and 1 leg), lifestyle counseling should be repeated, and BP should be

Key Action Statement 1. BP should be measured annually in children and adolescents ≥3 years of age (grade C, moderate recommendation).

Aggregate Evidence Quality	Grade C
Benefits	Early detection of asymptomatic HTN; prevention of short- and long-term HTN-related morbidity
Risks, harm, cost	Overtesting, misclassification, unnecessary treatment, discomfort from BP measurement procedure, time involved in measuring BP
Benefit–harm assessment	Benefit of annual BP measurement exceeds potential harm
Intentional vagueness	None
Role of patient preferences	Increased visit time, discomfort of cuff
Exclusions	None
Strength	Moderate recommendation
Key references	10,60,102,103

Key Action Statement 2. BP should be checked in all children and adolescents ≥3 years of age at every health care encounter if they have obesity, are taking medications known to increase BP, have renal disease, a history of aortic arch obstruction or coarctation, or diabetes (see Table 9) (grade C, moderate recommendation).

Aggregate Evidence Quality	Grade C
Benefits	Early detection of HTN and prevention of CV morbidity in predisposed children and adolescents
Risks, harm, cost	Time for and difficulty of conducting measurements
Benefit–harm assessment	Benefits exceed harm
Intentional vagueness	Frequency of evaluation
Role of patient preferences	Increased visit time, discomfort of cuff
Exclusions	Children and adolescents who are not at increased risk for HTN
Strength	Moderate recommendation
Key references	27,46,107,110–112

rechecked in 6 months (ie, at the next well-child care visit) by auscultation;

3. If BP continues at the elevated BP level after 12 months (eg, after 3 auscultatory measurements), ABPM should be ordered (if available), and diagnostic evaluation should be conducted (see Table 10 for a list of screening tests and the populations in which they should be performed). Consider subspecialty referral (ie, cardiology or nephrology) (see Table 11); and
4. If BP normalizes at any point, return to annual BP screening at well-child care visits.

4.3c Stage 1 HTN

1. If the BP reading is at the stage 1 HTN level (Table 3) and the patient is asymptomatic, provide lifestyle counseling and recheck the BP in 1 to 2 weeks by auscultation;
2. If the BP reading is still at the stage 1 level, upper and lower extremity BP should be checked (right arm, left arm, and 1 leg), and BP should be rechecked in 3 months by auscultation. Nutrition and/or weight management referral should be considered as appropriate; and
3. If BP continues to be at the stage 1 HTN level after 3 visits, ABPM should be ordered (if available), diagnostic evaluation should be conducted, and treatment should be initiated. Subspecialty referral should be considered (see Table 11).

4.3d Stage 2 HTN

1. If the BP reading is at the stage 2 HTN level (Table 3), upper and lower extremity BP should be checked (right arm, left arm, and 1 leg), lifestyle recommendations given, and the BP measurement should be repeated within 1 week. Alternatively, the patient could be referred to subspecialty care within 1 week;
2. If the BP reading is still at the stage 2 HTN level when repeated, then diagnostic evaluation, including ABPM, should be conducted and treatment should be initiated, or the patient should

TABLE 8 Common Pharmacologic Agents Associated With Elevated BP in Children

Over-the-counter drugs	Decongestants
	Caffeine
	Nonsteroidal anti-inflammatory drugs
	Alternative therapies, herbal and nutritional supplements
Prescription drugs	Stimulants for attention-deficit/hyperactivity disorder
	Hormonal contraception
	Steroids
	Tricyclic antidepressants
Illicit drugs	Amphetamines
	Cocaine

Adapted from the Fourth Report.[1]

TABLE 9 Conditions Under Which Children Younger Than 3 Years Should Have BP Measured

History of prematurity <32 week's gestation or small for gestational age, very low birth weight, other neonatal complications requiring intensive care, umbilical artery line
Congenital heart disease (repaired or unrepaired)
Recurrent urinary tract infections, hematuria, or proteinuria
Known renal disease or urologic malformations
Family history of congenital renal disease
Solid-organ transplant
Malignancy or bone marrow transplant
Treatment with drugs known to raise BP
Other systemic illnesses associated with HTN (neurofibromatosis, tuberous sclerosis, sickle cell disease,[114] etc)
Evidence of elevated intracranial pressure

Adapted from Table 3 in the Fourth Report.[1]

Key Action Statement 3. Trained health care professionals in the office setting should make a diagnosis of HTN if a child or adolescent has auscultatory-confirmed BP readings ≥95th percentile on 3 different visits (grade C, moderate recommendation).

Aggregate Evidence Quality	Grade C
Benefits	Early detection of HTN; prevention of CV morbidity in predisposed children and adolescents; identification of secondary causes of HTN
Risks, harm, cost	Overtesting, misclassification, unnecessary treatment, discomfort from BP measurement, time involved in taking BP
Benefit–harm assessment	Benefits of repeated BP measurement exceeds potential harm
Intentional vagueness	None
Role of patient preferences	Families may have varying levels of concern about elevated BP readings and may request evaluation on a different time line
Exclusions	None
Strength	Moderate recommendation
Key references	8,84,85

be referred to subspecialty care within 1 week (see Table 11); and

3. If the BP reading is at the stage 2 HTN level and the patient is symptomatic, or the BP is >30 mm Hg above the 95th percentile (or >180/120 mm Hg in an adolescent), refer to an immediate source of care, such as an emergency department (ED).

Key Action Statement 3

Trained health care professionals in the office setting should make a diagnosis of HTN if a child or adolescent has auscultatory-confirmed BP readings ≥95th percentile on 3 different visits (grade C, moderate recommendation).

4.4 Use of Electronic Health Records

Studies have demonstrated that primary care providers frequently fail to measure BP and often underdiagnose HTN.[85,115,116] One analysis using nationally representative survey data found that providers measured BP at only 67% of preventive visits for children 3 to 18 years of age. Older children and children with overweight or obesity were more likely to be screened.[117] In a large cohort study of 14 187 children, 507 patients met the criteria for HTN, but only 131 (26%) had the diagnosis documented in their electronic health records (EHRs). Elevated BP was only recognized in 11% of cases.[7]

It is likely that the low rates of screening and diagnosis of pediatric HTN are related, at least in part, to the need to use detailed reference tables incorporating age, sex, and height to classify BP levels.[118] Studies have shown that using health information technology can increase adherence to clinical guidelines and improve practitioner performance.[119–121] In fact, applying decision support in conjunction with an EHR in adult populations has also been associated with improved BP screening, recognition, medication prescribing, and control; pediatric data are limited, however.[122–125] Some studies failed to show improvement in BP screening or control,[122,126] but given the inherent complexity in the interpretation of pediatric BP measurements, EHRs should be designed to flag abnormal values both at the time of measurement and on entry into the EHR.

Key Action Statement 4. Organizations with EHRs used in an office setting should consider including flags for abnormal BP values both when the values are being entered and when they are being viewed (grade C, weak recommendation).

Aggregate Evidence Quality	Grade C
Benefits	Improved rate of screening and recognition of elevated BP
Risks, harm, cost	Cost of EHR development, alert fatigue
Benefit–harm assessment	Benefit of EHR flagging of elevated BP outweighs harm from development cost and potential for alert fatigue
Intentional vagueness	None
Role of patient preferences	None
Exclusions	None
Strength	Weak recommendation (because of a lack of pediatric data)
Key references	7,117,120,125

Key Action Statement 4

Organizations with EHRs used in an office setting should consider including flags for abnormal BP values both when the values are being entered and when they are being viewed (grade C, weak recommendation).

4.5 Oscillometric Versus Auscultatory (Manual) BP Measurement

Although pediatric normative BP data are based on auscultatory measurements, oscillometric BP devices have become commonplace in health care settings.[127] Ease of use, a lack of digit preference, and automation are all perceived benefits of using oscillometric devices. Unlike auscultatory measurement, however, oscillometric devices measure the oscillations transmitted from disrupted arterial flow by using the cuff as a transducer to determine mean arterial pressure (MAP). Rather than directly measuring any pressure that correlates to SBP or DBP, the device uses a proprietary algorithm to calculate these values from the directly measured MAP.[127] Because the algorithms vary for different brands of oscillometric devices, there is no standard oscillometric BP.[128]

Researchers in several studies have evaluated the accuracy of oscillometric devices[127,129–134] and compared auscultatory and

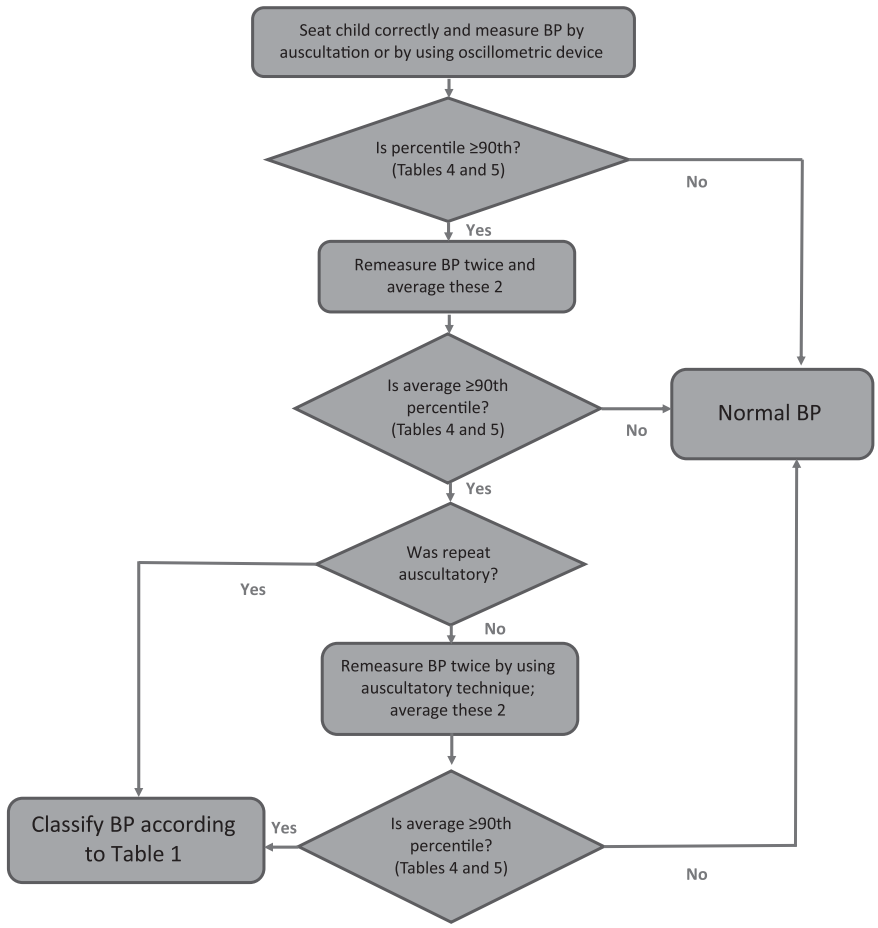


FIGURE 3
Modified BP measurement algorithm.

oscillometric readings' ability to predict target organ damage.[135] These studies demonstrated that oscillometric devices systematically overestimate SBP and DBP compared with values obtained by auscultation.[129,133] BP status potentially can be misclassified because of the different values obtained by these 2 methods, which may be magnified in the office setting.[86,88,129] Target organ damage (such as increased LV mass and elevated PWV) was best predicted by BPs obtained by auscultation.[135]

A major issue with oscillometric devices is that there appears to be great within-visit variation with inaccurately high readings obtained on initial measurement.[136] An elevated initial oscillometric reading should be ignored and repeat measures averaged to approximate values obtained by auscultation.

TABLE 10 Screening Tests and Relevant Populations

Patient Population	Screening Tests
All patients	Urinalysis
	Chemistry panel, including electrolytes, blood urea nitrogen, and creatinine
	Lipid profile (fasting or nonfasting to include high-density lipoproteina and total cholesterol)
	Renal ultrasonography in those <6 y of age or those with abnormal urinalysis or renal function
In the obese (BMI >95th percentile) child or adolescent, in addition to the above	Hemoglobin A1c (accepted screen for diabetes)
	Aspartate transaminase and alanine transaminase (screen for fatty liver)
	Fasting lipid panel (screen for dyslipidemia)
Optional tests to be obtained on the basis of history, physical examination, and initial studies	Fasting serum glucose for those at high risk for diabetes mellitus
	Thyroid-stimulating hormone
	Drug screen
	Sleep study (if loud snoring, daytime sleepiness, or reported history of apnea)
	Complete blood count, especially in those with growth delay or abnormal renal function

Adapted from Wiesen J, Adkins M, Fortune S, et al. Evaluation of pediatric patients with mild-to-moderate hypertension: yield of diagnostic testing. *Pediatrics*. 2008;122(5). Available at: www.pediatrics.org/cgi/content/full/122/5/e988.

Key Action Statement 5

Oscillometric devices may be used for BP screening in children

TABLE 11 Patient Evaluation and Management According to BP Level

BP Category (See Table 3)	BP Screening Schedule	Lifestyle Counseling (Weight and Nutrition)	Check Upper and Lower Extremity BP	ABPM[a]	Diagnostic Evaluation[b]	Initiate Treatment[c]	Consider Subspecialty Referral
Normal	Annual	X	—	—	—	—	—
Elevated BP	Initial measurement	X	—	—	—	—	—
	Second measurement: repeat in 6 mo	X	X	—	—	—	—
	Third measurement: repeat in 6 mo	X	—	X	X	—	X
Stage 1 HTN	Initial measurement	X	—	—	—	—	—
	Second measurement: repeat in 1–2 wk	X	X	—	—	—	—
	Third measurement: repeat in 3 mo	X	—	X	X	X	X
Stage 2 HTN[d]	Initial measurement	X	X	—	—	—	—
	Second measurement: repeat, refer to specialty care within 1 wk	X	—	X	X	X	X

X, recommended intervention; —, not applicable.
[a] ABPM is done to confirm HTN before initiating a diagnostic evaluation.
[b] See Table 15 for recommended studies.
[c] Treatment may be initiated by a primary care provider or subspecialist.
[d] If the patient is symptomatic or BP is >30 mm Hg above the 95th percentile (or >180/120 mm Hg in an adolescent), send to an ED.

and adolescents. When doing so, providers should use a device that has been validated in the pediatric age group. If elevated BP is suspected on the basis of oscillometric readings, confirmatory measurements should be obtained by auscultation (grade B, strong recommendation).

4.6 Forearm and/or Wrist BP Measurement

Wrist monitors have several potential advantages when compared with arm devices. They are smaller; they can be placed more easily; and, because wrist diameter is less affected by BMI, they do not need to be modified for patients with obesity.[83,137] Several studies in adults have found excellent reproducibility of wrist BP measurements, equivalence to readings obtained by mercury sphygmomanometers or ABPM, and better correlation with left ventricular mass index (LVMI) than systolic office BP.[138,139]

Although many wrist devices have been validated in adults,[140–142] some studies have shown greater variation and decreased accuracy in the resulting measurements.[143–146] These negative outcomes may possibly result from differences in the number of measurements taken,[139] the position of the wrist in relation to the heart,[147] flexion or extension of the wrist during measurement,[148] or differences in pulse pressure.[149] Technologies are being developed to help standardize wrist position.[150,151]

Few studies using wrist monitors have been conducted in children. One study in adolescents compared a wrist digital monitor with a mercury sphygmomanometer and found high agreement between systolic measurements but lower agreement for diastolic measurements, which was clinically relevant.[152] Researchers in 2 small studies conducted in PICUs compared wrist monitors with indwelling arterial lines and found good agreement between the 2 measurement modalities.[153,154] No large comparative studies or formal validation studies of wrist monitors have been conducted in children, however. Because of limited data, the use of wrist and forearm monitors is not recommended in the diagnosis or

Key Action Statement 5. Oscillometric devices may be used for BP screening in children and adolescents. When doing so, providers should use a device that has been validated in the pediatric age group. If elevated BP is suspected on the basis of oscillometric readings, confirmatory measurements should be obtained by auscultation (grade B, strong recommendation).

Aggregate Evidence Quality	Grade B
Benefits	Use of auscultatory readings prevents potential misclassification of patients as hypertensive because of inaccuracy of oscillometric devices
Risks, harm, cost	Auscultation requires more training and experience and has flaws such as digit preference
Benefit–harm assessment	Benefit exceeds harm
Intentional vagueness	None
Role of patient preferences	Patients may prefer the convenience of oscillometric monitors
Exclusions	None
Strength	Strong recommendation
Key references	86,88,128–136

TABLE 12 High-Risk Conditions for Which ABPM May Be Useful

Condition	Rationale
Secondary HTN	Severe ambulatory HTN or nocturnal HTN indicates higher likelihood of secondary HTN[161,167]
CKD or structural renal abnormalities	Evaluate for MH or nocturnal HTN,[168–172] better control delays progression of renal disease[173]
T1DM and T2DM	Evaluate for abnormal ABPM patterns,[174,175] better BP control delays the development of MA[176–178]
Solid-organ transplant	Evaluate for MH or nocturnal HTN, better control BP[179–188]
Obesity	Evaluate for WCH and MH[23,189–192]
OSAS	Evaluate for nondipping and accentuated morning BP surge[43,46,193,194]
Aortic coarctation (repaired)	Evaluate for sustained HTN and MH[58,112,113]
Genetic syndromes associated with HTN (neurofibromatosis, Turner syndrome, Williams syndrome, coarctation of the aorta)	HTN associated with increased arterial stiffness may only be manifest with activity during ABPM[58,195]
Treated hypertensive patients	Confirm 24-h BP control[155]
Patient born prematurely	Evaluate for nondipping[196]
Research, clinical trials	To reduce sample size[197]

TABLE 13 Recommended Procedures for the Application of ABPM

Procedure	Recommendation
Device	Should be validated by the Association for the Advancement of Medical Instrumentation or the British Hypertension Society for use in children
	May be oscillometric or auscultatory
Application	Trained personnel should apply the monitor
	Correct cuff size should be selected
	Right and left arm and a lower extremity BP should be obtained to rule out coarctation of the aorta
	Use nondominant arm unless there is large difference in size between the left arm and right arm, then apply to the arm with the higher BP
	Take readings every 15–20 min during the day and every 20–30 min at night
	Compare (calibrate) the device to resting BP measured by the same technique (oscillometric or auscultatory)
	Record time of medications, activity, and sleep
Assessment	A physician who is familiar with pediatric ABPM should interpret the results
	Interpret only recordings of adequate quality. Minimum of 1 reading per hour, 40–50 for a full day, 65%–75% of all possible recordings
	Edit outliers by inspecting for biologic plausibility, edit out calibration measures
	Calculate mean BP, BP load (% of readings above threshold), and dipping (% decline in BP from wake to sleep)
	Interpret with pediatric ABPM normal data by sex and height
	Use AHA staging schema[155]
	Consider interpretation of 24-h, daytime, and nighttime MAP, especially in patients with CKD[173,198]

Adapted from Flynn JT, Daniels SR, Hayman LL, et al; American Heart Association Atherosclerosis, Hypertension and Obesity in Youth Committee of the Council on Cardiovascular Disease in the Young. Update: ambulatory blood pressure monitoring in children and adolescents: a scientific statement from the American Heart Association. *Hypertension.* 2014;63(5):1116–1135.

management of HTN in children and adolescents at this time.

4.7 ABPM

An ambulatory BP monitor consists of a BP cuff attached to a box slightly larger than a cell phone, which records BP periodically (usually every 20–30 minutes) throughout the day and night; these data are later downloaded to a computer for analysis.[155]

ABPM has been recommended by the US Preventive Services Task Force for the confirmation of HTN in adults before starting treatment.[156] Although a growing number of pediatric providers have access to ABPM, there are still gaps in access and knowledge regarding the optimal application of ABPM to the evaluation of children's BP.[155,157] For example, there are currently no reference data for children whose height is <120 cm. Because no outcome data exist linking ABPM data from childhood to hard CV events in adulthood, recommendations either rely largely on surrogate outcome markers or are extrapolated from adult studies.

However, sufficient data exist to demonstrate that ABPM is more accurate for the diagnosis of HTN than clinic-measured BP,[158,159] is more predictive of future BP,[160] and can assist in the detection of secondary HTN.[161] Furthermore, increased LVMI and LVH correlate more strongly with ABPM parameters than casual BP.[162–166] In addition, ABPM is more reproducible than casual or home BP measurements.[159] For these reasons, the routine application of ABPM is recommended, when available, as indicated below (see also Tables 12 and 13). Obtaining ABPM may require referral to a specialist.

Key Action Statement 6

ABPM should be performed for the confirmation of HTN in children

and adolescents with office BP measurements in the elevated BP category for 1 year or more or with stage 1 HTN over 3 clinic visits (grade C, moderate recommendation).

For technical reasons, ABPM may need to be limited to children ≥5 years of age who can tolerate the procedure and those for whom reference data are available.

Key Action Statement 7

The routine performance of ABPM should be strongly considered in children and adolescents with high-risk conditions (see Table 12) to assess HTN severity and determine if abnormal circadian BP patterns are present, which may indicate increased risk for target organ damage (grade B, moderate recommendation).

Key Action Statement 8

ABPM should be performed by using a standardized approach (see Table 13) with monitors that have been validated in a pediatric population, and studies should be interpreted by using pediatric normative data (grade C, moderate recommendation).

4.7a Masked Hypertension

MH occurs when patients have normal office BP but elevated BP on ABPM, and it has been found in 5.8% of unselected children studied by ABPM.[199] There is growing evidence that compared with those with normal 24-hour BP, these patients have significant risk for end organ hypertensive damage.[200,203] Patients who are at risk of MH include patients with obesity and secondary forms of HTN, such as CKD or repaired aortic coarctation. MH is particularly prevalent in patients with CKD[48] and is associated with target organ damage.[203] Children with CKD should be periodically evaluated using ABPM for MH as part of routine CKD management.[201,204–206]

4.7b White Coat Hypertension

WCH is defined as BP ≥95th percentile in the office or clinical setting but <95th percentile outside of the office or clinical setting. WCH is diagnosed by ABPM when the mean SBP and DBP are <95th percentile and SBP and DBP load are <25%; load is defined as the percentage of valid ambulatory BP measurements above a set threshold value (eg, 95th percentile) for age, sex, and height.[155,156,206] It is estimated that up to half of children who are evaluated for elevated office BP have WCH.[207,208]

In adults, compared with normotension, WCH is associated with only a slightly increased risk of adverse outcomes but at a much lower risk compared with those with established HTN.[209] Most (but not all) studies suggest that WCH is not associated with increased LV mass.[200,207,210] Although the distinction between WCH and true HTN is important, abnormal BP response to exercise and increased LVM has been found to occur in children with WCH.[207] Furthermore, the identification of WCH may reduce costs by reducing the number of additional tests performed and decreasing the number of children who are exposed to antihypertensive medications.[208] Children and adolescents with WCH should have screening BP measured at regular well-child care visits with consideration of a repeat ABPM in 1 to 2 years.

Key Action Statement 9

Children and adolescents with suspected WCH should undergo ABPM. Diagnosis is based on the presence of mean SBP and DBP <95th percentile and SBP and DBP load <25% (grade B, strong recommendation).

4.8 Measurement in Children With Obesity

Accurate BP measurement can be challenging in individuals with obesity. [23,211,212] Elevated BMI in children and adolescents is associated with an increase in the midarm circumference,[96] requiring the use of a larger cuff to obtain accurate BP measurements.[83] During NHANES 2007–2010, among children 9 to 11 years of age with obesity, one-third of boys and one-quarter of girls required an adult BP cuff, and a fraction required a large adult cuff or an adult thigh cuff for an accurate measurement of BP.[213] Researchers in studies of adults have also noted the influence of the conical upper arm shape on BP measurements in people with obesity.[214,215] ABPM is a valuable tool in the diagnosis of HTN in children with obesity because of the discrepancies between casual and

Key Action Statement 6. ABPM should be performed for the confirmation of HTN in children and adolescents with office BP measurements in the elevated BP category for 1 year or more or with stage 1 HTN over 3 clinic visits (grade C, moderate recommendation).

Aggregate Evidence Quality	Grade C
Benefits	Avoids unnecessarily exposing youth with WCH to extensive diagnostic testing or medication
Risks, harm, cost	Risk of discomfort to patient. Some insurance plans may not reimburse for the test
Benefit–harm assessment	The risk of ABPM is lower than the risk of unnecessary treatment. The use of ABPM has also been shown to be more cost-effective than other approaches to diagnosing HTN
Intentional vagueness	None
Role of patient preferences	Some patients may prefer repeat office or home measurements to ABPM
Exclusions	None
Strength	Moderate recommendation
Key references	23,155,158,159

Key Action Statement 7. The routine performance of ABPM should be strongly considered in children and adolescents with high-risk conditions (see Table 12) to assess HTN severity and determine if abnormal circadian BP patterns are present, which may indicate increased risk for target organ damage (grade B, moderate recommendation).

Aggregate Evidence Quality	Grade B
Benefits	Improved 24-h control of BP improves outcomes. Recognition of MH or nocturnal HTN might lead to therapeutic changes that will limit end organ damage
Risks, harm, cost	Risk of discomfort to patient. Some insurance plans may not reimburse for the test. The risk of diagnosing and labeling a patient as having MH or nocturnal HTN might lead to increased anxiety and cost of evaluation
Benefit–harm assessment	The risk of ABPM is much lower than the risk of inadequate treatment
Intentional vagueness	Frequency at which normal or abnormal ABPM should be repeated is not known
Role of patient preferences	Some patients may prefer repeat office or home measurements to ABPM
Exclusions	None
Strength	Moderate recommendation
Key references	47,155,199–202

Key Action Statement 8. ABPM should be performed by using a standardized approach (see Table 13) with monitors that have been validated in a pediatric population, and studies should be interpreted by using pediatric normative data (grade C, moderate recommendation).

Aggregate Evidence Quality	Grade C
Benefits	Validated monitors applied and interpreted correctly will provide the most accurate results
Risks, harm, cost	Risk of discomfort to patient. Some insurance plans may not reimburse for the test. Monitors validated in the pediatric population and expertise in reading pediatric ABPM may not be universally available
Benefit–harm assessment	There is substantial evidence showing incorrect application or interpretation reduces the accuracy of results
Intentional vagueness	None
Role of patient preferences	Some patients may prefer repeat office or home measurements to ABPM
Exclusions	None
Strength	Moderate recommendation
Key references	155

ambulatory BP[23,33] and the higher prevalence of MH.[26,29,155,216,217]

4.9. At-Home Measurement

Home measurement (or self-monitoring) of BP has advantages over both office and ambulatory monitoring, including convenience and the ability to obtain repeated measurements over time.[83,218] Furthermore, automated devices with memory capacity are straightforward to use and avoid potential problems, such as observer bias, inaccurate reporting, and terminal digit preference (ie, overreporting of certain digits, like 0, as the terminal digit in recording BP).[219,220]

Numerous studies have shown that it is feasible for families to conduct repeated measurements at home.[221–223] Home BP measurements appear to be more reproducible than those conducted in the office, likely because of the familiarity of the home environment and greater comfort with repeated measurements.[159,223,224] Inaccuracies occur when measurements obtained at home are either excluded or inappropriately recorded.[219] Inconsistencies in home, office, and ambulatory BP measurements seem to be influenced by both age and HTN status, with ABPM tending to be higher than home BP measurements in children.[222,225–227] Home BP measurements show no consistent pattern when compared with office measurements.[228–230]

There are several practical concerns with the use of home BP measurement, however. The only normative data available are from the relatively small Arsakeion School study.[231] In addition, only a few automated devices have been validated for use in the pediatric population, and available cuff sizes for them are limited. Furthermore, there is no consensus regarding how many home measurements across what period of time are needed to evaluate BP.

Key Action Statement 10

Home BP monitoring should not be used to diagnose HTN, MH, or WCH but may be a useful adjunct to office and ambulatory BP measurement after HTN has been diagnosed (grade C, moderate recommendation).

4.10 School Measurement and the Role of School-Based Health Professionals

There is limited evidence to support school-based measurement of children's BP.[8,232] Observational studies demonstrate that school measurements can be reliable[233] and that longitudinal follow-up is feasible.[8,232,234] Available data do not distinguish between the efficacy of school-based screening programs in which measurements are obtained by trained clinical personnel (not a school nurse) versus measurements obtained by the school nurse. Because of insufficient evidence and a lack of established protocols, the routine use of school-based measurements to diagnose HTN cannot be recommended. However, school-based BP measurement can be a useful tool to identify children who require formal evaluation as well as a helpful adjunct in the monitoring of diagnosed HTN. Note: School-based health clinics are considered part of

Key Action Statement 9. Children and adolescents with suspected WCH should undergo ABPM. Diagnosis is based on the presence of mean SBP and DBP <95th percentile and SBP and DBP load <25% (grade B, strong recommendation).

Aggregate Evidence Quality	Grade B (Evidence Level A in Adults)
Benefits	Improved diagnosis of WCH and the benefit of fewer additional laboratory tests and/or treatment of primary HTN. Costs might be reduced if the treatment of those misdiagnosed as hypertensive is prevented
Risks, harm, cost	Additional costs; costs may not be covered by insurance companies. The ambulatory BP monitor is uncomfortable for some patients
Benefit–harm assessment	Benefit exceeds risk
Intentional vagueness	None
Role of patient preferences	Important; some patients may not want to undergo ABPM. Benefits of the procedure should be reviewed with families to assist in decision-making
Exclusions	None
Strength	Strong recommendation
Key references	206

Key Action Statement 10. Home BP monitoring should not be used to diagnose HTN, MH, or WCH but may be a useful adjunct to office and ambulatory BP measurement after HTN has been diagnosed (grade C, moderate recommendation).

Aggregate Evidence Quality	Grade C
Benefits	Convenient, cost-effective, widely available, can be used over time
Risks, harm, cost	Risk of inaccurate diagnosis. Unclear what norms or schedule should be used. Few validated devices in children, and cuff sizes are limited
Benefit–harm assessment	Benefits outweigh harm when used as an adjunctive measurement technique
Intentional vagueness	None
Role of patient preferences	Patients may find home BP more convenient and accessible than office or ambulatory BP
Exclusions	None
Strength	Moderate recommendation
Key references	159,221–225,227,230

systems of pediatric primary care, and these comments would not apply to them.

5. PRIMARY AND SECONDARY CAUSES OF HTN

5.1 Primary HTN

Primary HTN is now the predominant diagnosis for hypertensive children and adolescents seen in referral centers in the United States,[235,236] although single-center studies from outside the United States still find primary HTN to be uncommon.[237] Although prospective, multicenter studies are generally lacking, at least one large study in which researchers used insurance claims data confirmed that primary HTN is significantly more common than secondary HTN among American youth.[238]

General characteristics of children with primary HTN include older age (≥6 years),[239,240] positive family history (in a parent and/or grandparent) of HTN,[236,237,240] and overweight and/or obesity.[16,236,237,239] Severity of BP elevation has not differed significantly between children with primary and secondary HTN in some studies,[235,237] but DBP elevation appears to be more predictive of secondary HTN,[239,240] whereas systolic HTN appears to be more predictive of primary HTN.[236,239]

Key Action Statement 11

Children and adolescents ≥6 years of age do not require an extensive evaluation for secondary causes of HTN if they have a positive family history of HTN, are overweight or obese, and/or do not have history or physical examination findings (Table 14) suggestive of a secondary cause of HTN (grade C, moderate recommendation).

5.2 Secondary Causes: Renal and/or Renovascular

Renal disease and renovascular disease are among the most common secondary causes of HTN in children. Renal parenchymal disease and renal structural abnormalities accounted for 34% to 79% of patients with secondary HTN in 3 retrospective, single-center case series, and renovascular disease was present in 12% to 13%.[101,240,241] The literature suggests that renal disease is a more common cause of HTN in younger children.[239] Renal disorders (including vascular problems) accounted for 63% to 74% of children <6 years of age who were enrolled in 3 recent clinical trials of angiotensin receptor blockers (ARBs).[239,242–244] No increased frequency was seen in younger patients in a recent single-center case series, however.[101] It is appropriate to have a high index of suspicion for renal and renovascular disease in hypertensive pediatric patients, particularly in those <6 years of age.

5.3 Secondary Causes: Cardiac, Including Aortic Coarctation

Coarctation of the aorta is a congenital abnormality of the aortic arch characterized by discrete narrowing of the aortic arch, generally at the level of the aortic isthmus. It is usually associated with HTN and right arm BP that is 20 mm Hg (or more) greater than the lower extremity BP. Repair in infants is often surgical; adolescents may be treated with angioplasty or stenting. Long-segment narrowing of the abdominal aorta can also cause HTN and should be considered in children with refractory

Key Action Statement 11. Children and adolescents ≥6 years of age do not require an extensive evaluation for secondary causes of HTN if they have a positive family history of HTN, are overweight or obese, and/or do not have history or physical examination findings (Table 14) suggestive of a secondary cause of HTN (grade C, moderate recommendation).

Aggregate Evidence Quality	Grade C
Benefits	Avoidance of unnecessary diagnostic evaluation
Risks, harm, cost	Potential to miss some children with secondary HTN
Benefit–harm assessment	Benefit equals harm
Intentional vagueness	Not applicable
Role of patient preferences	Some families may want further testing performed
Exclusions	Hypertensive children <6 y of age
Strength	Moderate recommendation
Key references	16,129,235–240

HTN and a gradient between the upper and lower extremities in which the upper extremity SBP exceeds the lower extremity SBP by 20 mm Hg.[245] Of note, children with abdominal aortic obstruction may have neurofibromatosis, Williams syndrome, Alagille syndrome, or Takayasu arteritis.

Patients with coarctation can remain hypertensive or develop HTN even after early and successful repair, with reported prevalence varying from 17% to 77%.[112] HTN can be a manifestation of recoarctation. Recoarctation in repaired patients should be assessed for by using 4 extremity BP measurements and echocardiography. HTN can also occur without recoarctation.[246] The prevalence of HTN increases over time after successful coarctation repair.[112]

Routine office BP measurement alone is often insufficient for diagnosing HTN after coarctation repair.[113,246] Children who have undergone coarctation repair may have normal in-office BP but high BP out of the office, which is consistent with MH.[58,112] Of children with a history of aortic coarctation, ~45% have MH at ~1 to 14 years after coarctation repair.[58,113] Children with a history of repaired aortic coarctation and normal in-office BP are at risk for LVH,[58] HTN, and MH.[58,112]

ABPM has emerged as the gold standard for diagnosing HTN among individuals who have undergone coarctation repair, and it is likely more useful than casual BP.[58,245–247] Screening is recommended as a part of usual care on an annual basis beginning, at most, 12 years after coarctation repair. Earlier screening may be considered on the basis of risk factors and clinician discretion.

Key Action Statement 12

Children and adolescents who have undergone coarctation repair should undergo ABPM for the detection of HTN (including MH) (grade B, strong recommendation).

5.4 Secondary Causes: Endocrine HTN

HTN resulting from hormonal excess accounts for a relatively small proportion of children with secondary HTN. Although rare (with a prevalence ranging from 0.05% to 6% in children[101,237,239,240]), an accurate diagnosis of endocrine HTN provides the clinician with a unique treatment opportunity to render a surgical cure or achieve a dramatic response with pharmacologic therapy.[248] Known endocrine causes with associated molecular defects (when known) are summarized in Table 15.

5.5 Secondary Causes: Environmental Exposures

Several environmental exposures have been associated with higher childhood BP, although most studies are limited to small case series. Among the most prominent are lead, cadmium, mercury, and phthalates.

- Lead: Long-term exposure to lead in adults has been associated with higher BP in population studies[295,296] and in studies of industrial workers with high lead exposure,[297] although findings have not been consistent.[298] At least 1 cross-sectional study of 122 children demonstrated that children with higher blood lead concentrations had higher BP; lower socioeconomic status was also seen in this group, which may have confounded the BP results.[299] Furthermore, in a randomized study of lead-exposed children, those who received chelation with succimer did not have lower BP than in those who received a placebo.[300]
- Cadmium: Environmental cadmium exposure has been linked to higher BP levels and the development of HTN in adults, particularly among women.[296,301–303] Although cross-sectional studies have

Key Action Statement 12. Children and adolescents who have undergone coarctation repair should undergo ABPM for the detection of HTN (including MH) (grade B, strong recommendation).

Aggregate Evidence Quality	Grade B (Aggregate Level of Evidence Equals B, Given 3 Studies With Similar Findings)
Benefits	Early detection of HTN
Risks, harm, cost	Additional costs related to the placement of ABPM
Benefit–harm assessment	Benefits exceed harms
Intentional vagueness	Frequency of measurement. Because the development of HTN after coarctation repair is influenced by many factors, the ideal onset of screening for HTN (including MH) is unknown
Role of patient preferences	None
Exclusions	Individuals with a history of residual aortic arch obstruction
Strength	Strong recommendation
Key references	58,112,113

TABLE 14 Examples of Physical Examination Findings and History Suggestive of Secondary HTN or Related to End Organ Damage Secondary to HTN

Body System	Finding, History	Possible Etiology
Vital signs	Tachycardia	Hyperthyroidism
		PCC
		Neuroblastoma
	Decreased lower extremity pulses; drop in BP from upper to lower extremities	Coarctation of the aorta
Eyes	Proptosis	Hyperthyroidism
	Retinal changes[a]	Severe HTN, more likely to be associated with secondary HTN
Ear, nose, throat	Adenotonsillar hypertrophy	SDB
	History of snoring	Sleep apnea
Height, weight	Growth retardation	Chronic renal failure
	Obesity (high BMI)	Cushing syndrome
	Truncal obesity	Insulin resistance syndrome
Head, neck	Elfin facies	Williams syndrome
	Moon facies	Cushing syndrome
	Thyromegaly, goiter	Hyperthyroidism
	Webbed neck	Turner syndrome
Skin	Pallor, flushing, diaphoresis	PCC
	Acne, hirsutism, striae	Cushing syndrome
		Anabolic steroid abuse
	Café-au-lait spots	Neurofibromatosis
	Adenoma sebaceum	Tuberous sclerosis
	Malar rash	Systemic lupus
	Acanthosis nigricans	T2DM
Hematologic	Pallor	Renal disease
	Sickle cell anemia	
Chest, cardiac	Chest pain	Heart disease
	Palpitations	
	Exertional dyspnea	
	Widely spaced nipples	Turner syndrome
	Heart murmur	Coarctation of the aorta
	Friction rub	Systemic lupus (pericarditis)
		Collagen vascular disease
	Apical heave[a]	LVH
Abdomen	Abdominal mass	Wilms tumor
		Neuroblastoma
		PCC
	Epigastric, flank bruit	RAS
	Palpable kidneys	Polycystic kidney disease
		Hydronephrosis
		Multicystic dysplastic kidney
Genitourinary	Ambiguous or virilized genitalia	Congenital adrenal hyperplasia
	Urinary tract infection	Renal disease
	Vesicoureteral reflux	
	Hematuria, edema, fatigue	
	Abdominal trauma	
Extremities	Joint swelling	Systemic lupus
		Collagen vascular disease
	Muscle weakness	Hyperaldosteronism
		Liddle syndrome
Neurologic, metabolic	Hypokalemia, headache, dizziness, polyuria, nocturia	Reninoma
	Muscle weakness, hypokalemia	Monogenic HTN (Liddle syndrome, GRA, AME)

AME, apparent mineralocorticoid excess; GRA, glucocorticoid-remediable aldosteronism. Adapted from Flynn JT. Evaluation and management of hypertension in childhood. *Prog Pediatr Cardiol.* 2001;12(2):177–188; National High Blood Pressure Education Program Working Group on Hypertension Control in Children and Adolescents. The fourth report on the diagnosis, evaluation, and treatment of high blood pressure in children and adolescents. *Pediatrics.* 2004;114(2):555–576.
[a] Findings that may be indicative of end organ damage related to HTN.

confirmed potential nephrotoxicity of cadmium in children,[304] no definite effect on BP has been demonstrated.[304,305]

- Mercury: Mercury is a known nephrotoxin, particularly in its elemental form.[306,307] Severe mercury intoxication has been linked to acute HTN in children in several case reports; patients' symptoms may resemble those seen in patients with pheochromocytoma (PCC).[308–310]
- Phthalates: Antenatal and childhood exposure to phthalates has recently been associated with higher childhood BP[311–313] but not with the development of overt HTN. Specific metabolites of these ubiquitous chemicals may have differential effects on BP,[313] indicating that much more detailed study is needed to completely understand the effect of such exposure.

5.6 Secondary Causes: Neurofibromatosis

Neurofibromatosis type 1 (NF-1) (also known as Von Recklinghausen disease) is a rare autosomal dominant disorder characterized by distinct clinical examination findings. These include the following: cafe-au-lait macules, neurofibromas, Lisch nodules of the iris, axillary freckling, optic nerve gliomas, and distinctive bone lesions. Patients with NF-1 have several unique and potential secondary causes of HTN, most commonly renal artery stenosis (RAS); coarctation of the aorta, middle aortic syndrome, and PCC are also well described.[314–319]

Additionally, an increased incidence of idiopathic HTN has been documented in patients with NF-1, as high as 6.1% in a recent pediatric case series, which is a much greater incidence than in the general population.[320] PCC has also been well described in patients with NF-1, although exact incidences are difficult

TABLE 15 Endocrine Causes of HTN

Name of Disorder	Genetic Mutation	Mode of Inheritance	Clinical Feature(s)	Biochemical Mechanism and Notes	Ref No(s).
Catecholamine excess					
PCC, paraganglioma	VHL (49%)	De novo, AD	HTN	Diagnostic test: fractionated plasma[a] and/or urine metanephrines and normetanephrines	248–254
	SDHB (15%)		Palpitations, headache, sweating		
	SDHD (10%)		Abdominal mass		
	RET		Incidental radiographic finding		
			Family screening		
Mineralocorticoid excess					
Specific etiologies addressed below		Screening test: ARR: PAC, PRA preferably obtained between 8:00 and 10:00 AM			255,256
Consider if:					
Early onset HTN					
Potassium level abnormalities					
Family history of primary aldosteronism					
Resistant HTN					
Congenital adrenal hyperplasia					
11β–hydroxylase deficiency	CYP11B1 (loss of function)	AR	HTN	Elevated levels of DOC, 11-deoxycortisol, androstenedione, testosterone, and DHEAS	257–259
			Hypokalemia	Higher prevalence in Moroccan Jews	
			Acne, hirsutism, and virilization in girls		
			Pseudoprecocious puberty in boys		
			11% of congenital adrenal hyperplasia		
17-α hydroxylase deficiency	CYP17 (loss of function)	AR	HTN and hypokalemia	Elevated DOC and corticosterone	260–262
			Low aldosterone and renin	Decreased androstenedione, testosterone and DHEAS	
			Undervirilized boys, sexual infantilism in girls	Prominent in Dutch Mennonites	
			<1% of congenital adrenal hyperplasia		
Familial hyperaldosteronism					
Type 1	Hybrid CYP11B1 and CYP11B2 (11β-hydroxylase–aldosterone synthase, gain of function)	AD	Young subjects with PA	Excessive, ACTH-regulated aldosterone production	263,264
			Family history of young strokes	Prescription with low-dose dexamethasone	
				May add low-dose spironolactone, calcium channel blocker, or potassium supplementation	
Type 2	Unknown, possibly 7p22	AD (prevalence varies from 1.2% to 6%)	PA in the patient with an affected first-degree relative	Excessive autonomous aldosterone production	265–267
			Unresponsive to dexamethasone		
			May have adrenal adenoma or bilateral adrenal hyperplasia		
Type 3	KCNJ5 G-protein potassium channel (loss of function)	AD	Early onset severe HTN in the first family described	Mutation leads to loss of potassium+ sensitivity causing sodium+ influx that activates Ca^{++} channels, leading to aldosterone synthesis	268–270
			Milder phenotypes also seen		
Type 4	CACNA1D coding for calcium channel (gain of function)	AD	PA and HTN age <10 y	Increased Ca^{++} channel sensitivity causing increased aldosterone synthesis	271,272
			Variable developmental abnormalities		
Other genetic causes					

TABLE 15 Continued

Name of Disorder	Genetic Mutation	Mode of Inheritance	Clinical Feature(s)	Biochemical Mechanism and Notes	Ref No(s).
Carney complex	PRKAR1A	AD	Skin pigmentation Pituitary and other tumors	Rare familial cause	273,274
McCune Albright syndrome	GNAS, α-subunit	Somatic	Cutaneous pigmentation Fibrous dysplasia	Tumors in the breast, thyroid, pituitary gland, or testicles may be present	275,276
Primary glucocorticoid resistance (Chrousos syndrome)	NR3C1 (loss of function glucocorticoid receptor)	AD	HTN Ambiguous genitalia Precocious puberty Androgen excess, menstrual abnormalities or infertility in women	Loss of function of glucocorticoid receptor	277–279
Apparent mineralocorticoid excess	HSD11B2 (loss of function)	AR	HTN Hypokalemia Low birth weight Failure to thrive Polyuria, polydipsia	Reduced or absent activity of 11 β-HSD2: cortisol gains access to MR Mimicked by licorice toxicity	280,281
Liddle syndrome	SCNN1B β-subunit–SCNN1G γ-subunit (activating mutation)		Severe HTN Hypokalemia Metabolic alkalosis Muscle weakness	Constitutive activation of the epithelial sodium channel causing salt retention and volume expansion	282,283
Geller syndrome	MCR (mineralocorticoid-d receptor, activating mutation)	AD	Onset of HTN <20 y Exacerbated by pregnancy	Constitutive activation of MR Also activated by progesterone	284
Pseudohypo-aldosteronism type 2 (Gordon syndrome)	WNK1,4; KLHL3; CUL3; SPAK (activating mutation)	AD	Short stature Hyperkalemic and hyperchloremic metabolic acidosis Borderline HTN	Increased activity of sodium chloride cotransporter causing salt retention and volume expansion	285–287
Glucocorticoid excess					
Cushing syndrome, adrenocortical carcinoma, iatrogenic excess	To be discovered	—	HTN Other signs of Cushing syndrome	Likely attributable to increased DOC, sensitivity to vasoconstriction, cardiac output, activation of RAS	288–290
Other endocrine abnormalities					
Hyperthyroidism	To be discovered	—	Tachycardia HTN Tremors Other signs of hyperthyroidism	Mechanism increased cardiac output, stroke volume, and decreased peripheral resistance Initial prescription with β blockers	291,292
Hyperparathyroidism	—	—	Hypercalcemia Other signs of hyperparathyroidism	Mechanism unknown, may not remit after treatment of hyperparathyroidism	293,294

ACTH, adrenocorticotropic hormone; AD, autosomal dominant; AR, autosomal recessive; DHEAS, dehydroepiandrosterone sulfate; DOC, deoxycortisol; MR, magnetic resonance; PA, primary hyperaldosteronism; PAC, plasma aldosterone concentration; RAS, renin angiotensin system; —, not applicable.

[a] influenced by posture, specialized center preferred.

to determine, and patients may not have classic symptoms of PCC.[321,322]

Vascular causes of HTN and PCC all require specific treatment and follow-up, so maintaining a high index of suspicion for these disorders is important in evaluating hypertensive children and adolescents with NF-1.

5.7 Secondary Causes: Medication Related

Many over-the-counter drugs, prescription medications, alternative therapies (ie, herbal and nutritional supplements), dietary products, and recreational drugs can increase BP. Common prescription medications associated with a rise in BP include oral contraceptives,[323–325] central nervous system stimulants,[326] and corticosteroids.[1,327] When a child has elevated BP measurements, the practitioner should inquire about the intake of pharmacologic agents (see Table 8).

Usually, the BP elevation is mild and reversible on discontinuation of the medication, but a significant increase in BP can occasionally occur with higher doses or as an idiosyncratic response. Over-the-counter cold medications that contain decongestants (eg, pseudoephedrine and phenylpropanolamine) may cause a mild increase in BP with the recommended dosing, but severe HTN has been observed as an idiosyncratic response with appropriate dosing as well as with excessive doses.

Nonsteroidal anti-inflammatory drugs may antagonize the BP-lowering effect of antihypertensive medications (specifically, angiotensin-converting enzyme [ACE] inhibitors) but do not appear to have an impact on BP in those without HTN. The commonly used supplement ephedra (ma haung) likely contains some amount of ephedrine and caffeine that can cause an unpredictable rise in BP. Recreational drugs associated with HTN include stimulants (eg, cocaine and amphetamine derivatives) and anabolic steroids.

5.8 Monogenic HTN

Monogenic forms of HTN are uncommon, although the exact incidence is unknown. In a study of select hypertensive children without a known etiology, genetic testing for familial hyperaldosteronism type I (FH-I), or glucocorticoid-remediable aldosteronism, confirmed responsible genetic mutations in 3% of the population.[263]

Other monogenic forms of HTN in children include Liddle syndrome, pseudohypoaldosteronism type II (Gordon syndrome), apparent mineralocorticoid excess, familial glucocorticoid resistance, mineralocorticoid receptor activating mutation, and congenital adrenal hyperplasia (see "Secondary Causes: Endocrine Causes of Hypertension").[328] All manifest as HTN with suppressed plasma renin activity (PRA) and increased sodium absorption in the distal tubule. Other features may include serum potassium abnormalities, metabolic acid-base disturbances, and abnormal plasma aldosterone concentrations, although the clinical presentations can be highly variable.[263,328,329] In the study of FH-I, all affected children had suppressed PRA and an aldosterone to renin ratio (ARR) (ng/dL and ng/M1 per hour, respectively) of >10; the authors suggest that an ARR >10 is an indication to perform genetic testing in a hypertensive child.[263] Monogenic forms of HTN should be suspected in hypertensive children with a suppressed PRA or elevated ARR, especially if there is a family history of early-onset HTN.

6. DIAGNOSTIC EVALUATION

6.1 Patient Evaluation

As with any medical condition, appropriate diagnostic evaluation is a critical component in the evaluation of a patient with suspected HTN. Evaluation focuses on determining possible causes of and/or comorbidities associated with HTN. Evaluation, as is detailed in the following sections, should include appropriate patient history, family history, physical examination, laboratory evaluation, and imaging.

6.2 History

The first step in the evaluation of the child or adolescent with elevated BP is to obtain a history. The various components of the history include the perinatal history, past medical history, nutritional history, activity history, and psychosocial history. Each is discussed in the following sections.

6.2a Perinatal History

As discussed, perinatal factors such as maternal HTN and low birth weight have been shown to influence later BP, even in childhood.[56,330] Additionally, a high incidence of preterm birth among hypertensive children has recently been reported in 1 large case series.[101] Thus, it is appropriate to obtain a history of pertinent prenatal information, including maternal pregnancy complications; gestational age; birth weight; and, if pertinent, complications occurring in the neonatal nursery and/or ICU. It is also appropriate to document pertinent procedures, such as umbilical catheter placement.

6.2b Nutritional History

High sodium intake has been linked to childhood HTN and increased LVMI and is the focus of several population health campaigns.[4,331] In NHANES 2003–2008, among children 8 to 18 years of age (n = 6235), higher sodium intake (as assessed by dietary recall) was associated with a twofold increase in the combined outcome of elevated BP or HTN. The effect was threefold among participants with obesity.[332] Limited data suggest

the same effect is seen in younger children.[333] One study found that high intake of total fat and saturated fat, as well as adiposity and central obesity, were also predictors of SBP.[334–336]

Nutrition history is an important part of the patient assessment because it may identify dietary contributors to HTN and detect areas in which lifestyle modification may be appropriate. The important components to discuss include salt intake (including salt added in the kitchen and at the table and sodium hidden in processed and fast food), consumption of high-fat foods, and consumption of sugary beverages.[337,338] Infrequent consumption of fruits, vegetables, and low-fat dairy products should also be identified.

6.2c Physical Activity History

A detailed history of physical activity and inactivity is an integral part of the patient assessment, not only to understand contributors to the development of HTN but also to direct lifestyle modification counseling as an important part of management.[339–344]

6.2d Psychosocial History

Providers should obtain a psychosocial history in children and adolescents with suspected or confirmed HTN. Adverse experiences both prenatally[345] and during childhood (including maltreatment, early onset depression, and anxiety) are associated with adult-onset HTN.[346,347] The identification of stress may suggest a diagnosis of WCH. The psychosocial history should include questions about feelings of depression and anxiety, bullying, and body perceptions. The latter is particularly important for patients with overweight or obesity because ~70% of these children report having bullying and body perception concerns.[348] Starting at 11 years of age, the psychosocial history should include questions about smoking,[349,350] alcohol, and other drug use.[351]

6.2e Family History

Taking and updating the family history is a quick and easy way to risk-stratify pediatric patients with an increased risk for HTN. It is important to update the family history for HTN over the course of the pediatric patient's lifetime in the practice (typically until 18–21 years of age) because first- and second-degree relatives may develop HTN during this time. All too often, the diagnosis of HTN in the pediatric patient stimulates the collection of a detailed family history of HTN, sometimes even years after the pediatric patient has had elevated BP, instead of the other way around.[352]

6.3 Physical Examination

A complete physical examination may provide clues to potential secondary causes of HTN and assess possible hypertensive end organ damage. The child's height, weight, calculated BMI, and percentiles for age should be determined at the start of the physical examination. Poor growth may indicate an underlying chronic illness.

At the second visit with confirmed elevated BP or stage 1 HTN or the first visit with confirmed stage 2 HTN, BP should be measured in both arms and in a leg. Normally, BP is 10 to 20 mm Hg higher in the legs than the arms. If the leg BP is lower than the arm BP, or if femoral pulses are weak or absent, coarctation of the aorta may be present. Obesity alone is an insufficient explanation for diminished femoral pulses in the presence of high BP.

The remainder of the physical examination should pursue clues found in the history and should focus on body systems and findings that may indicate secondary HTN and/or end organ damage related to HTN. Table 14 lists important physical examination findings in hypertensive children.[353] These are examples of history and physical findings and do not represent all possible history and physical examination findings. The physical examination in hypertensive children is frequently normal except for the BP elevation.

Key Action Statement 13

In children and adolescents being evaluated for high BP, the provider should obtain a perinatal history, appropriate nutritional history, physical activity history, psychosocial history, and family history and perform a physical examination to identify findings suggestive of secondary causes of HTN (grade B, strong recommendation).

6.4 Laboratory Evaluation

The purpose of the laboratory evaluation is to identify underlying secondary causes of HTN (eg, renal or endocrine disease) that would require specific treatment guided by a subspecialist. In general, such testing includes a basic set of screening tests and additional, specific tests; the latter are selected on the basis of clues obtained from the history and physical examination and/or the results of the initial screening tests.[354] Table 10 provides a list of screening tests and the populations in which they should be performed.

6.5 Electrocardiography

Approximately one-half of adolescents with HTN have undergone electrocardiography at least once as an assessment for LVH.[355] Unlike echocardiography, electrocardiography takes little time and is a relatively low-cost test. Electrocardiography has high specificity but poor sensitivity for identifying children and adolescents with LVH.[356–358] The positive predictive value of electrocardiography to identify LVH is extremely low.[359]

Key Action Statement 14

Clinicians should not perform electrocardiography in hypertensive

Key Action Statement 13. In children and adolescents being evaluated for high BP, the provider should obtain a perinatal history, appropriate nutritional history, physical activity history, psychosocial history, and family history and perform a physical examination to identify findings suggestive of secondary causes of HTN (grade B, strong recommendation).

Aggregate Evidence Quality	Grade B
Benefits	Identify personal risk factors for HTN
Risks, harm, cost	None
Benefit–harm assessment	Identification of personal risk factors is useful in the assessment of childhood HTN
Intentional vagueness	None
Role of patient preferences	None
Exclusions	Children with normal BP
Strength	Strong recommendation
Key references	56,330

children and adolescents being evaluated for LVH (grade B, strong recommendation).

6.6 Imaging Evaluation, Echocardiography: Detection of Target Organ Damage

Echocardiography was identified in the Fourth Report as a tool to measure left ventricular (LV) target organ injury related to HTN in children.[1] The basis for this assessment is as follows: (1) the relationship of LV mass to BP,[361] (2) the independent and strong relationship of LVH to adverse CVD outcomes in adults,[362–364] and (3) that a significant percentage of children and adolescents with HTN demonstrate the degree of LVH associated with adverse outcomes in adults.[365–367] Antihypertensive treatment reduces LVH. Observational data suggest that the regression of LVH independently predicts outcomes in adults.[368]

The best-studied measures of LV target organ injury are measures of LV structure (LV mass and the relationship of LV wall thickness or mass to LV cavity volume) and systolic function (LV ejection fraction). LV structure is usually stratified into 4 groups on the basis of LV mass (normal or hypertrophied) and relative LV wall thickness (normal or increased). These 4 are as follows: (1) normal geometry with normal LV mass and wall thickness, (2) concentric geometry with normal LV mass and increased LV wall thickness, (3) eccentric LVH with increased LV mass and normal LV wall thickness, and (4) concentric LVH with both increased LV mass and increased relative wall thickness.[369,370]

Key Action Statement 14. Clinicians should not perform electrocardiography in hypertensive children and adolescents being evaluated for LVH (grade B, strong recommendation).

Aggregate Evidence Quality	Grade B (Aggregate of Level of Evidence Equals B Because of Multiple Level of Evidence C References With Similar Findings)
Benefits	Electrocardiography is less expensive than echocardiography or other imaging modalities for identifying LVH
Risks, harm, cost	Electrocardiography has a low sensitivity for detecting LVH
Benefit–harm assessment	The risk of concluding that a child with HTN does not have LVH on the basis of a normal electrocardiogram means that a diagnosis of end organ injury is potentially missed
Intentional vagueness	None
Role of patient preferences	Patients and families may prefer electrocardiography because of cost and convenience, but the sensitivity of the test is poor
Exclusions	None
Strength	Strong recommendation
Key references	1,355–360

The American Society of Echocardiography recommendations should be followed with regard to image acquisition and LV measurement for calculating LV ejection fraction, mass, and relative wall thickness.[369,371] LV ejection fraction may be significantly decreased in severe or acute onset HTN with associated congestive heart failure.[1] Rarely, LV ejection fraction may be mildly depressed in chronic HTN.

Because the heart increases in size in relation to body size, indexing LV mass is required.[361] Indexing LV mass is particularly important in infants and younger children because of their rapid growth.[372,373] Physical training increases LV mass in a healthful manner. Lean body mass is more strongly associated with LV mass than fat mass.[370] Because body composition is not routinely measured clinically, surrogate formulae for indexing are required. It is unclear whether expected values for LV mass should be derived from reference populations of normal weight and normotensive children or should include normotensive children who have overweight or obesity. The best method for indexing LV mass in children is an area of active investigation.

For this document, the following definitions for LV target organ injury have been chosen regarding hypertrophy, relative wall thickness, and ejection fraction. These definitions are based on published guidelines from the American Society of Echocardiography and associations of thresholds for indexed LV mass with adverse outcomes in adults[362,363,369]:

- LVH is defined as LV mass >51 g/$m^{2.7}$ or LV mass >115 g per body surface area (BSA) for boys and LV mass >95 g/BSA for girls. (Note that the values for LVH are well above the 95th percentile for distributions of LV mass in children and adolescents.[369] The clinical significance of values between the

95th percentile of a population-based distribution and these thresholds is uncertain[372]);

- An LV relative wall thickness >0.42 cm indicates concentric geometry. LV wall thickness >1.4 cm is abnormal[373]; and
- Decreased LV ejection fraction is a value <53%.

There are a number of additional evidence gaps related to the echocardiographic assessment of LV target organ injury. The value of LV mass assessment in risk reclassification independent of conventional risk assessment has not been established in adults.[364] The costs and benefits of incorporation of echocardiography into HTN care has not been assessed. Quality control regarding reproducibility of measurements across laboratories may be suboptimal.[374] The most accurate method to measure LV mass (M-mode; two-dimensional; or, in the near future, three-dimensional techniques) requires further research.

Key Action Statement 15

1. It is recommended that echocardiography be performed to assess for cardiac target organ damage (LV mass, geometry, and function) at the time of consideration of pharmacologic treatment of HTN;
2. LVH should be defined as LV mass >51 g/m$^{2.7}$ (boys and girls) for children and adolescents older than 8 years and defined by LV mass >115 g/BSA for boys and LV mass >95 g/BSA for girls;
3. Repeat echocardiography may be performed to monitor improvement or progression of target organ damage at 6- to 12-month intervals. Indications to repeat echocardiography include persistent HTN despite treatment, concentric LV hypertrophy, or reduced LV ejection fraction; and
4. In patients without LV target organ injury at initial echocardiographic assessment, repeat echocardiography at yearly intervals may be considered in those with stage 2 HTN, secondary HTN, or chronic stage 1 HTN incompletely treated (noncompliance or drug resistance) to assess for the development of worsening LV target organ injury (grade C, moderate recommendation).

TABLE 16 DASH Diet Recommendations

Food	Servings per Day
Fruits and vegetables	4–5
Low-fat milk products	≥2
Whole grains	6
Fish, poultry, and lean red meats	≤2
Legumes and nuts	1
Oils and fats	2–3
Added sugar and sweets (including sweetened beverages)	≤1
Dietary sodium	<2300 mg per d

Adapted from Barnes TL, Crandell JL, Bell RA, Mayer-Davis EJ, Dabelea D, Liese AD. Change in DASH diet score and cardiovascular risk factors in youth with type 1 and type 2 diabetes mellitus: the SEARCH for Diabetes in Youth study. *Nutr Diabetes*. 2013;3:e91; US Department of Health and Human Services, US Department of Agriculture. Appendix 7. Nutritional goals for age-sex groups based on dietary reference intakes and dietary guidelines recommendations. In: *2015-2020 Dietary Guidelines for Americans*. Washington, DC: US Department of Health and Human Services, US Department of Agriculture; 2015; and Expert Panel on Integrated Guidelines for Cardiovascular Health and Risk Reduction in Children and Adolescents; National Heart, Lung, and Blood Institute. Expert Panel on Integrated Guidelines for Cardiovascular Health and Risk Reduction in Children and Adolescents: Summary Report. *Pediatrics*. 2011;128 (suppl 5): S213–S256.

6.7 Vascular Structure and Function

Emerging data demonstrate an association of higher levels of BP in youth with adverse changes in measures of vascular structure and function, including ultrasonography of the cIMT, PWV, a robust measure of central arterial stiffness[66] that is related to hard CV events in adults

Key Action Statement 15. It is recommended that echocardiography be performed to assess for cardiac target organ damage (LV mass, geometry, and function) at the time of consideration of pharmacologic treatment of HTN;

LVH should be defined as LV mass >51 g/m2.7 (boys and girls) for children and adolescents older than 8 years and defined by LV mass >115 g/BSA for boys and LV mass >95 g/BSA for girls;

Repeat echocardiography may be performed to monitor improvement or progression of target organ damage at 6- to 12-month intervals. Indications to repeat echocardiography include persistent HTN despite treatment, concentric LV hypertrophy, or reduced LV ejection fraction; and

In patients without LV target organ injury at initial echocardiographic assessment, repeat echocardiography at yearly intervals may be considered in those with stage 2 HTN, secondary HTN, or chronic stage 1 HTN incompletely treated (noncompliance or drug resistance) to assess for the development of worsening LV target organ injury (grade C, moderate recommendation).

Aggregate Evidence Quality	Grade C
Benefits	Severe LV target organ damage can only be identified with LV imaging. May improve risk stratification
Risks, harm, cost	Adds cost; improvement in outcomes from incorporating echocardiography into clinical care is not established
Benefit–harm assessment	Benefits exceed harms
Intentional vagueness	None
Role of patient preferences	Patients may elect to not to have the study
Exclusions	None
Strength	Moderate recommendation
Key references	361,363,364,367–369

(eg, stroke, myocardial infarction, etc),[69] and FMD, which assesses endothelial function and describes the ability of the endothelium to release nitric oxide in response to stress.[375]

Although there are multiple large studies of PWV in youth,[376–381] they all suffer from notable limitations, primarily the lack of racial and ethnic diversity and differences in measurement devices and protocols. Researchers in the largest study of PWV in youth to date (N = 6576) only evaluated 10 and 11 year olds and measured only carotid-radial PWV across the arm; this measure has not been linked to CV events in adults.[382] Researchers in one large study of FMD performed in youth (N = 5809) only included 10- to 11-year-old children in England.[382] The largest set of data for cIMT included 1155 European youth who were 6 to 18 years of age.[383] No racial and ethnic breakdown was provided for this study. The wide heterogeneity in the methods for cIMT measurement hinders the pooling of data. For instance, researchers in the aforementioned article only measured common carotid,[383] although the bulb and internal carotid are the sites of earliest atherosclerotic disease.[384]

Many studies have had significant issues related to methodology. For example, carotid-femoral PWV is not measured identically with different devices and is not equivalent to other measures of PWV, such as brachial-femoral PWV.[385,386] No direct comparisons have been made between carotid-femoral and brachial-ankle PWV, methods in which brachial-ankle PWV provide values considerably higher than carotid-femoral PWV.[378] The brachial-ankle PWV measures stiffness along both a central elastic artery (aorta) and the medium muscular arteries of the leg.

Therefore, insufficient normative data are available to define clinically actionable cut-points between normal and abnormal for these vascular parameters. The routine measurement of vascular structure and function to stratify risk in hypertensive youth cannot be recommended at this time.

6.8 Imaging for Renovascular Disease

There are no evidence-based criteria for the identification of children and adolescents who may be more likely to have RAS. Some experts will do a more extensive evaluation for RAS in children and adolescents with stage 2 HTN, those with significant diastolic HTN (especially on ABPM), those with HTN and hypokalemia on screening laboratories, and those with a notable size discrepancy between the kidneys on standard ultrasound imaging. Bruits over the renal arteries are also suggestive of RAS but are not always present. Consultation with a subspecialist is recommended to help decide which patients warrant further investigation and to aid in the selection of the appropriate imaging modality.

6.8a Renal Ultrasonography

The utility of Doppler renal ultrasonography as a noninvasive screening study for the identification of RAS in children and adolescents has been examined in at least 2 recent case series; sensitivity has been reported to be 64% to 90%, with a specificity of 68% to 70%.[387,388] In another study that included both children and adults, sensitivity and specificity for the detection of renal artery stenoses was 75% and 89%, respectively.[389] Factors that may affect the accuracy of Doppler ultrasonography include patient cooperation, the technician's experience, the age of the child, and the child's BMI. Best results are obtained in older (≥8 years),[388] nonobese (BMI ≤85th percentile), cooperative children and adolescents who are examined in a facility with extensive pediatric vascular imaging experience. Doppler ultrasonography should probably not be obtained in patients who do not meet these criteria or in facilities that lack appropriate pediatric experience.

Key Action Statement 16

Doppler renal ultrasonography may be used as a noninvasive screening study for the evaluation of possible RAS in normal-weight children and adolescents ≥8 years of age who are suspected of having renovascular HTN and who will cooperate with the procedure (grade C, moderate recommendation).

6.8b Computed Tomographic Angiography, Magnetic Resonance Angiography, and Renography

Other noninvasive imaging studies that have been assessed for their ability to identify RAS include computed tomographic angiography (CTA), magnetic resonance angiography (MRA), and nuclear medicine studies. Each of these

Key Action Statement 16. Doppler renal ultrasonography may be used as a noninvasive screening study for the evaluation of possible RAS in normal-weight children and adolescents ≥8 years of age who are suspected of having renovascular HTN and who will cooperate with the procedure (grade C, moderate recommendation).

Aggregate Evidence Quality	Grade C
Benefits	Avoidance of complications of invasive procedure (angiography) or radiation from traditional or computed tomography angiography
Risks, harm, cost	Potential false-positive or false-negative results
Benefit–harm assessment	Potential for avoidance of an invasive procedure outweighs risk of false-negative or false-positive results
Intentional vagueness	None
Role of patient preferences	None
Exclusions	Children and adolescents without suspected renovascular HTN
Strength	Moderate recommendation
Key references	387–390

TABLE 17 Dosing Recommendations for the Initial Prescription of Antihypertensive Drugs for Outpatient Management of Chronic HTN

Drug	Age	Initial Dose	Maximal Dose	Dosing Interval	Formulations
ACE inhibitors					
Contraindications: pregnancy, angioedema					
Common adverse effects: cough, headache, dizziness, asthenia					
Severe adverse effects: hyperkalemia, acute kidney injury, angioedema, fetal toxicity					
Benazepril	≥6 y[a]	0.2 mg/kg per d (up to 10 mg per d)	0.6 mg/kg per d (up to 40 mg per d)	Daily	Tablet: 5, 10, 20, 40 mg (generic) Extemporaneous liquid: 2 mg/mL
Captopril	Infants	0.05 mg/kg per dose	6 mg/kg per d	Daily to 4 times a day	Tablet: 12.5, 25, 50, 100 mg (generic)
	Children	0.5 mg/kg per dose	6 mg/kg per d	Three times a day	Extemporaneous liquid: 1 mg/mL
Enalapril	≥1 mo[a]	0.08 mg/kg per d (up to 5 mg per d)	0.6 mg/kg per d (up to 40 mg per d)	Daily to twice a day	Tablet: 2.5, 5, 10, 20 mg (generic) Solution: 1 mg/mL
Fosinopril	≥6 y <50 kg	0.1 mg/kg per d (up to 5 mg per d)	40 mg per d	Daily	Tablet: 10, 20, 40 mg (generic)
	≥50 kg[a]	5 mg per d	40 mg per d		
Lisinopril	≥6 y[a]	0.07 mg/kg per d (up to 5 mg per d)	0.6 mg/kg per d (up to 40 mg per d)	Daily	Tablet: 2.5, 5, 10, 20, 30, 40 mg (generic) Solution: 1 mg/mL
Ramipril	—	1.6 mg/m^2 per d	6 mg/m^2 per d	Daily	Capsule: 1.25, 2.5, 5 10 mg (generic)
Quinapril	—	5 mg per d	80 mg per d	Daily	Tablet: 5, 10, 20, 40 mg (generic)
ARBs					
Contraindications: pregnancy					
Common adverse effects: headache, dizziness					
Severe adverse effects: hyperkalemia, acute kidney injury, fetal toxicity					
Candesartan	1–5 y[a]	0.02 mg/kg per d (up to 4 mg per d)	0.4 mg/kg per d (up to 16 mg per d)	Daily to twice a day	Tablet: 4, 8, 16, 32 mg
	≥6 y[a]				Extemporaneous liquid: 1 mg/mL
	<50 kg	4 mg per d	16 mg per d		
	≥50 kg	8 mg per d	32 mg per d		
Irbesartan	6–12 y	75 mg per d	150 mg per d	Daily	Tablet: 75, 150, 300 mg (generic)
	≥13	150 mg per d	300 mg per d		
Losartan	≥6 y[a]	0.7 mg/kg (up to 50 mg)	1.4 mg/kg (up to 100 mg)	Daily	Tablet: 25, 50 100 (generic) Extemporaneous liquid: 2.5 mg/mL
Olmesartan	≥6 y[a]	—	—	Daily	Tablet: 5, 20, 40 mg
	<35 kg	10 mg	20 mg		Extemporaneous liquid: 2 mg/mL
	≥35 kg	20 mg	40 mg		
Valsartan	≥6 y[a]	1.3 mg/kg (up to 40 mg)	2.7 mg/kg (up to 160 mg)	Daily	Tablet: 40, 80, 160, 320 mg (generic) Extemporaneous liquid: 4 mg/mL
Thiazide diuretics					
Contraindications: anuria					
Common adverse effects: dizziness, hypokalemia					
Severe adverse effects: cardiac dysrhythmias, cholestatic jaundice, new onset diabetes mellitus, pancreatitis					
Chlorthalidone	Child	0.3 mg/kg	2 mg/k per d (50 mg)	Daily	Tablet: 25, 50, 100 mg (generic)
Chlorothiazide	Child[a]	10 mg/kg per d	20 mg/kg per d (up to 375 mg per d)	Daily to twice a day	Tablet: 250, 500 mg (generic) Suspension: 250/5 mL Extemporaneous liquid: 1 mg/mL
Hydrochlorothiazide	Child[a]	1 mg/kg per d	2 mg/kg per d (up to 37.5 mg per d)	Daily to twice a day	Tablet: 12.5, 25, 50 mg

TABLE 17 Continued

Drug	Age	Initial Dose	Maximal Dose	Dosing Interval	Formulations
Calcium channel blockers					
Contraindications: hypersensitivity to CCBs					
Common adverse effects: flushing, peripheral edema, dizziness					
Severe adverse effects: angioedema					
Amlodipine	1–5 y	0.1 mg/kg	0.6 mg/kg (up to 5 mg per d)	Daily	Tablet: 2.5, 5,10 mg
	≥6 y[a]	2.5 mg	10 mg		Extemporaneous liquid: 1 mg/mL
Felodipine	≥6 y	2.5 mg	10 mg	Daily	Tablet (extended release): 2.5,5,10 mg (generic)
Isradipine	Child	0.05–0.1 mg/kg	0.6 mg/kg (up to 10 mg per d)	Capsule: twice daily to 3 times a day; extended-release tablet: daily	Capsule: 2.5, 5 mg Extended-release tablet: 5, 10 mg
Nifedipine extended release	Child	0.2–0.5 mg/kg per d	3 mg/kg/d (up to 120 mg per d)	Daily to twice a day	Tablet (extended-release): 30, 60, 90 mg (generic)

—, not applicable.
[a] FDA pediatric labeling.

has been compared with the gold standard, renal arteriography. CTA and MRA have generally been found to be acceptable as noninvasive imaging modalities for the identification of hemodynamically significant vascular stenosis. One study that included both pediatric and adult patients showed that the sensitivity and specificity for the detection of RAS was 94% and 93% for CTA and 90% and 94% for MRA, respectively.[389]

Unfortunately, studies of either technique that include only pediatric patients are limited at best for CTA and are nonexistent for MRA. Despite this, expert opinion holds that either modality may be used for noninvasive screening for suspected RAS, but neither is a substitute for angiography.[390] CTA typically involves significant radiation exposure, and MRA generally requires sedation or anesthesia in young children, which are factors that must be considered when deciding to use one of these modalities.

Nuclear renography is based on the principle that after the administration of an agent affecting the renin-angiotensin-aldosterone system (RAAS), there will be reduced blood flow to a kidney or kidney segment affected by hemodynamically significant RAS. Such reduced blood flow can be detected by a comparison of perfusion before and after the administration of the RAAS agent. Limited pediatric nuclear renography studies exist that show variable sensitivity and specificity, ranging from 48% to 85.7% and 73% to 92.3%, respectively.[391–393] The utility of nuclear renography may be less in children then adults because children with RAS often have more complicated vascular abnormalities than adults.[394] Given these issues, nuclear renography has generally been abandoned as a screening test for RAS in children and adolescents.[390]

Key Action Statement 17

In children and adolescents suspected of having RAS, either CTA or MRA may be performed as a noninvasive imaging study. Nuclear renography is less useful in pediatrics and should generally be avoided (grade D, weak recommendation).

6.9 Uric Acid

Cross-sectional data have suggested a relationship between elevated serum uric acid (UA) levels and HTN. Two recent studies of adolescents included in NHANES 1999–2000 and a small study conducted in Italy found that elevated UA levels were associated with higher BP.[395–397] In the Italian study and in another US study of youth with obesity and HTN,[397,398] elevated UA was also associated with other markers of CV risk. These findings suggest that the measurement of UA levels may best be viewed as 1 component of CV risk assessment, especially in those with obesity.

A causative role for elevated UA in the development of childhood HTN has not been definitively established, although recent studies suggest that it may be on the causal pathway. A longitudinal study in which researchers followed a group of children for an average of 12 years demonstrated that childhood UA levels were associated with adult BP levels even after controlling for baseline BP.[399] A few small, single-center clinical trials have also shown that lowering UA can decrease BP levels, and increased UA levels blunt the efficacy of lifestyle modifications on BP control.[400–404] No large-scale, multicenter study has yet been conducted to confirm these preliminary findings. Hence, there is currently not sufficient evidence to support the routine measurement of serum UA in the evaluation and management of children with elevated BP.

6.10 Microalbuminuria

Microalbuminuria (MA), which should be differentiated from proteinuria in CKD, has been shown to be a marker of HTN-related kidney injury and a predictor of CVD in adults.[405–408] MA has been shown to be effectively reduced via the use of ARBs and ACE inhibitors in adults. Lowering the degree of MA in adults has been associated with decreased CVD risk.

In contrast, data to support a clear relationship between HTN and MA in pediatric patients with primary HTN are limited.[408–410] A single, retrospective study of children with primary HTN and WCH found that 20% of the former had MA versus 0% of the latter.[411] MA appears to be a nonspecific finding in children that can occur in the absence of HTN; it can occur in children who have obesity, insulin resistance, diabetes, dyslipidemia, and even in those who have recently participated in vigorous physical activity.[412] The previously mentioned study by Seeman et al[411] did not control for these potential confounders.

Limited, single-center data suggest that a reduction in the degree of MA, more than a reduction in BMI or SBP, is associated with a decrease in LVMI. In particular, researchers in this single-center, nonrandomized, prospective study of 64 hypertensive children without kidney disease who were 11 to 19 years of age evaluated the children at baseline and after 12 months of combination ACE and hydrochlorothiazide (N = 59) or ACE, hydrochlorothiazide, and ARB therapy (N = 5). Results found that lowering MA in children is associated with a regression of LVH.[413] Given the single-center design and lack of a control group, however, the applicability of these findings to the general population of children with primary HTN is unknown.

Key Action Statement 18

Routine testing for MA is not recommended for children and adolescents with primary HTN (grade C, moderate recommendation).

7. TREATMENT

7.1 Overall Goals

The overall goals for the treatment of HTN in children and adolescents, including both primary and secondary HTN, include achieving a BP level that not only reduces the risk for target organ damage in childhood but also reduces the risk for HTN and related CVD in adulthood. Several studies have shown that currently available treatment options can even reverse target organ damage in hypertensive youth.[105,414,415]

The previous recommendations for HTN treatment target in children without CKD or diabetes were SBP and DBP <95th percentile. Since that recommendation was made, evidence has emerged that markers of target organ damage, such as increased LVMI, can be detected among some

Key Action Statement 17. In children and adolescents suspected of having RAS, either CTA or MRA may be performed as a noninvasive imaging study. Nuclear renography is less useful in pediatrics and should generally be avoided (grade D, weak recommendation).

Aggregate Evidence Quality	Grade D
Benefits	Avoidance of complications of an invasive procedure (angiography)
Risks, harm, cost	Potential false-positive or false-negative results
Benefit–harm assessment	Potential for avoidance of an invasive procedure outweighs risk of false-negative or false-positive results
Intentional vagueness	None
Role of patient preferences	None
Exclusions	Children and adolescents without suspected RAS
Strength	Weak recommendation; pediatric data are limited
Key references	389,390

Key Action Statement 18. Routine testing for MA is not recommended for children and adolescents with primary HTN (grade C, moderate recommendation).

Aggregate Evidence Quality	Grade C
Benefits	Avoid improper detection of MA in children with HTN. Detection of MA is strongly influenced by other factors, such as recent participation in rigorous physical activity, obesity, insulin resistance and diabetes. Hence, there is no clear benefit for testing for MA in the absence of other known comorbidities
Risks, harm, cost	No known risks given a lack of clear association between MA and primary HTN in children
Benefit–harm assessment	Limited data to support any real benefit for screening children for MA
Intentional vagueness	Screening of children with primary HTN versus screening of children with single kidney or CKD and HTN
Role of patient preferences	Unknown
Exclusions	None
Strength	Moderate recommendation
Key references	408,410,411,413

children with BP >90th percentile (or >120/80 mm Hg) but <95th percentile.[66,416,417] Longitudinal studies on BP from childhood to adulthood that include indirect measures of CV injury indicate that the risk for subsequent CVD in early adulthood increases as the BP level in adolescence exceeds 120/80 mm Hg.[11,103,418] In addition, there is some evidence that targeting a BP <90th percentile results in reductions in LVMI and prevalence of LVH.[104] Therefore, an optimal BP level to be achieved with treatment of childhood HTN is <90th percentile or <130/80 mm Hg, whichever is lower.

Treatment and management options are discussed below, including lifestyle modifications and pharmacologic therapy to achieve optimal BP levels in children and adolescents with HTN.

Key Action Statement 19

In children and adolescents diagnosed with HTN, the treatment goal with nonpharmacologic and pharmacologic therapy should be a reduction in SBP and DBP to <90th percentile and <130/80 mm Hg in adolescents ≥ 13 years old (grade C, moderate recommendation).

7.2 Lifestyle and Nonpharmacologic Interventions

Lifestyle interventions are recommended to lower BP. There is good evidence from studies in adults showing that nutritional interventions lower BP,[419] including clinical trials demonstrating that reducing dietary sodium results in lower BP and CV mortality,[338] and a diet high in olive oil polyphenols lowers BP.[420] Studies of hypertensive youth suggest that the relationship between diet, physical activity, and BP in childhood is similar to that observed in adults.

Key Action Statement 19. In children and adolescents diagnosed with HTN, the treatment goal with nonpharmacologic and pharmacologic therapy should be a reduction in SBP and DBP to <90th percentile and <130/80 mm Hg in adolescents ≥ 13 years old (grade C, moderate recommendation).

Aggregate Evidence Quality	Grade C
Benefits	Lower risk of childhood target organ damage, lower risk of adulthood HTN and CVD
Risk, harm, cost	Risk of drug adverse effects and polypharmacy
Benefit–harm assessment	Preponderance of benefit
Intentional vagueness	None
Role of patient preferences	Patient may have preference for nonpharmacologic or pharmacologic treatment
Exclusions	None
Strength	Moderate recommendation
Key references	11,66,103,104,416–418

7.2a Diet

The Dietary Approaches to Stop Hypertension (DASH) approach and specific elements of that diet have been the primary dietary strategy tested in the literature. These elements include a diet that is high in fruits, vegetables, low-fat milk products, whole grains, fish, poultry, nuts, and lean red meats; it also includes a limited intake of sugar and sweets along with lower sodium intake (see Table 16). Cross-sectional studies demonstrate associations between elements of the DASH diet and BP. For example, population-based data from NHANES show correlations between dietary sodium and BP in childhood and elevated BP and HTN, particularly in people with excess weight.[332]

A high intake of fruits, vegetables, and legumes (ie, a plant-strong diet) is associated with lower BP.[421] A lack of fruit consumption in childhood has been linked to increases in cIMT in young adulthood in the Young Finns study.[422] Higher intake of low-fat dairy products has been associated with lower BP in childhood.[423]

Longitudinal, observational, and interventional data also support relationships between diet and BP in youth. The National Heart Lung and Blood Institute's Growth and Health Study, which followed 2185 girls over 10 years, demonstrated that consuming ≥2 servings of dairy and ≥3 servings of fruits and vegetables daily was associated with lower BP in childhood and a 36% lower risk of high BP by young adulthood.[424] Similar associations have been demonstrated in children and adolescents with diabetes.[425] Moreover, an improvement in diet

led to lower BP in some studies of adolescents with elevated BP,[426] youth with overweight,[427] girls with metabolic syndrome,[428] and youth with T2DM.[429] However, consuming a healthier diet may increase costs.[430]

7.2b Physical Activity

Observational data support a relationship between physical activity and lower BP, although the data are scant.[339] Interventional data demonstrate increasing physical activity leads to lower BP. A review of 9 studies of physical activity interventions in children and adolescents with obesity suggested that 40 minutes of moderate to vigorous, aerobic physical activity at least 3 to 5 days per week improved SBP by an average of 6.6 mm Hg and prevented vascular dysfunction.[340] A number of subsequent, additional studies with small sample sizes support a benefit of physical activity on BP.[341] A more recent analysis of 12 randomized controlled trials including 1266 subjects found reductions of 1% and 3% for resting SBP and DBP, respectively. These results did not reach statistical significance, however, and the authors suggested that longer studies with larger sample sizes are needed.[344] Any type of exercise, whether it's aerobic training, resistance training, or combined training, appears to be beneficial[342] (see "HTN and the Athlete").

Programs that combine diet and physical activity can have a beneficial effect on SBP, as is shown in several studies designed to prevent childhood obesity and address cardiometabolic risk.[431]

Key Action Statement 20

At the time of diagnosis of elevated BP or HTN in a child or adolescent, clinicians should provide advice on the DASH diet and recommend moderate to vigorous physical activity at least 3 to 5 days per week (30–60 minutes per session) to help reduce BP (grade C, weak recommendation).

TABLE 18 OSAS Symptoms and Signs

History of frequent snoring (≥3 nights per week)
Labored breathing during sleep
Gasps, snorting noises, observed episodes of apnea
Sleep enuresis (especially secondary enuresis)
Sleeping in a seated position or with the neck hyperextended
Cyanosis
Headaches on awakening
Daytime sleepiness
Attention-deficit/hyperactivity disorder
Learning problems
Physical examination
Underweight or overweight
Tonsillar hypertrophy
Adenoidal facies
Micrognathia, retrognathia
High-arched palate
Failure to thrive
HTN

Adapted from Marcus CL, Brooks LJ, Draper KA, et al; American Academy of Pediatrics. Diagnosis and management of childhood obstructive sleep apnea syndrome. *Pediatrics*. 2012;130(3). Available at: www.pediatrics.org/cgi/content/full/130/3/e714.

7.2c Weight Loss and Related CV Risk Factors

As is true for children and adolescents with isolated HTN, a DASH diet[426,432] and vigorous physical activity[431] are recommended in pediatric patients with multiple obesity-related risk factors as part of intensive weight-loss therapy.[433,434] Motivational interviewing (MI) is a tool recommended for pediatricians' use by the AAP Expert Committee Statement on Obesity.[435] MI may be a useful counseling tool to use in combination with other behavioral techniques to address overweight and obesity in children.[436] Studies in hypertensive adults support the use of MI to improve adherence to antihypertensive medications[437] and decrease SBP.[436] Although there are no trials investigating the use of MI in the care of hypertensive youth, a number of studies have shown that MI can be used successfully to address or prevent childhood obesity by promoting physical activity and dietary changes.[438–441] However, other studies have been less promising.[442,443] In addition to the standard lifestyle approaches, intensive weight-loss therapy

Key Action Statement 20. At the time of diagnosis of elevated BP or HTN in a child or adolescent, clinicians should provide advice on the DASH diet and recommend moderate to vigorous physical activity at least 3 to 5 days per week (30–60 minutes per session) to help reduce BP (grade C, weak recommendation).

Aggregate Evidence Quality	Grade C
Benefits	Potential to reduce BP
Risk, harm, cost	No or low potential for harm. Following a healthier diet may increase costs to patients and families
Benefit–harm assessment	Potential benefit outweighs lack of harm and minimal cost
Intentional vagueness	None
Role of patient preferences	Level of caregiver and patient concern may influence adoption of the DASH diet and physical activity. Patients may also have preferences around the use of a medication. These factors may influence the efficacy of lifestyle change
Exclusions	None
Strength	Weak recommendation
Key references	332,339–342,424–431

involving regular patient and/or family contact and at least 1 hour of moderate to vigorous physical activity on a daily basis should be offered to children and adolescents with obesity and HTN.[444]

7.2d Stress Reduction

Complimentary medicine interventions have shown some promise in studies in normotensive children and adolescents and in those with elevated BP. Breathing-awareness meditation, a component of the Mindfulness-Based Stress Reduction Program at the University of Massachusetts Memorial Medical Center,[445] led to a reduction in daytime, nighttime, and 24-hour SBP (3–4 mm Hg) and DPB (1 mm Hg) in normotensive African American adolescents and African American adolescents with elevated BP.[446] Another study of transcendental meditation showed no significant BP effect but did lead to a decrease in LVM in African American adolescents with elevated BP.[447] Scant data suggest yoga may also be helpful.[448]

7.3 Pharmacologic Treatment

Children who remain hypertensive despite a trial of lifestyle modifications or who have symptomatic HTN, stage 2 HTN without a clearly modifiable factor (eg, obesity), or any stage of HTN associated with CKD or diabetes mellitus therapy should be initiated with a single medication at the low end of the dosing range (see Table 17). Depending on repeated BP measurements, the dose of the initial medication can be increased every 2 to 4 weeks until BP is controlled (eg, <90th percentile), the maximal dose is reached, or adverse effects occur. Although the dose can be titrated every 2 to 4 weeks using home BP measurements, the patient should be seen every 4 to 6 weeks until BP has normalized. If BP is not controlled with a single agent, a second agent can be added to the regimen and titrated as with the initial drug. Because of the salt and water retention that occurs with many antihypertensive medications, a thiazide diuretic is often the preferred second agent.

Lifestyle modifications should be continued in children requiring pharmacologic therapy. An ongoing emphasis on a healthy, plant-strong diet rich in fruits and vegetables; reduced sodium intake; and increased exercise can improve the effectiveness of antihypertensive medications. The use of a combination product as initial treatment has been studied only for bisoprolol and hydrochlorothiazide,[449] so the routine use of combination products to initiate treatment in children cannot be recommended. Once BP control has been achieved, a combination product can be considered as a means to improve adherence and reduce cost if the dose and formulation are appropriate.

7.3a Pharmacologic Treatment and Pediatric Exclusivity Studies

Studies completed in hypertensive children show that antihypertensive drugs decrease BP with few adverse effects.[173,202,242–244,450–467] There are few studies in children in which researchers compare different antihypertensive agents.[453] These studies do not show clinically significant differences in the degree of BP lowering between agents. There are no clinical trials in children that have CV end points as outcomes. Long-term studies on the safety of antihypertensive medications in children and their impact on future CVD are limited.[455]

Because of legislative acts that provide incentives and mandates for drug manufacturers to complete pediatric assessments,[468] most of the newer antihypertensive medications have undergone some degree of efficacy and safety evaluation. Antihypertensive drugs without patent protection have not been, and are unlikely to be, studied in children despite their continued widespread use.[238]

7.3b Pharmacologic Treatment: Choice of Agent

Pharmacologic treatment of HTN in children and adolescents should be initiated with an ACE inhibitor, ARB,[469] long-acting calcium channel blocker, or a thiazide diuretic. Because African American children may not have as robust a response to ACE inhibitors,[470,471] a higher initial dose for the ACE inhibitor may be considered; alternatively, therapy may be initiated with a thiazide diuretic or long-acting calcium channel blocker. In view of the expanded adverse effect profile and lack of association in adults with improved outcomes compared with other agents, β-blockers are not recommended as initial treatment in children. ACE inhibitors and ARBs are contraindicated in pregnancy because these agents can cause injury and death to the developing fetus. Adolescents of childbearing potential should be informed of the potential risks of these agents on the developing fetus; alternative medications (eg, calcium channel blocker, β-blocker) can be considered when appropriate.

In children with HTN and CKD, proteinuria, or diabetes mellitus, an ACE inhibitor or ARB is recommended as the initial antihypertensive agent unless there is an absolute contraindication. Other antihypertensive medications (eg, α-blockers, β-blockers, combination α- and β-blockers, centrally acting agents, potassium-sparing diuretics, and direct vasodilators) should be reserved for children who are not responsive to 2 or more of the preferred agents (see "Treatment in CKD").

Key Action Statement 21

In hypertensive children and adolescents who have failed lifestyle modifications (particularly those

TABLE 19 Oral and Intravenous Antihypertensive Medications for Acute Severe HTN

Drug	Class	Dose	Route	Comments
Useful for Severely Hypertensive Patients With Life-Threatening Symptoms				
Esmolol	β-adrenergic blocker	100–500 mcg/kg per min	Intravenous infusion	Short acting, constant infusion preferred. May cause profound bradycardia
Hydralazine	Direct vasodilator	0.1–0.2 mg/kg per dose up to 0.4 mg/kg per dose	Intravenous, intramuscular	Causes tachycardia Give every 4 h when given intravenous bolus
Labetalol	α- and β-adrenergic blocker	Bolus: 0.20–1.0 mg/kg per dose up to 40 mg per dose Infusion: 0.25–3.0 mg/kg per h	Intravenous bolus or infusion	Asthma and overt heart failure are relative contraindications
Nicardipine	Calcium channel blocker	Bolus: 30 mcg/kg up to 2 mg per dose Infusion: 0.5–4 mcg/kg per min	Intravenous bolus or infusion	May cause reflex tachycardia. Increases cyclosporine and tacrolimus levels
Sodium nitroprusside	Direct vasodilator	Starting: 0–3 mcg/kg per min Maximum: 10 mcg/kg per min	Intravenous infusion	Monitor cyanide levels with prolonged (>72 h) use or in renal failure; or coadminister with sodium thiosulfate
Useful for Severely Hypertensive Patients With Less Significant Symptoms				
Clonidine	Central α-agonist	2–5 mcg/kg per dose up to 10 mcg/kg per dose given every 6–8 h	Oral	Adverse effects include dry mouth and drowsiness
Fenoldopam	Dopamine receptor agonist	0.2–0.5 mcg/kg per min up to 0.8 mcg/kg per min	Intravenous infusion	Higher doses worsen tachycardia without further reducing BP
Hydralazine	Direct vasodilator	0.25 mg/kg per dose up to 25 mg per dose given every 6–8 h	Oral	Half-life varies with genetically determined acetylation rates
Isradipine	Calcium channel blocker	0.05–0.1 mg/kg per dose up to 5 mg per dose given every 6–8 h	Oral	Exaggerated decrease in BP can be seen in patients receiving azole antifungal agents
Minoxidil	Direct vasodilator	0.1–0.2 mg/kg per dose up to 10 mg per dose given Q 8–12 h	Oral	Most potent oral vasodilator, long acting

who have LV hypertrophy on echocardiography, symptomatic HTN, or stage 2 HTN without a clearly modifiable factor [eg, obesity]), clinicians should initiate pharmacologic treatment with an ACE inhibitor, ARB, long-acting calcium channel blocker, or thiazide diuretic (grade B, moderate recommendation).

7.3c Treatment: Follow-Up and Monitoring

Treatment of a child or adolescent with HTN requires ongoing monitoring because goal BP can be difficult to achieve.[472] If the decision has been made to initiate treatment with medication, the patient should be seen frequently (every 4–6 weeks) for dose adjustments and/or addition of a second or third agent until goal BP has been achieved (see the preceding section). After that, the frequency of visits can be extended to every 3 to 4 months.

If the decision has been made to proceed with lifestyle changes only, then follow-up visits can occur at longer intervals (every 3–6 months) so that adherence to lifestyle change can be reinforced and the need for initiation of medication can be reassessed.

In patients treated with antihypertensive medications, home BP measurement is frequently used to get a better assessment of BP control (see "At-Home Measurement"). Repeat ABPM may also be used to assess BP control and is especially important in patients with CKD (see "Treatment: Use of ABPM and Assessment").

At each follow-up visit, the patient should be assessed for adherence to prescribed therapy and for any adverse effects of the prescribed medication; such assessment may include laboratory testing depending on the medication (for example, electrolyte monitoring if the patient is on a diuretic). It is also important to continually reinforce adherence

Key Action Statement 21. In hypertensive children and adolescents who have failed lifestyle modifications (particularly those who have LV hypertrophy on echocardiography, symptomatic HTN, or stage 2 HTN without a clearly modifiable factor [eg, obesity]), clinicians should initiate pharmacologic treatment with an ACE inhibitor, ARB, long-acting calcium channel blocker, or thiazide diuretic (grade B, moderate recommendation).

Aggregate Evidence Quality	Grade B
Benefits	Potential prevention of progressive CVD; regression or avoidance of target organ damage; resolution of hypertensive symptoms; improved cognition; avoidance of worsening HTN; potential avoidance of stroke, heart failure, coronary artery disease, kidney failure
Risks, harm, cost	Potential for hypotension, financial cost, chronic medication treatment, adverse medication effects, impact on insurability (health and life)
Benefit–harm assessment	Preponderance of benefits over harms
Intentional vagueness	None
Role of patient preferences	The choice of which antihypertensive medication to use should be made in close discussion with the patient and parent regarding risk, benefits, and adverse effects
Exclusions	None
Strength	Moderate recommendation
Key references	452,455,467

to lifestyle changes because effective treatment will depend on the combination of effects from both medication and lifestyle measures. Finally, known hypertensive target organ damage (such as LVH) should be reassessed according to the recommendations in "Imaging Evaluation, Echocardiography: Coarctation of the Aorta and Detection of Target Organ Damage."

7.3d Treatment: Use of ABPM to Assess Treatment

ABPM can be an objective method to evaluate treatment effect during antihypertensive drug therapy. Data obtained in a multicenter, single-blind, crossover study in which hypertensive children received a placebo or no treatment demonstrated no change in ABPM after receiving the placebo.[473] A report from a single center found that among hypertensive children receiving antihypertensive drugs, BP data from ABPM resulted in medication changes in 63% of patients.[474] Another study of 38 hypertensive children used ABPM to evaluate the effectiveness of antihypertensive therapy (nonpharmacologic and pharmacologic). After 1 year of treatment, ABPM results indicated that treatment-goal BP was achieved in only one-third of children with HTN.[17]

Key Action Statement 22

ABPM may be used to assess treatment effectiveness in children and adolescents with HTN, especially when clinic and/or home BP measurements indicate insufficient BP response to treatment (grade B, moderate recommendation).

7.4 Treatment-Resistant HTN

Resistant HTN in adults is defined as persistently elevated BP despite treatment with 3 or more antihypertensive agents of different classes. All of these drugs should be prescribed at maximally effective doses, and at least 1 should be a diuretic. Key to the identification of patients with true resistant HTN is correct office BP measurement, confirmation of adherence to current therapy, and confirmation of treatment resistance by ABPM.

The treatment of patients with resistant HTN includes dietary sodium restriction, the elimination of substances known to elevate BP, the identification of previously undiagnosed secondary causes of HTN, the optimization of current therapy, and the addition of additional agents as needed.[475] Recent clinical trial data suggest that an aldosterone receptor antagonist (such as spironolactone) is the optimal additional agent in adults with resistant HTN; it helps address volume excess as well as untreated hyperaldosteronism, which is common in adult patients with true resistant HTN.[476,477]

At present, there are no data on whether true treatment-resistant HTN exists in pediatric patients. Evaluation and management strategies similar to those proven effective in adults with resistant HTN would be reasonable in children and adolescents who present with apparent treatment resistance.

Key Action Statement 22. ABPM may be used to assess treatment effectiveness in children and adolescents with HTN, especially when clinic and/or home BP measurements indicate insufficient BP response to treatment (grade B, moderate recommendation).

Aggregate Evidence Quality	Grade B
Benefits	ABPM results can guide adjustment in medication. ABPM can facilitate achieving treatment-goal BP levels
Risks, harm, cost	Inconvenience and patient annoyance in wearing an ABPM monitor. Cost of ABPM monitors
Benefit–harm assessment	Overall benefit
Intentional vagueness	None
Role of patient preferences	Patients may choose not to wear the ambulatory BP monitor repeatedly, which may necessitate alternative approaches to evaluate treatment efficacy
Exclusions	Uncomplicated HTN with satisfactory BP control
Strength	Moderate recommendation
Key references	17,474,475

8. TREATMENT IN SPECIAL POPULATIONS

8.1 Treatment in Patients With CKD and Proteinuria

8.1a CKD

Children and adolescents with CKD often present with or develop HTN.[478] HTN is a known risk factor for the progression of kidney disease in adults and children.[173,479,480] Evidence suggests that the treatment of HTN in children with CKD might slow the progression of or reverse end organ damage.[173,415] When evaluated by 24-hour ABPM, children and adolescents with CKD often have poor BP control even if BP measured in the clinic appears to be normal.[48] MH is associated with end organ damage, such as LVH.[203,481] Threshold values that define HTN are not different in children with CKD, although there is some evidence that lower treatment goals might improve outcomes.

In the European Effect of Strict Blood Pressure Control and ACE-Inhibition on Progression of Chronic Renal Failure in Pediatric Patients study, researchers randomly assigned children with CKD to standard antihypertensive therapy (with a treatment goal of 24-hour MAP <90th percentile by ABPM) or to intensive BP control (24-hour MAP <50th percentile by ABPM). The study demonstrated fewer composite CKD outcomes in children with the lower BP target.[173] Recent adult data from the Systolic Blood Pressure Intervention Trial suggest lower BP targets may be beneficial in preventing other, adverse CV outcomes as well.[482]

Key Action Statement 23

1. Children and adolescents with CKD should be evaluated for HTN at each medical encounter;
2. Children or adolescents with both CKD and HTN should be treated to lower 24-hour MAP to <50th percentile by ABPM; and
3. Regardless of apparent control of BP with office measures, children and adolescents with CKD and a history of HTN should have BP assessed by ABPM at least yearly to screen for MH (grade B; strong recommendation).

8.1b Proteinuria

Proteinuric renal disease is often associated with HTN and a rapid decline in glomerular filtration.[483] Studies in both adults and children have indicated that both BP control and a reduction in proteinuria are beneficial for preserving renal function. Researchers in multiple studies have evaluated the utility of RAAS blockade therapy in patients with CKD and HTN.[452,464,465,484–487] These medications have been shown to benefit both BP and proteinuria.

The benefit of such therapies may not be sustained, however.[173,488] The Effect of Strict Blood Pressure Control and ACE-Inhibition on Progression of Chronic Renal Failure in Pediatric Patients study demonstrated an initial 50% reduction in proteinuria in children with CKD after treatment with ramipril but with a rebound effect after 36 months.[450,464,488] This study also showed that BP reduction with a ramipril-based antihypertensive regimen improved renal outcomes. In children with HTN related to underlying CKD, the assessment of proteinuria and institution of RAAS blockade therapy appears to have important prognostic implications.

Key Action Statement 24

Children and adolescents with CKD and HTN should be evaluated for proteinuria (grade B, strong recommendation).

Key Action Statement 25

Children and adolescents with CKD, HTN, and proteinuria should be treated with an ACE inhibitor or ARB (grade B, strong recommendation).

Key Action Statement 23. Children and adolescents with CKD should be evaluated for HTN at each medical encounter;

Children or adolescents with both CKD and HTN should be treated to lower 24-hour MAP to <50th percentile by ABPM; and

Regardless of apparent control of BP with office measures, children and adolescents with CKD and a history of HTN should have BP assessed by ABPM at least yearly to screen for MH (grade B; strong recommendation).

Aggregate Evidence Quality	Grade B
Benefits	Control of BP in children and adolescents with CKD has been shown to decrease CKD progression and lead to resolution of LVH
Risks, harm, cost	Cost of ABPM and BP control, both financial and nonfinancial
Benefit–harm assessment	Benefits of BP control in patients with CKD outweigh treatment risks
Intentional vagueness	Threshold
Role of patient preferences	Patients may not want to wear the ambulatory BP monitor repeatedly, which should lead to detailed counseling regarding the benefits of this procedure in CKD
Exclusions	None
Strength	Strong recommendation
Key references	47,173,203,415,480–483

8.2. Treatment in Patients With Diabetes

Based on the Fourth Report criteria for the diagnosis of HTN,[1] between 4% and 16% of children and adolescents with T1DM are found to have HTN.[14,489–491] In the SEARCH study of 3691 youth between the ages of 3 and 17 years, elevated BP was documented in 6% of children with T1DM, with the highest prevalence in Asian Pacific Islander and American Indian children followed by African American and Hispanic children and those with

higher glycosylated hemoglobin A1c levels.[14] An office-based study in Australia found much higher rates (16%) and a positive correlation with BMI.[490] BP >130/90 mm Hg has been associated with a more-than-fourfold increase in the relative risk of coronary artery disease and mortality at 10-year follow-up of individuals with T1DM.[492]

The prevalence of HTN is higher in youth with T2DM compared with T1DM, ranging from 12% at baseline (*N* = 699) in the Treatment Options for Type 2 Diabetes in Adolescents and Youth study[493] to 31% (*N* = 598) in the Pediatric Diabetes Consortium Type 2 Diabetes Clinic Registry.[494] BP and arterial stiffness in cohort studies have correlated with BMI, male sex, African American race, and age of onset of diabetes.[14,494,495] Unlike T1DM, HTN in T2DM is not correlated with glycosylated hemoglobin A1c levels or glycemic failure, and it develops early in the course of the disease.[496] It is also associated with rapid onset of adverse cardiac changes[111,497] and may not respond to diet changes.[425] The concurrence of obesity and T2DM compounds the risks for target end organ damage.[111,498]

Empirical evidence shows a poor awareness of HTN in youth with T1DM and T2DM.[14] Additionally, only a fraction of children with HTN and diabetes were found to be on pharmacologic therapy[14,490,498,499] despite treatment recommendations from the American Diabetes Association,[499] the International Society for Pediatric and Adolescent Diabetes,[500] AHA,[110] and the National Heart, Lung, and Blood Institute.[501]

Key Action Statement 26

Children and adolescents with T1DM or T2DM should be evaluated for HTN at each medical encounter and treated if BP is ≥95th percentile or >130/80 mm Hg in adolescents ≥13 years of age (grade C, moderate recommendation).

9. COMORBIDITIES

9.1 Comorbidities: Dyslipidemia

Children and adolescents with HTN are at increased risk for lipid disorders attributable to the "common soil" phenomenon,[502] in which poor diet, inactivity, and obesity contribute to both disorders. Some observational pediatric data confirm this association.[503–506] Furthermore, both HTN and dyslipidemias are associated with subclinical atherosclerosis[206] and are risk factors for future CVD.[503] Screening is recommended to identify those at increased risk for early atherosclerosis.[503] Treatment of lipid disorders identified in the setting of HTN should follow existing pediatric lipid guidelines with lifestyle advice, including weight loss and pharmacotherapy, as necessary.[503]

9.2 Comorbidities: OSAS

Children with snoring, daytime sleepiness (in adolescents), or hyperactivity (in younger children) may have OSAS and consequent HTN.[507] The more severe the OSAS, the more likely a child is to have elevated BP[44,45] (see Table 18). Children with moderate to severe OSAS are at increased risk for HTN. However, it is not known whether OSAS treatment with continuous positive airway pressure results in improved BP in all children.[44] Furthermore, adenotonsillectomy may not result in BP improvement in all children with OSAS. In particular, children who have obesity and OSAS may be less likely to experience a lowering of BP after an adenotonsillectomy.[508]

Therefore, children with signs of OSAS (eg, daytime fatigue, snoring, hyperactivity, etc) should undergo evaluation for elevated BP regardless of treatment status. Given that both nighttime and daytime BP is affected by OSAS, the use of ABPM is the recommended method for assessing the BP of children with suspected OSAS.

9.3 Comorbidities: Cognitive Impairment

Data from studies conducted in adults suggest that the central nervous system is a target organ that can be affected by HTN.[419] Preliminary studies suggest that this is true in children as well. Hypertensive children score lower on tests of neurocognition and on parental reports of executive function compared with normotensive controls.[509,510] Adams et al[511] found an increased prevalence of learning disabilities in children with primary HTN compared with normotensive controls. The postulated mechanism for these findings is impaired cerebrovascular reactivity.[512–515] At the present time, these findings do not have specific clinical implications with respect to the diagnostic evaluation of childhood HTN, although they underscore the importance of early detection and treatment.

Key Action Statement 24. Children and adolescents with CKD and HTN should be evaluated for proteinuria (grade B, strong recommendation).

Aggregate Evidence Quality	Grade B
Benefits	Detection of proteinuria among children with CKD and HTN may foster early detection and treatment of children at risk for more advanced renal disease
Risks, harm, cost	Additional testing
Benefit–harm assessment	Benefit of detection of a higher-risk group exceeds the risk of testing
Intentional vagueness	Whether to screen children with HTN without CKD for proteinuria
Role of patient preferences	None
Exclusions	Children without CKD
Strength	Strong recommendation
Key references	47,484

Key Action Statement 25. Children and adolescents with CKD, HTN, and proteinuria should be treated with an ACE inhibitor or ARB (grade B, strong recommendation).

Aggregate Evidence Quality	Grade B
Benefits	ACE inhibitor and ARB therapy has been shown in the short-term to be effective in reducing urine proteinuria
Risks, harm, cost	Positive effect on urine protein concentrations after the receipt of an ACE inhibitor may not be sustained over time
Benefit–harm assessment	Treatment with an ACE inhibitor or ARB may lower the rate of progression of renal disease even if the effect is not sustained in the long-term
Intentional vagueness	Whether to aggressively treat the BP so that it is <90th percentile
Role of patient preferences	Patients may have concerns about the choice of medication, which should be addressed
Exclusions	Children without CKD
Strength	Strong recommendation
Key references	173,464,465,485,487,488

Key Action Statement 26. Children and adolescents with T1DM or T2DM should be evaluated for HTN at each medical encounter and treated if BP is ≥95th percentile or >130/80 mm Hg in adolescents ≥13 years of age (grade C, moderate recommendation).

Aggregate Evidence Quality	Grade C
Benefits	Early detection and treatment of HTN in children with T1DM and T2DM may reduce future CV and kidney disease
Risks, harm, cost	Risk of drug adverse effects and polypharmacy
Benefit–harm assessment	Preponderance of benefit
Intentional vagueness	None
Role of patient preferences	Family concerns about additional testing and/or medication may need to be addressed
Exclusions	None
Strength	Weak to moderate recommendation
Key references	14,110,111,494

10. SEX, RACIAL, AND ETHNIC DIFFERENCES IN BP AND MEDICATION CHOICE

BP differences between various ethnic groups are well described in the adult population.[216,516] Large, cross-sectional studies have demonstrated that, per capita, minority ethnic groups have both a higher prevalence of HTN and more significant end organ damage and outcomes.[517,518] Although a growing body of evidence indicates that racial and ethnic differences in BP appear during adolescence,[519–521] the cause of these differences and when they develop in childhood are yet to be fully determined. The risk of HTN correlates more with obesity status than with ethnicity or race, although there may be some interaction.[216] At this time, although limited data suggest that there may be a racial difference in response to ACE inhibitors in the pediatric age group,[471] the strength of available evidence is insufficient to recommend using racial, sex, or ethnic factors to inform the evaluation or management of HTN in children.

11. SPECIAL POPULATIONS AND SITUATIONS

11.1 Acute Severe HTN

There is a lack of robust evidence to guide the evaluation and management of children and adolescents with acute presentations of severe HTN. Thus, much of what is known is derived from studies conducted in adults, including medication choice.[522] The evidence base has been enhanced somewhat over the past decade by the publication of several pediatric clinical trials and case series of antihypertensive agents that can be used to treat such patients.[465,523–530]

Although children and adolescents can become symptomatic from HTN at lesser degrees of BP elevation, in general, patients who present with acute severe HTN will have BP elevation well above the stage 2 HTN threshold. In a study of 55 children presenting to a pediatric ED in Taiwan with hypertensive crisis, 96% had SBP greater than that of stage 2 HTN, and 76% had DBP greater than that of stage 2 HTN.[531] The major clinical issue in such children is that this level of BP elevation may produce acute target organ effects, including encephalopathy, acute kidney injury, and congestive heart failure. Clinicians should be concerned about the development of these complications when a child's BP increases 30 mm Hg or more above the 95th percentile.

Although a few children with primary HTN may present with features of acute severe HTN,[532] the vast majority will have an underlying secondary cause of HTN.[532,533] Thus, for patients who present with acute severe HTN, an evaluation for secondary causes is appropriate and should be conducted expediently. Additionally, target organ effects should be assessed with renal function, echocardiography, and central nervous system imaging, among others.

Given the potential for the development of potentially life-threatening complications, expert opinion holds that children and adolescents who present with acute severe HTN require immediate treatment with short-acting antihypertensive medications that may abort such sequelae.[533,534] Treatment may be initiated with oral agents if the patient is able to tolerate oral therapy and if

TABLE 20 Comparison of HTN Screening Strategies

Dimension	Option A (Clinic BP Alone)	Option B (Clinic BP Confirmed by ABPM)	Option C (ABPM Only)	Preferred Option	Assumptions Made
Population: 170 cardiology, nephrology referred patients; analyzed at single-patient level	Auscultatory or oscillatory BP >95%	Auscultatory or oscillatory BP >90% then ABPM	Patients referred to provider who only used ABPM	—	—
Operational factors					
Percent adherence to care (goal of 80%)	Assumes 100%	Assumes 100%	Assumes 100%	—	—
Care delivery team effects	Baseline	Additional work to arrange or interpret confirmatory ABPM	Additional work to arrange and interpret ABPM for all patients	—	Assumes ABPM can be arranged and interpreted correctly
Patient, family effects	Baseline	Less desirable to have more visits; more desirable to have better accuracy		Family opinion depends on family's values	—
Benefits					
Clinical significance	Baseline	If HTN, treatment improves long-term outcome	If HTN, treatment improves long-term outcome	C	WCH estimated at 35%, ABPM results in fewer false-positive screening results
Cost of options					
Visit, diagnosis costs (annual estimated cost for 1 patient)	$1860 for visits and laboratory tests	$1330 for visits, ABPM, and laboratory tests	$1880 for visits, ABPM, and laboratory tests	B	—
Costs from complications, adverse events, nonoptimal treatment					
Likelihood of nonoptimal treatment	60% undiagnosed patients; 35% of those diagnosed with WCH	30% undiagnosed patients	All patients correctly diagnosed; fewer complications	C	Assumes treatment benefit for correctly diagnosed HTN has no complications
Costs of nonoptimal treatment	Increased mortality for not treating undiagnosed HTN; inconvenience of treatment of patients with WCH	Increased mortality for not treating undiagnosed HTN	All patients correctly diagnosed who are treated	C	—

—, none.

life-threatening complications have not yet developed. Intravenous agents are indicated when oral therapy is not possible because of the patient's clinical status or when a severe complication has developed (such as congestive heart failure) that warrants a more controlled BP reduction. In such situations, the BP should be reduced by no more than 25% of the planned reduction over the first 8 hours, with the remainder of the planned reduction over the next 12 to 24 hours.[533,534] The ultimate short-term BP goal in such patients should generally be around the 95th percentile. Table 19 lists suggested doses for oral and intravenous antihypertensive medications that may be used to treat patients with acute severe HTN.

Key Action Statement 27

In children and adolescents with acute severe HTN and life-threatening symptoms, immediate treatment with short-acting antihypertensive medication should be initiated, and BP should be reduced by no more than 25% of the planned reduction over the first 8 hours (grade expert opinion D, weak recommendation).

11.2 HTN and the Athlete

Sports participation and increased physical activity should be encouraged in children with HTN. In adults, physical fitness is associated with lower all-cause mortality.[536] Although meta-analyses and randomized controlled trials consistently show lower BP after exercise training in adults,[535] the results are less robust in children.[340] On the basis of this evidence, sports participation should improve BP over time. Additionally, there is evidence that exercise itself has a beneficial effect on cardiac structure in adolescents.[537]

The athlete interested in participating in competitive sports

and/or intense training presents a special circumstance. Existing guidelines present conflicting recommendations.[1,538] Although increased LV wall dimension may be a consequence of athletic training,[360] recommendations from AHA and ACC include the following: (1) limiting competitive athletic participation among athletes with LVH beyond that seen with athlete's heart until BP is normalized by appropriate antihypertensive drug therapy, and (2) restricting athletes with stage 2 HTN (even among those without evidence of target organ injury) from participating in high-static sports (eg, weight lifting, boxing, and wrestling) until HTN is controlled with either lifestyle modification or drug therapy.[539]

The AAP policy statement "Athletic Participation by Children and Adolescents Who Have Systemic Hypertension" recommends that children with stage 2 HTN be restricted from high-static sports (classes IIIA to IIIC) in the absence of end organ damage, including LVH or concomitant heart disease, until their BP is in the normal range after lifestyle modification and/or drug therapy.[538] It is further recommended that athletes be promptly referred and evaluated by a qualified pediatric medical subspecialist within 1 week if they are asymptomatic or immediately if they are symptomatic. The subcommittee agrees with these recommendations.

It should be acknowledged that there are no data linking the presence of HTN to sudden death related to sports participation in children, although many cases of sudden death are of unknown etiology. That said, athletes identified as hypertensive (eg, during preparticipation sports screening) should undergo appropriate evaluation as outlined above. For athletes with more severe HTN (stage 2 or greater), treatment should be initiated before sports participation.

Key Action Statement 28

Children and adolescents with HTN may participate in competitive sports once hypertensive target organ effects and risk have been assessed (grade C, moderate recommendation).

Key Action Statement 29

Children and adolescents with HTN should receive treatment to lower BP below stage 2 thresholds before participating in competitive sports (grade C, weak recommendation).

11.3 HTN and the Posttransplant Patient

HTN is common in children after solid-organ transplants, with prevalence rates ranging from 50% to 90%.[179,180,540,541] Contributing factors include the use of steroids, calcineurin inhibitors, and mTOR (mammalian target of rapamycin) inhibitors. In patients with renal transplants, the presence of native kidneys, CKD, and transplant glomerulopathy are additional risk factors for HTN. HTN rates are higher by 24-hour ABPM compared with clinic BP measurements because these populations commonly have MH and nocturnal HTN.[179–183,542] Control of HTN in renal-transplant patients has been improved with the use of annual ABPM.[184,185] Therefore, ABPM should be used to identify and monitor nocturnal BP abnormalities and MH in pediatric kidney and heart-transplant recipients. The use of home BP assessment may provide a comparable alternative to ABPM for BP assessment after transplant as well.[186]

The management of identified HTN in the pediatric transplant patient can be challenging. Rates of control of HTN in renal-transplant patients generally range from 33% to 55%.[180,187] In studies by Seeman et al,[188] intensified antihypertensive treatment in pediatric renal-transplant recipients improved nocturnal SBP and significantly reduced proteinuria.[543] Children in these studies who achieved normotension had stable graft function, whereas those who remained hypertensive at 2 years had a progression of renal disease.[544]

Antihypertensive medications have rarely been systematically studied in this population. There is limited evidence that ACE inhibitors and ARBs may be superior to other agents in achieving BP control and improving long-term graft survival in renal-transplant patients.[185,543,544] However, the combination of ACE inhibitors and ARBs in renal-transplant patients has been associated with acidosis and hyperkalemia and is not recommended.[545]

Key Action Statement 27. In children and adolescents with acute severe HTN and life-threatening symptoms, immediate treatment with short-acting antihypertensive medication should be initiated, and BP should be reduced by no more than 25% of the planned reduction over the first 8 hours (grade expert opinion D, weak recommendation).

Aggregate Evidence Quality	Expert Opinion, D
Benefits	Avoidance of complications caused by rapid BP reduction
Risks, harm, cost	Severe BP elevation may persist
Benefit–harm assessment	Benefit outweighs harm
Intentional vagueness	None
Role of patient preferences	None
Exclusions	Patients without acute severe HTN and life-threatening symptoms
Strength	Weak recommendation because of expert opinion
Key references	240,533,535

12. LIFETIME HTN TREATMENT AND TRANSITION TO ADULTHOOD

For adolescents with HTN requiring ongoing treatment, the

Key Action Statement 28. Children and adolescents with HTN may participate in competitive sports once hypertensive target organ effects and risk have been assessed (grade C, moderate recommendation).

Aggregate Evidence Quality	Grade C
Benefits	Aerobic exercise improves CVD risk factors in children and adolescents with HTN
Risks, harm, cost	Unknown, but theoretical risk related to a rise in BP with strenuous exercise may exist
Benefit–harm assessment	The benefits of exercise likely outweigh the potential risk in the vast majority of children and adolescents with HTN
Intentional vagueness	None
Role of patient preferences	Families may have different opinions about sports participation in children with HTN
Exclusions	None
Strength	Moderate recommendation
Key references	341,360,538,540,541

Key Action Statement 29. Children and adolescents with HTN should receive treatment to lower BP below stage 2 thresholds before participating in competitive sports (grade C, weak recommendation).

Aggregate Evidence Quality	Grade C
Benefits	Aerobic exercise improves CVD risk factors in children and adolescents with HTN
Risks, harm, cost	Unknown, but theoretical risk related to a rise in BP with strenuous exercise may exist
Benefit–harm assessment	The benefits of exercise likely outweigh the potential risk in the vast majority of children and adolescents with HTN
Intentional vagueness	None
Role of patient preferences	None
Exclusions	None
Strength	Weak recommendation
Key references	341,360,538,540,541

transition from pediatric care to an adult provider is essential.[546] HTN definition and treatment recommendations in this guideline are generally consistent with the forthcoming adult HTN treatment guideline, so diagnosis and treatment should not typically change with transition.

Key Action Statement 30

Adolescents with elevated BP or HTN (whether they are receiving antihypertensive treatment) should typically have their care transitioned to an appropriate adult care provider by 22 years of age (recognizing that there may be individual cases in which this upper age limit is exceeded, particularly in the case of youth with special health care needs). There should be a transfer of information regarding HTN etiology and past manifestations and complications of the patient's HTN (grade X, strong recommendation).

13. PREVENTION OF HTN

13.1 Importance of Preventing HTN

BP levels tend to increase with time even after adult height is reached. The rate of progression to frank HTN in a study of more than 12 000 Japanese adults (20–35 years of age at baseline, followed for 9 years) was 36.5% and was greater with higher baseline BP category.[548] The rate of progression may also be accelerated in African American individuals. Similarly, both the Bogalusa Heart[63] and Fels Longitudinal[60] studies have clearly demonstrated that the risk of HTN in early adulthood is dependent on childhood BP, with greater numbers of elevated BP measurements in childhood conferring an increased risk of adult HTN.

Because the tracking of BP levels in children has also been well documented,[10] it is not surprising that analyses of the National Childhood BP database found 7% of adolescents with elevated BP per year progressed to true hypertensive BP levels. Of note, initial BMI and change in BMI were major determinants of the development of HTN.[22] Therefore, in both children and adults, efforts (discussed below) should be made to prevent progression to sustained HTN and to avoid the development of hypertensive CV diseases.

13.2 Strategies for Prevention

One of the largest trials of preventing progression to HTN in adults, the Trial of Preventing Hypertension study, proved that 2 years of treatment with candesartan reduced the number of subjects with elevated BP from developing stage 1 HTN even after the drug was withdrawn.[547] However, no similar study has been conducted in youth; for this reason, prevention efforts to date have focused on lifestyle modification, especially dietary intervention,[426] exercise,[549] and treatment of obesity.[550] The best evidence for the potential of such prevention strategies comes from epidemiologic evidence for risk factors for the development of HTN or from studies focused on the treatment of established HTN. These risk factors include positive family history, obesity, a high-sodium diet, the absence of a DASH-type diet, larger amounts of

Key Action Statement 30. Adolescents with elevated BP or HTN (whether they are receiving antihypertensive treatment) should typically have their care transitioned to an appropriate adult care provider by 22 years of age (recognizing that there may be individual cases in which this upper age limit is exceeded, particularly in the case of youth with special health care needs). There should be a transfer of information regarding HTN etiology and past manifestations and complications of the patient's HTN (grade X, strong recommendation).

Aggregate Evidence Quality	Grade X
Benefits	Provides continuity of care for patients
Risks, harm, cost	None
Benefit–harm assessment	No risk
Intentional vagueness	None
Role of patient preferences	Patient can pick adult care provider
Exclusions	None
Strength	Strong recommendation
Key references	547

sedentary time, and possibly other dietary factors.[551–553]

Because family history is immutable, it is difficult to build a preventive strategy around it. However, a positive family history of HTN should suggest the need for closer BP monitoring to detect HTN if it occurs.

Appropriate energy balance with calories eaten balanced by calories expended in physical activity is important. This is the best strategy to maintain an appropriate BMI percentile for age and sex and to avoid the development of obesity.[554] From a broader dietary perspective, a DASH-type diet (ie, high in fruits, vegetables, whole grains, and low-fat dairy, with decreased intake of foods high in saturated fat or sugar) may be beneficial (see Table 16).[423,427] Avoiding high-sodium foods may prove helpful in preventing HTN, particularly for individuals who are more sensitive to dietary sodium intake.[555]

Adhering to recommendations for 60 minutes a day of moderate to vigorous physical activity can be important to maintaining an appropriate weight and may be independently helpful to maintaining a lower BP.[344] The achievement of normal sleep habits and avoidance of tobacco products are also reasonable strategies to reduce CV risk.

These preventive strategies can be implemented as part of routine primary health care for children and adolescents.

14. CHALLENGES IN THE IMPLEMENTATION OF PEDIATRIC HTN GUIDELINES

Many studies have shown that physicians fail to meet benchmarks with respect to screening, especially universal screening for high BP in children.[7,115] Although the reasons for this failure likely vary from practice to practice, a number of common challenges can be identified.

The first challenge is determining how to identify every child in a clinic who merits a BP measurement. This could be accomplished through flags in an EHR, documentation rules for specific patients, and/or clinic protocols.

The second challenge is establishing a local clinic protocol for measuring BP correctly on the basis of the algorithms in this guideline. It is important to determine the optimal approach on the basis of the available equipment, the skills of clinic personnel, and the clinic's throughput needs.

The third challenge is for clinic personnel to be aware of what to do with high BP measurements when they occur. Knowing when to counsel patients, order tests or laboratory work, and reach out for help is essential. Making this part of standard practice so every child follows the prescribed pathway may be challenging.

The final diagnosis of HTN also relies on a number of sequential visits. Ensuring that patients return for all of these visits and are not lost to follow-up may require new clinic processes or mechanisms. Information technology may help remind providers to schedule these visits and remind patients to attend these visits; even with that assistance, however, completing all the visits may be difficult for some patients.

In addition, family medicine physicians and general pediatricians may face challenges in having normative pediatric BP values available for use at all times. Although adult BP cutoffs are easy to memorize, pediatric BP percentile cutoffs are greatly dependent on age and height. The BP tables in this guideline provide cutoffs to use for the proper diagnosis of HTN; their availability will simplify the recognition of abnormal BP values.

The AAP Education in Quality Improvement for Pediatric Practice module on HTN identification and management[556] and its accompanying implementation guide[557] should be of assistance to practitioners who wish to improve their approach to identifying and managing childhood HTN. This module is currently being updated to incorporate the new recommendations in this guideline.

15. OTHER TOPICS

15.1 Economic Impact of BP Management

Researchers in a small number of studies have examined the potential economic impacts related to pediatric BP management.[208,558,559] Wang et al[558] estimated both the effectiveness and cost-effectiveness of 3 screening strategies and interventions to normalize pediatric BP based on the literature and through a simulation of children (n = 4 017 821). The 3 screening strategies included the following: (1) no screening; (2) selected screening and treatment, as well as "treating everyone" (ie, with population-wide interventions, such as targeted programs for overweight adolescents [eg, weight-loss programs, exercise programs, and salt-reduction programs]); and (3) nontargeted programs for exercise and salt reduction.

The simulation suggested that these various strategies could reduce mortality, with a modest expected survival benefit of 0.5 to 8.6 days. The researchers also examined quality-adjusted life-years (QALYs) and the cost per QALY. Only 1 intervention, a nontargeted salt-reduction campaign, had a negative cost per QALY. This intervention and the other 2 described in that article support the concept that population-wide interventions may be the most cost-effective way to improve CV health. The article has serious limitations, however, including the fact that population-wide interventions for exercise and the reduction of sodium intake have not, thus far, been effective.

The accurate determination of those who actually have HTN (as opposed to WCH) is fundamental to providing sound care to patients. Researchers in two studies examined the effects of using ABPM in the diagnosis of HTN.[208,559] Davis et al[559] compared 3 HTN screening strategies; these options are summarized in the following value-analysis framework (see Table 20).[560] It appears that the implementation of ABPM for all patients is not ensured. The next best option, screening clinic BP with ABPM, is most likely to be implementable and has significant clinical benefit given the high prevalence of WCH.

Swartz et al[208] conducted a retrospective review of 267 children with elevated clinic BP measurements referred for ABPM. Of the 126 patients who received ABPM, 46% had WCH, 49% had stage 1 HTN, and 5% had stage 2 HTN. This is consistent with the concept that screening with clinic BP alone results in high numbers of false-positive results for HTN. The diagnosis of HTN in this study resulted in an additional $3420 for evaluation (includes clinic visit, facility fee, laboratory testing, renal ultrasound, and echocardiography) vs $1265 (includes clinic visit, facility fee, and ABPM). This suggests that ABPM is cost-effective because of the reduction of unnecessary testing in patients with WCH.

When examining these costs, the availability of ABPM, and the availability of practitioners who are skilled in pediatric interpretation, the most cost-effective and implementable screening solution is to measure clinic BP and confirm elevated readings by ABPM.

15.2 Patient Perspective and Pediatric HTN

Children and adolescents are not just patients; they are active participants in their health management. If children and adolescents lack a clear understanding of what is happening inside their bodies, they will not be able to make informed choices in their daily activities. Better choices lead to better decisions executed in self-care. For clear judgments to be made, there needs to be open communication between physicians and families, a provision of appropriate education on optimal HTN management, and a strong partnership assembled within a multidisciplinary health care team including physicians, advanced practice providers, dietitians, nurses, and medical and clinical assistants.

It is important for physicians to be mindful that children and adolescents want, and need, to be involved in their medical care. Pediatric HTN patients are likely to feel excluded when clinicians or other providers speak to their parents instead of including them in the conversation. When patients are neither included in the discussion nor encouraged to ask questions, their anxiety can increase, thus worsening their HTN. Keeping an open line of communication is important and is best done by using a team approach consisting of the patient, the family, health care support staff, and physicians. With practical education on HTN management provided in easily understandable terms, the patients will be more likely to apply the concepts presented to them. Education is important and should be given in a way that is appropriate for young children and their families to understand. Education should consist of suitable medication dosing, a proper diet and level of activity, the identification of symptoms, and appropriate BP monitoring (including cuff size).

15.3 Parental Perspective and Pediatric HTN

Parents play a key role in the management and care of their children's health. Parents and physicians should act as a cohesive unit to foster the best results. It

is vital for physicians to provide concise information in plain language and do so using a team approach. This will facilitate parents having a clear understanding of the required tests, medications, follow-ups, and outcomes.

Patient Perspective, by Matthew Goodwin

"I am not just a 13 year old, I am a teenager who has lived with hypertension, renal disease, and midaortic syndrome since I was 4 years old. I have experienced surgeries, extended hospitalizations, daily medications, procedures, tests, continued blood pressure monitoring, lifestyle changes, and dietary restrictions. Hypertension is a part of my everyday life. It will always be a component of me. I had to learn the effects of hypertension at a young age. I knew what would happen to me if I ate too much salt or did not fully hydrate, thus I became watchful. I did this so I could efficiently communicate with my physicians any changes I physically felt or any symptoms that were new or different regarding my illness. This has allowed me, my family, and my doctors to work effectively as one unit. I am grateful for my doctors listening to me as a person and not as a kid."

Parents of children with hypertensive issues can encounter 1 or more specialists in addition to their pediatric clinician. This can prove to be overwhelming, frightening, and may fill the parent with anxiety. Taking these things into account and creating unified partners, built with the physician and family, will encourage the family to be more involved in the patient's health management. Plain language in a team approach will yield the most positive outcomes for the patient.

Understanding the family and patient's perception of HTN and any underlying disease that may be contributing to it is important to resolve any misconceptions and encourage adherence to the physician's recommendations. To attain therapeutic goals, proper education must be provided to the family as a whole. This education should include proper medication dosages, recommended sodium intake, any dietary changes, exercise expectations, and any other behavioral changes. It is equally important to stress to the family the short- and long-term effects of HTN if it is not properly managed. Parents with younger children will carry the ultimate burden of daily decisions as it applies to medications, food choices, and activity. Parents of older adolescents will partner with the children to encourage the right choices. Education as a family unit is important for everyone involved to understand the consequences.

A family-based approach is important for all pediatric diseases but plays a particular role in conditions that are substantially influenced by lifestyle behaviors. This has been shown in several pediatric populations, including those with T2DM and obesity.[561–565]

16. EVIDENCE GAPS AND PROPOSED FUTURE DIRECTIONS

In general, the pediatric HTN literature is not as robust as the adult HTN literature. The reasons for this are many, but the 2 most important are as follows: (1) the lower prevalence of HTN in childhood compared with adults, and (2) the lack of adverse CV events (myocardial infarction, stroke, and death) attributable to HTN in young patients. These factors make it difficult to conduct the types of clinical trials that are needed to produce high-quality evidence. For example, no large pediatric cohort has ever been assembled to answer the question of whether routine BP measurement in childhood is useful to prevent adult CVD.[566] Given this, other types of evidence, such as from cross-sectional and observational cohort studies, must be examined to guide practice.[567]

From the standpoint of the primary care provider, the most significant evidence gaps relate to whether diagnosing elevated BP and HTN in children and adolescents truly has long-term health consequences, whether antihypertensive medications should be used in a child or adolescent with elevated BP, and what medications should be preferentially used. These evidence gaps have been alluded to previously in this document.

Other important evidence gaps should be highlighted, including the following:

- Is there a specific BP level in childhood that predicts adverse outcomes, and can a single number (or numbers) be used to define HTN, as in adults?
- Can and should ABPM ever replace auscultation in the diagnosis of childhood HTN?
- Are the currently used, normative standards for ABPM appropriate, or are new normative data needed?[568]
- What is the best diagnostic evaluation to confidently exclude secondary causes of HTN?
- Are other assessments of hypertensive target organ damage (such as urine MA or vascular studies) better than echocardiography?
- How confident can we be that a child or teenager with elevated BP

will have HTN and/or CVD disease as an adult?

Some of these questions may eventually be answered by research that is currently in progress, such as further analysis of the International Childhood Cardiovascular Cohort Consortium[569] and the promising Adult Hypertension Onset in Youth study, which seeks to better define the level of BP in childhood that predicts the development of hypertensive target organ damage.[570] Other studies will need to be performed in children and adolescents to fill in the remaining gaps, including more rigorous validation studies of automated BP devices in the pediatric population, expanded trials of lifestyle interventions, further comparative trials of antihypertensive medications, and studies of the clinical applicability of hypertensive target organ assessments.

Furthermore, and perhaps more crucially, there needs to be prospective assessment of the recommendations made in this document with regular updates based on new evidence as it is generated (generally, per AAP policy, these occur approximately every 5 years). With such ongoing reassessment and revision, it is hoped that this document and its future revisions will come to be viewed as an effective guide to practice and will improve the care of the young patients who are entrusted to us.

Implementation tools for this guideline are available on the AAP Web site (https://www.aap.org/en-us/about-the-aap/Committees-Councils-Sections/coqips/Pages/Implementation-Guide.aspx).

AUTHORS

Joseph T. Flynn, MD, MS, FAAP
David C. Kaelber, MD, PhD, MPH, FAAP, FACP, FACMI
Carissa M. Baker-Smith, MD, MS, MPH, FAAP, FAHA
Douglas Blowey, MD
Aaron E. Carroll, MD, MS, FAAP
Stephen R. Daniels, MD, PhD, FAAP
Sarah D. de Ferranti, MD, MPH, FAAP
Janis M. Dionne, MD, FRCPC
Susan K. Flinn, MA
Bonita Falkner, MD
Samuel S. Gidding, MD
Celeste Goodwin
Michael G. Leu, MD, MS, MHS, FAAP
Makia E. Powers, MD, MPH, FAAP
Corinna Rea, MD, MPH, FAAP
Joshua Samuels, MD, MPH, FAAP
Madeline Simasek, MD, MSCP, FAAP
Vidhu V. Thaker, MD, FAAP
Elaine M. Urbina, MD, MS, FAAP

SUBCOMMITTEE ON SCREENING AND MANAGEMENT OF HIGH BLOOD PRESSURE IN CHILDREN (OVERSIGHT BY THE COUNCIL ON QUALITY IMPROVEMENT AND PATIENT SAFETY)†

Joseph T. Flynn, MD, MS, FAAP, Co-chair, Section on Nephrology
David Kaelber, MD, MPH, PhD, FAAP, Co-chair, Section on Medicine-Pediatrcs, Council on Clinical Information Technology
Carissa M. Baker-Smith, MD, MS, MPH, Epidemiologist and Methodologist
Aaron Carroll, MD, MS, FAAP, Partnership for Policy Implementation
Stephen R. Daniels, MD, PhD, FAAP, Committee on Nutrition
Sarah D. de Ferranti, MD, MPH, FAAP, Committee on Cardiology and Cardiac Surgery
Michael G. Leu, MD, MS, MHS, FAAP, Council on Quality Improvement and Patient Safety
Makia Powers, MD, MPH, FAAP, Committee on Adolescence
Corinna Rea, MD, MPH, FAAP, Section on Early Career Physicians
Joshua Samuels, MD, MPH, FAAP, Section on Nephrology
Madeline Simasek, MD, FAAP, Quality Improvement Innovation Networks
Vidhu Thaker, MD, FAAP, Section on Obesity

LIAISONS

Douglas Blowey, MD, *American Society of Pediatric Nephrology*
Janis Dionne, MD, FRCPC, *Canadian Association of Paediatric Nephrologists*
Bonita Falkner, MD, *International Pediatric Hypertension Association*
Samuel Gidding, MD, *American College of Cardiology, American Heart Association*
Celeste Goodwin, *National Pediatric Blood Pressure Awareness Foundation*
Elaine Urbina, MD, FAAP, *American Heart Association AHOY Committee*

MEDICAL WRITER

Susan K. Flinn, MA

STAFF

Kymika Okechukwu, MPA, Manager, Evidence-Based Practice Initiatives

ABBREVIATIONS

AAP: American Academy of Pediatrics
ABPM: ambulatory blood pressure monitoring
ACC: American College of Cardiology
ACE: angiotensin-converting enzyme
AHA: American Heart Association
ARB: angiotensin receptor blocker
ARR: aldosterone to renin ratio
BP: blood pressure
BSA: body surface area
cIMT: carotid intimamedia thickness
CKD: chronic kidney disease
CTA: computed tomographic angiography
CV: cardiovascular
CVD: cardiovascular disease
DASH: Dietary Approaches to Stop Hypertension
DBP: diastolic blood pressure
ED: emergency department
EHR: electronic health record
FMD: flow-mediated dilation
HTN: hypertension
LVH: left ventricular hypertrophy
LVMI: left ventricular mass index
MA: microalbuminuria
MAP: mean arterial pressure
MH: masked hypertension
MI: motivational interviewing
MRA: magnetic resonance angiography
NF-1: neurofibromatosis type 1
OSAS: obstructive sleep apnea syndrome
PCC: pheochromocytoma
PICOT: Patient, Intervention/Indicator, Comparison, Outcome, and Time
PRA: plasma renin activity
PWV: pulse wave velocity
QALY: quality-adjusted life-year
RAAS: renin-angiotensin-aldosterone system
RAS: renal artery stenosis
SBP: systolic blood pressure
SDB: sleep-disordered breathing
T1DM: type 1 diabetes mellitus
T2DM: type 2 diabetes mellitus
UA: uric acid
WCH: white coat hypertension

Seattle, Washington; [n]Department of Pediatrics, School of Medicine, Morehouse College, Atlanta, Georgia; [o]Associate Director, General Academic Pediatric Fellowship, Staff Physician, Boston's Children's Hospital Primary Care at Longwood, Instructor, Harvard Medical School, Boston, Massachusetts; Departments of [p]Pediatrics and Internal Medicine, McGovern Medical School, University of Texas, Houston, Texas; [q]Pediatric Education, University of Pittsburgh Medical Center Shadyside Family Medicine Residency, Clinical Associate Professor of Pediatrics, Children's Hospital of Pittsburgh of University of Pittsburgh Medical Center, and School of Medicine, University of Pittsburgh, Pittsburgh, Pennsylvania; [r]Division of Molecular Genetics, Department of Pediatrics, Columbia University Medical Center, New York, New York; and [s]Preventive Cardiology, Cincinnati Children's Hospital Medical Center, Department of Pediatrics, University of Cincinnati, Cincinnati, Ohio

Drs Flynn and Kaelber served as the specialty and primary care chairs of the Subcommittee and had lead roles in developing the framework for the guidelines and coordinating the overall guideline development; Dr Baker-Smith served as the epidemiologist and led the evidence review and synthesis; Ms. Flinn compiled the first draft of the manuscript and coordinated manuscript revisions; All other authors were significantly involved in all aspects of the guideline creation including initial scoping, literature review and synthesis, draft manuscript creation and manuscript review; and all authors approved the final manuscript as submitted.

The guidance in this report does not indicate an exclusive course of treatment or serve as a standard of medical care. Variations, taking into account individual circumstances, may be appropriate.

All clinical practice guidelines from the American Academy of Pediatrics automatically expire 5 years after publication unless reaffirmed, revised, or retired at or before that time.

Endorsed by the American Heart Association.

DOI: https://doi.org/10.1542/peds.2017-1904

Address correspondence to Joseph T Flynn. Email: joseph.flynn@seattlechildrens.org

PEDIATRICS (ISSN Numbers: Print, 0031-4005; Online, 1098-4275).

FINANCIAL DISCLOSURE: The authors have indicated that they have no financial relationships relevant to this article to disclose.

FUNDING: The American Academy of Pediatrics provided funding to cover travel costs for subcommittee members to attend subcommittee meetings, to pay for the epidemiologist (Dr Baker-Smith) and consultant (Susan Flynn), and to produce the revised normative blood pressure tables.

POTENTIAL CONFLICT OF INTEREST: The authors have indicated that they have no potential conflicts of interest to disclose.

REFERENCES

1. National High Blood Pressure Education Program Working Group on High Blood Pressure in Children and Adolescents. The fourth report on the diagnosis, evaluation, and treatment of high blood pressure in children and adolescents. *Pediatrics*. 2004;114(2, suppl 4th Report):555–576
2. Institute of Medicine, Committee on Standards for Systematic Reviews of Comparative Effectiveness Research. In: Eden J, Levit L, Berg A, Morton S, eds. *Finding What Works in Health Care: Standards for Systematic Reviews*. Washington, DC: National Academies Press; 2011
3. American Academy of Pediatrics Steering Committee on Quality Improvement and Management. Classifying recommendations for clinical practice guidelines. *Pediatrics*. 2004;114(3):874–877
4. Rosner B, Cook NR, Daniels S, Falkner B. Childhood blood pressure trends and risk factors for high blood pressure: the NHANES experience 1988-2008. *Hypertension*. 2013;62(2):247–254
5. Din-Dzietham R, Liu Y, Bielo MV, Shamsa F. High blood pressure trends in children and adolescents in national surveys, 1963 to 2002. *Circulation*. 2007;116(13):1488–1496
6. Kit BK, Kuklina E, Carroll MD, Ostchega Y, Freedman DS, Ogden CL. Prevalence of and trends in dyslipidemia and blood pressure among US children and adolescents, 1999-2012. *JAMA Pediatr*. 2015;169(3):272–279
7. Hansen ML, Gunn PW, Kaelber DC. Underdiagnosis of hypertension in children and adolescents. *JAMA*. 2007;298(8):874–879
8. McNiece KL, Poffenbarger TS, Turner JL, Franco KD, Sorof JM, Portman RJ. Prevalence of hypertension and pre-hypertension among adolescents. *J Pediatr*. 2007;150(6):640–644, 644.e1
9. Chiolero A, Cachat F, Burnier M, Paccaud F, Bovet P. Prevalence of hypertension in schoolchildren based on repeated measurements and association with overweight. *J Hypertens*. 2007;25(11):2209–2217
10. Chen X, Wang Y. Tracking of blood pressure from childhood to adulthood: a systematic review and meta-regression analysis. *Circulation*. 2008;117(25):3171–3180
11. Theodore RF, Broadbent J, Nagin D, et al. Childhood to early-midlife systolic blood pressure trajectories: early-life predictors, effect modifiers, and adult cardiovascular outcomes. *Hypertension*. 2015;66(6):1108–1115
12. Mozaffarian D, Benjamin EJ, Go AS, et al; Writing Group Members; American Heart Association Statistics Committee; Stroke Statistics Subcommittee. Executive summary: heart disease and stroke statistics—2016 update: a report from the American Heart Association. *Circulation*. 2016;133(4):447–454
13. Liberman JN, Berger JE, Lewis M. Prevalence of antihypertensive, antidiabetic, and dyslipidemic prescription medication use among children and adolescents. *Arch Pediatr Adolesc Med*. 2009;163(4):357–364
14. Rodriguez BL, Dabelea D, Liese AD, et al; SEARCH Study Group. Prevalence and correlates of elevated blood pressure in youth with diabetes mellitus: the

SEARCH for diabetes in youth study. *J Pediatr*. 2010;157(2):245–251.e1

15. Willi SM, Hirst K, Jago R, et al; HEALTHY Study Group. Cardiovascular risk factors in multi-ethnic middle school students: the HEALTHY primary prevention trial. *Pediatr Obes*. 2012;7(3):230–239
16. DiPietro A, Kees-Folts D, DesHarnais S, Camacho F, Wassner SJ. Primary hypertension at a single center: treatment, time to control, and extended follow-up. *Pediatr Nephrol*. 2009;24(12):2421–2428
17. Seeman T, Gilík J. Long-term control of ambulatory hypertension in children: improving with time but still not achieving new blood pressure goals. *Am J Hypertens*. 2013;26(7):939–945
18. Foglia CF, von Vigier RO, Fossali E, et al. A simplified antihypertensive drug regimen does not ameliorate control of childhood hypertension. *J Hum Hypertens*. 2005;19(8):653–654
19. Sorof J, Daniels S. Obesity hypertension in children: a problem of epidemic proportions. *Hypertension*. 2002;40(4):441–447
20. Sorof JM, Lai D, Turner J, Poffenbarger T, Portman RJ. Overweight, ethnicity, and the prevalence of hypertension in school-aged children. *Pediatrics*. 2004;113(3, pt 1):475–482
21. Koebnick C, Black MH, Wu J, et al. High blood pressure in overweight and obese youth: implications for screening. *J Clin Hypertens (Greenwich)*. 2013;15(11):793–805
22. Falkner B, Gidding SS, Ramirez-Garnica G, Wiltrout SA, West D, Rappaport EB. The relationship of body mass index and blood pressure in primary care pediatric patients. *J Pediatr*. 2006;148(2):195–200
23. Lurbe E, Invitti C, Torro I, et al. The impact of the degree of obesity on the discrepancies between office and ambulatory blood pressure values in youth [published correction appears in *J Hypertens*. 2007;25(1):258]. *J Hypertens*. 2006;24(8):1557–1564
24. Skinner AC, Perrin EM, Moss LA, Skelton JA. Cardiometabolic risks and severity of obesity in children and young adults. *N Engl J Med*. 2015;373(14):1307–1317
25. Zhang T, Zhang H, Li S, et al. Impact of adiposity on incident hypertension is modified by insulin resistance in adults: longitudinal observation from the Bogalusa Heart Study. *Hypertension*. 2016;67(1):56–62
26. So H-K, Yip GW-K, Choi K-C, et al; Hong Kong ABP Working Group. Association between waist circumference and childhood-masked hypertension: a community-based study. *J Paediatr Child Health*. 2016;52(4):385–390
27. Friedemann C, Heneghan C, Mahtani K, Thompson M, Perera R, Ward AM. Cardiovascular disease risk in healthy children and its association with body mass index: systematic review and meta-analysis. *BMJ*. 2012;345:e4759
28. Kelishadi R, Mirmoghtadaee P, Najafi H, Keikha M. Systematic review on the association of abdominal obesity in children and adolescents with cardio-metabolic risk factors. *J Res Med Sci*. 2015;20(3):294–307
29. Török K, Pálfi A, Szelényi Z, Molnár D. Circadian variability of blood pressure in obese children. *Nutr Metab Cardiovasc Dis*. 2008;18(6):429–435
30. Framme J, Dangardt F, Mårild S, Osika W, Währborg P, Friberg P. 24-h systolic blood pressure and heart rate recordings in lean and obese adolescents. *Clin Physiol Funct Imaging*. 2006;26(4):235–239
31. Westerståhl M, Marcus C. Association between nocturnal blood pressure dipping and insulin metabolism in obese adolescents. *Int J Obes*. 2010;34(3):472–477
32. Westerståhl M, Hedvall Kallerman P, Hagman E, Ek AE, Rössner SM, Marcus C. Nocturnal blood pressure non-dipping is prevalent in severely obese, prepubertal and early pubertal children. *Acta Paediatr*. 2014;103(2):225–230
33. Macumber IR, Weiss NS, Halbach SM, Hanevold CD, Flynn JT. The association of pediatric obesity with nocturnal non-dipping on 24-hour ambulatory blood pressure monitoring. *Am J Hypertens*. 2016;29(5):647–652
34. Perng W, Rifas-Shiman SL, Kramer MS, et al. Early weight gain, linear growth, and mid-childhood blood pressure: a prospective study in project viva. *Hypertension*. 2016;67(2):301–308
35. Parker ED, Sinaiko AR, Kharbanda EO, et al. Change in weight status and development of hypertension. *Pediatrics*. 2016;137(3):e20151662
36. Yip J, Facchini FS, Reaven GM. Resistance to insulin-mediated glucose disposal as a predictor of cardiovascular disease. *J Clin Endocrinol Metab*. 1998;83(8):2773–2776
37. Kashyap SR, Defronzo RA. The insulin resistance syndrome: physiological considerations. *Diab Vasc Dis Res*. 2007;4(1):13–19
38. Lurbe E, Torro I, Aguilar F, et al. Added impact of obesity and insulin resistance in nocturnal blood pressure elevation in children and adolescents. *Hypertension*. 2008;51(3):635–641
39. Chinali M, de Simone G, Roman MJ, et al. Cardiac markers of pre-clinical disease in adolescents with the metabolic syndrome: the strong heart study. *J Am Coll Cardiol*. 2008;52(11):932–938
40. Archbold KH, Vasquez MM, Goodwin JL, Quan SF. Effects of sleep patterns and obesity on increases in blood pressure in a 5-year period: report from the Tucson Children's Assessment of Sleep Apnea Study. *J Pediatr*. 2012;161(1):26–30
41. Javaheri S, Storfer-Isser A, Rosen CL, Redline S. Sleep quality and elevated blood pressure in adolescents. *Circulation*. 2008;118(10):1034–1040
42. Hartzell K, Avis K, Lozano D, Feig D. Obstructive sleep apnea and periodic limb movement disorder in a population of children with hypertension and/or nocturnal nondipping blood pressures. *J Am Soc Hypertens*. 2016;10(2):101–107
43. Au CT, Ho CK, Wing YK, Lam HS, Li AM. Acute and chronic effects of sleep duration on blood pressure. *Pediatrics*. 2014;133(1). Available at: www.pediatrics.org/cgi/content/full/133/1/e64
44. Li AM, Au CT, Ng C, Lam HS, Ho CKW, Wing YK. A 4-year prospective follow-up study of childhood OSA

and its association with BP. *Chest*. 2014;145(6):1255–1263

45. Li AM, Au CT, Sung RY, et al. Ambulatory blood pressure in children with obstructive sleep apnoea: a community based study. *Thorax*. 2008;63(9):803–809
46. Flynn JT, Mitsnefes M, Pierce C, et al; Chronic Kidney Disease in Children Study Group. Blood pressure in children with chronic kidney disease: a report from the Chronic Kidney Disease in Children study. *Hypertension*. 2008;52(4):631–637
47. Samuels J, Ng D, Flynn JT, et al; Chronic Kidney Disease in Children Study Group. Ambulatory blood pressure patterns in children with chronic kidney disease. *Hypertension*. 2012;60(1):43–50
48. Shatat IF, Flynn JT. Hypertension in children with chronic kidney disease. *Adv Chronic Kidney Dis*. 2005;12(4):378–384
49. Chavers BM, Solid CA, Daniels FX, et al. Hypertension in pediatric long-term hemodialysis patients in the United States. *Clin J Am Soc Nephrol*. 2009;4(8):1363–1369
50. Seeman T. Hypertension after renal transplantation. *Pediatr Nephrol*. 2009;24(5):959–972
51. Tkaczyk M, Nowicki M, Bałasz-Chmielewska I, et al. Hypertension in dialysed children: the prevalence and therapeutic approach in Poland–a nationwide survey. *Nephrol Dial Transplant*. 2006;21(3):736–742
52. Kramer AM, van Stralen KJ, Jager KJ, et al. Demographics of blood pressure and hypertension in children on renal replacement therapy in Europe. *Kidney Int*. 2011;80(10):1092–1098
53. Halbach SM, Martz K, Mattoo T, Flynn J. Predictors of blood pressure and its control in pediatric patients receiving dialysis. *J Pediatr*. 2012;160(4):621–625.e1
54. Kaelber DC. IBM explorys cohort discovery tool. Available at: www.ibm.com/watson/health/explorys. Accessed February 3, 2017
55. Barker DJ. The fetal and infant origins of adult disease. *BMJ*. 1990;301(6761):1111
56. Edvardsson VO, Steinthorsdottir SD, Eliasdottir SB, Indridason OS, Palsson R. Birth weight and childhood blood pressure. *Curr Hypertens Rep*. 2012;14(6):596–602
57. Mhanna MJ, Iqbal AM, Kaelber DC. Weight gain and hypertension at three years of age and older in extremely low birth weight infants. *J Neonatal Perinatal Med*. 2015;8(4):363–369
58. Di Salvo G, Castaldi B, Baldini L, et al. Masked hypertension in young patients after successful aortic coarctation repair: impact on left ventricular geometry and function. *J Hum Hypertens*. 2011;25(12):739–745
59. Bayrakci US, Schaefer F, Duzova A, Yigit S, Bakkaloglu A. Abnormal circadian blood pressure regulation in children born preterm. *J Pediatr*. 2007;151(4):399–403
60. Sun SS, Grave GD, Siervogel RM, Pickoff AA, Arslanian SS, Daniels SR. Systolic blood pressure in childhood predicts hypertension and metabolic syndrome later in life. *Pediatrics*. 2007;119(2):237–246
61. Juhola J, Oikonen M, Magnussen CG, et al. Childhood physical, environmental, and genetic predictors of adult hypertension: the cardiovascular risk in young Finns study. *Circulation*. 2012;126(4):402–409
62. Juhola J, Magnussen CG, Viikari JS, et al. Tracking of serum lipid levels, blood pressure, and body mass index from childhood to adulthood: the Cardiovascular Risk in Young Finns Study. *J Pediatr*. 2011;159(4):584–590
63. Bao W, Threefoot SA, Srinivasan SR, Berenson GS. Essential hypertension predicted by tracking of elevated blood pressure from childhood to adulthood: the Bogalusa Heart Study. *Am J Hypertens*. 1995;8(7):657–665
64. Falkner B, Gidding SS, Portman R, Rosner B. Blood pressure variability and classification of prehypertension and hypertension in adolescence. *Pediatrics*. 2008;122(2):238–242
65. Tracy RE, Newman WP III, Wattigney WA, Srinivasan SR, Strong JP, Berenson GS. Histologic features of atherosclerosis and hypertension from autopsies of young individuals in a defined geographic population: the Bogalusa Heart Study. *Atherosclerosis*. 1995;116(2):163–179
66. Urbina EM, Khoury PR, McCoy C, Daniels SR, Kimball TR, Dolan LM. Cardiac and vascular consequences of pre-hypertension in youth. *J Clin Hypertens (Greenwich)*. 2011;13(5):332–342
67. de Simone G, Devereux RB, Daniels SR, Koren MJ, Meyer RA, Laragh JH. Effect of growth on variability of left ventricular mass: assessment of allometric signals in adults and children and their capacity to predict cardiovascular risk. *J Am Coll Cardiol*. 1995;25(5):1056–1062
68. O'Leary DH, Polak JF, Kronmal RA, Manolio TA, Burke GL, Wolfson SK Jr; Cardiovascular Health Study Collaborative Research Group. Carotid-artery intima and media thickness as a risk factor for myocardial infarction and stroke in older adults. *N Engl J Med*. 1999;340(1):14–22
69. Mitchell GF, Hwang SJ, Vasan RS, et al. Arterial stiffness and cardiovascular events: the Framingham Heart Study. *Circulation*. 2010;121(4):505–511
70. Lloyd-Jones DM, Hong Y, Labarthe D, et al; American Heart Association Strategic Planning Task Force and Statistics Committee. Defining and setting national goals for cardiovascular health promotion and disease reduction: the American Heart Association's strategic impact goal through 2020 and beyond. *Circulation*. 2010;121(4):586–613
71. Ning H, Labarthe DR, Shay CM, et al. Status of cardiovascular health in US children up to 11 years of age: the National Health and Nutrition Examination Surveys 2003-2010. *Circ Cardiovasc Qual Outcomes*. 2015;8(2):164–171
72. Steinberger J, Daniels SR, Hagberg N, et al; American Heart Association Atherosclerosis, Hypertension, and Obesity in the Young Committee of the Council on Cardiovascular Disease in the Young; Council on Cardiovascular and Stroke Nursing; Council on Epidemiology and Prevention; Council on Functional Genomics and Translational Biology; Stroke Council. Cardiovascular health promotion in children: challenges and opportunities for 2020 and beyond: a

scientific statement from the American Heart Association. *Circulation*. 2016;134(12):e236–e255

73. Ogden CL, Carroll MD, Lawman HG, et al. Trends in obesity prevalence among children and adolescents in the United States, 1988-1994 through 2013-2014. *JAMA*. 2016;315(21):2292–2299
74. Skinner AC, Perrin EM, Skelton JA. Prevalence of obesity and severe obesity in US children, 1999-2014. *Obesity (Silver Spring)*. 2016;24(5):1116–1123
75. Skinner AC, Skelton JA. Prevalence and trends in obesity and severe obesity among children in the United States, 1999-2012. *JAMA Pediatr*. 2014;168(6):561–566
76. Shay CM, Ning H, Daniels SR, Rooks CR, Gidding SS, Lloyd-Jones DM. Status of cardiovascular health in US adolescents: prevalence estimates from the National Health and Nutrition Examination Surveys (NHANES) 2005-2010. *Circulation*. 2013;127(13):1369–1376
77. Rosner B, Cook N, Portman R, Daniels S, Falkner B. Determination of blood pressure percentiles in normal-weight children: some methodological issues. *Am J Epidemiol*. 2008;167(6):653–666
78. Kaelber DC, Pickett F. Simple table to identify children and adolescents needing further evaluation of blood pressure. *Pediatrics*. 2009;123(6). Available at: www.pediatrics.org/cgi/content/full/123/6/e972
79. Dionne JM, Abitbol CL, Flynn JT. Hypertension in infancy: diagnosis, management and outcome [published correction appears in *Pediatr Nephrol*. 2012;27(1):159-60]. *Pediatr Nephrol*. 2012;27(1):17–32
80. Kent AL, Chaudhari T. Determinants of neonatal blood pressure. *Curr Hypertens Rep*. 2013;15(5):426–432
81. Report of the second task force on blood pressure control in children–1987. Task force on blood pressure control in children. National Heart, Lung, and Blood Institute, Bethesda, Maryland. *Pediatrics*. 1987;79(1):1–25
82. Savoca MR, MacKey ML, Evans CD, Wilson M, Ludwig DA, Harshfield GA. Association of ambulatory blood pressure and dietary caffeine in adolescents. *Am J Hypertens*. 2005;18(1):116–120
83. Pickering TG, Hall JE, Appel LJ, et al. Recommendations for blood pressure measurement in humans and experimental animals: part 1: blood pressure measurement in humans: a statement for professionals from the Subcommittee of Professional and Public Education of the American Heart Association Council on High Blood Pressure Research. *Circulation*. 2005;111(5):697–716
84. Becton LJ, Egan BM, Hailpern SM, Shatat IF. Blood pressure reclassification in adolescents based on repeat clinic blood pressure measurements. *J Clin Hypertens (Greenwich)*. 2013;15(10):717–722
85. Daley MF, Sinaiko AR, Reifler LM, et al. Patterns of care and persistence after incident elevated blood pressure. *Pediatrics*. 2013;132(2). Available at: www.pediatrics.org/cgi/content/full/132/2/e349
86. Ostchega Y, Prineas RJ, Nwankwo T, Zipf G. Assessing blood pressure accuracy of an aneroid sphygmomanometer in a national survey environment. *Am J Hypertens*. 2011;24(3):322–327
87. Ma Y, Temprosa M, Fowler S, et al; Diabetes Prevention Program Research Group. Evaluating the accuracy of an aneroid sphygmomanometer in a clinical trial setting. *Am J Hypertens*. 2009;22(3):263–266
88. Podoll A, Grenier M, Croix B, Feig DI. Inaccuracy in pediatric outpatient blood pressure measurement. *Pediatrics*. 2007;119(3). Available at: www.pediatrics.org/cgi/content/full/119/3/e538
89. Mourad A, Carney S. Arm position and blood pressure: an audit. *Intern Med J*. 2004;34(5):290–291
90. Mourad A, Carney S, Gillies A, Jones B, Nanra R, Trevillian P. Arm position and blood pressure: a risk factor for hypertension? *J Hum Hypertens*. 2003;17(6):389–395
91. Zaheer S, Watson L, Webb NJ. Unmet needs in the measurement of blood pressure in primary care. *Arch Dis Child*. 2014;99(5):463–464
92. Veiga EV, Arcuri EAM, Cloutier L, Santos JL. Blood pressure measurement: arm circumference and cuff size availability. *Rev Lat Am Enfermagem*. 2009;17(4):455–461
93. Thomas M, Radford T, Dasgupta I. Unvalidated blood pressure devices with small cuffs are being used in hospitals. *BMJ*. 2001;323(7309):398
94. Burke MJ, Towers HM, O'Malley K, Fitzgerald DJ, O'Brien ET. Sphygmomanometers in hospital and family practice: problems and recommendations. *Br Med J (Clin Res Ed)*. 1982;285(6340):469–471
95. Centers for Disease Control and Prevention. National Health and Nutrition Examination Survey (NHANES) Anthropometry Procedures Manual. Available at: https://www.cdc.gov/nchs/data/nhanes/nhanes_07_08/manual_an.pdf. Published January 2013. Accessed May 9, 2016
96. Prineas RJ, Ostchega Y, Carroll M, Dillon C, McDowell M. US demographic trends in mid-arm circumference and recommended blood pressure cuffs for children and adolescents: data from the National Health and Nutrition Examination Survey 1988-2004. *Blood Press Monit*. 2007;12(2):75–80
97. Kimble KJ, Darnall RA Jr, Yelderman M, Ariagno RL, Ream AK. An automated oscillometric technique for estimating mean arterial pressure in critically ill newborns. *Anesthesiology*. 1981;54(5):423–425
98. Sonesson SE, Broberger U. Arterial blood pressure in the very low birthweight neonate. Evaluation of an automatic oscillometric technique. *Acta Paediatr Scand*. 1987;76(2):338–341
99. Duncan AF, Rosenfeld CR, Morgan JS, Ahmad N, Heyne RJ. Interrater reliability and effect of state on blood pressure measurements in infants 1 to 3 years of age. *Pediatrics*. 2008;122(3). Available at: www.pediatrics.org/cgi/content/full/122/3/e590
100. Nwankwo MU, Lorenz JM, Gardiner JC. A standard protocol for blood pressure measurement in the newborn. *Pediatrics*. 1997;99(6). Available at: www.pediatrics.org/cgi/content/full/99/6/e10

101. Gupta-Malhotra M, Banker A, Shete S, et al. Essential hypertension vs. secondary hypertension among children. *Am J Hypertens*. 2015;28(1):73–80

102. Kelly RK, Thomson R, Smith KJ, Dwyer T, Venn A, Magnussen CG. Factors affecting tracking of blood pressure from childhood to adulthood: the Childhood Determinants of Adult Health Study. *J Pediatr*. 2015;167(6):1422–1428.e2

103. Juhola J, Magnussen CG, Berenson GS, et al. Combined effects of child and adult elevated blood pressure on subclinical atherosclerosis: the International Childhood Cardiovascular Cohort Consortium. *Circulation*. 2013;128(3):217–224

104. Sladowska-Kozłowska J, Litwin M, Niemirska A, Wierzbicka A, Wawer ZT, Janas R. Change in left ventricular geometry during antihypertensive treatment in children with primary hypertension. *Pediatr Nephrol*. 2011;26(12):2201–2209

105. Litwin M, Niemirska A, Sladowska-Kozlowska J, et al. Regression of target organ damage in children and adolescents with primary hypertension. *Pediatr Nephrol*. 2010;25(12):2489–2499

106. Meyer AA, Kundt G, Lenschow U, Schuff-Werner P, Kienast W. Improvement of early vascular changes and cardiovascular risk factors in obese children after a six-month exercise program. *J Am Coll Cardiol*. 2006;48(9):1865–1870

107. Juonala M, Magnussen CG, Berenson GS, et al. Childhood adiposity, adult adiposity, and cardiovascular risk factors. *N Engl J Med*. 2011;365(20):1876–1885

108. Lo JC, Chandra M, Sinaiko A, et al. Severe obesity in children: prevalence, persistence and relation to hypertension. *Int J Pediatr Endocrinol*. 2014;2014(1):3

109. Rademacher ER, Jacobs DR Jr, Moran A, Steinberger J, Prineas RJ, Sinaiko A. Relation of blood pressure and body mass index during childhood to cardiovascular risk factor levels in young adults. *J Hypertens*. 2009;27(9):1766–1774

110. Maahs DM, Daniels SR, de Ferranti SD, et al; American Heart Association Atherosclerosis, Hypertension and Obesity in Youth Committee of the Council on Cardiovascular Disease in the Young; Council on Clinical Cardiology; Council on Cardiovascular and Stroke Nursing; Council for High Blood Pressure Research; Council on Lifestyle and Cardiometabolic Health. Cardiovascular disease risk factors in youth with diabetes mellitus: a scientific statement from the American Heart Association. *Circulation*. 2014;130(17):1532–1558

111. Levitt Katz L, Gidding SS, Bacha F, et al; TODAY Study Group. Alterations in left ventricular, left atrial, and right ventricular structure and function to cardiovascular risk factors in adolescents with type 2 diabetes participating in the TODAY clinical trial. *Pediatr Diabetes*. 2015;16(1):39–47

112. Hager A, Kanz S, Kaemmerer H, Schreiber C, Hess J. Coarctation Long-term Assessment (COALA): significance of arterial hypertension in a cohort of 404 patients up to 27 years after surgical repair of isolated coarctation of the aorta, even in the absence of restenosis and prosthetic material. *J Thorac Cardiovasc Surg*. 2007;134(3):738–745

113. O'Sullivan JJ, Derrick G, Darnell R. Prevalence of hypertension in children after early repair of coarctation of the aorta: a cohort study using casual and 24 hour blood pressure measurement. *Heart*. 2002;88(2):163–166

114. Becker AM, Goldberg JH, Henson M, et al. Blood pressure abnormalities in children with sickle cell anemia. *Pediatr Blood Cancer*. 2014;61(3):518–522

115. Brady TM, Solomon BS, Neu AM, Siberry GK, Parekh RS. Patient-, provider-, and clinic-level predictors of unrecognized elevated blood pressure in children. *Pediatrics*. 2010;125(6). Available at: www.pediatrics.org/cgi/content/full/125/6/e1286

116. Stabouli S, Sideras L, Vareta G, et al. Hypertension screening during healthcare pediatric visits. *J Hypertens*. 2015;33(5):1064–1068

117. Shapiro DJ, Hersh AL, Cabana MD, Sutherland SM, Patel AI. Hypertension screening during ambulatory pediatric visits in the United States, 2000-2009. *Pediatrics*. 2012;130(4):604–610

118. Bijlsma MW, Blufpand HN, Key Action Statementpers GJ, Bökenkamp A. Why pediatricians fail to diagnose hypertension: a multicenter survey. *J Pediatr*. 2014;164(1):173–177.e7

119. Chaudhry B, Wang J, Wu S, et al. Systematic review: impact of health information technology on quality, efficiency, and costs of medical care. *Ann Intern Med*. 2006;144(10):742–752

120. Shojania KG, Jennings A, Mayhew A, Ramsay CR, Eccles MP, Grimshaw J. The effects of on-screen, point of care computer reminders on processes and outcomes of care. *Cochrane Database Syst Rev*. 2009;(3):CD001096

121. Garg AX, Adhikari NKJ, McDonald H, et al. Effects of computerized clinical decision support systems on practitioner performance and patient outcomes: a systematic review. *JAMA*. 2005;293(10):1223–1238

122. Hicks LS, Sequist TD, Ayanian JZ, et al. Impact of computerized decision support on blood pressure management and control: a randomized controlled trial. *J Gen Intern Med*. 2008;23(4):429–441

123. Samal L, Linder JA, Lipsitz SR, Hicks LS. Electronic health records, clinical decision support, and blood pressure control. *Am J Manag Care*. 2011;17(9):626–632

124. Heymann AD, Hoch I, Valinsky L, Shalev V, Silber H, Kokia E. Mandatory computer field for blood pressure measurement improves screening. *Fam Pract*. 2005;22(2):168–169

125. Brady TM, Neu AM, Miller ER III, Appel LJ, Siberry GK, Solomon BS. Real-time electronic medical record alerts increase high blood pressure recognition in children. *Clin Pediatr (Phila)*. 2015;54(7):667–675

126. Romano MJ, Stafford RS. Electronic health records and clinical decision support systems: impact on national ambulatory care quality. *Arch Intern Med*. 2011;171(10):897–903

127. Alpert BS, Quinn D, Gallick D. Oscillometric blood pressure: a review for clinicians. *J Am Soc Hypertens*. 2014;8(12):930–938

128. Alpert BS. Oscillometric blood pressure values are algorithm-specific. *Am J Cardiol*. 2010;106(10):1524–1525, author reply 1524–1525

129. Flynn JT, Pierce CB, Miller ER III, et al; Chronic Kidney Disease in Children Study Group. Reliability of resting blood pressure measurement and classification using an oscillometric device in children with chronic kidney disease. *J Pediatr*. 2012;160(3):434–440.e1

130. Kamath N, Goud BR, Phadke KD, Iyengar A. Use of oscillometric devices for the measurement of blood pressure-comparison with the gold standard. *Indian J Pediatr*. 2012;79(9):1230–1232

131. Chiolero A, Bovet P, Stergiou GS. Automated oscillometric blood pressure measurement in children. *J Clin Hypertens (Greenwich)*. 2014;16(6):468

132. Chiolero A, Paradis G, Lambert M. Accuracy of oscillometric devices in children and adults. *Blood Press*. 2010;19(4):254–259

133. Chio SS, Urbina EM, Lapointe J, Tsai J, Berenson GS. Korotkoff sound versus oscillometric cuff sphygmomanometers: comparison between auscultatory and DynaPulse blood pressure measurements. *J Am Soc Hypertens*. 2011;5(1):12–20

134. Eliasdottir SB, Steinthorsdottir SD, Indridason OS, Palsson R, Edvardsson VO. Comparison of aneroid and oscillometric blood pressure measurements in children. *J Clin Hypertens (Greenwich)*. 2013;15(11):776–783

135. Urbina EM, Khoury PR, McCoy CE, Daniels SR, Dolan LM, Kimball TR. Comparison of mercury sphygmomanometry blood pressure readings with oscillometric and central blood pressure in predicting target organ damage in youth. *Blood Press Monit*. 2015;20(3):150–156

136. Negroni-Balasquide X, Bell CS, Samuel J, Samuels JA. Is one measurement enough to evaluate blood pressure among adolescents? A blood pressure screening experience in more than 9000 children with a subset comparison of auscultatory to mercury measurements. *J Am Soc Hypertens*. 2016;10(2):95–100

137. Leblanc M-É, Croteau S, Ferland A, et al. Blood pressure assessment in severe obesity: validation of a forearm approach. *Obesity (Silver Spring)*. 2013;21(12):E533–E541

138. Altunkan S, Genç Y, Altunkan E. A comparative study of an ambulatory blood pressure measuring device and a wrist blood pressure monitor with a position sensor versus a mercury sphygmomanometer. *Eur J Intern Med*. 2007;18(2):118–123

139. Uen S, Fimmers R, Brieger M, Nickenig G, Mengden T. Reproducibility of wrist home blood pressure measurement with position sensor and automatic data storage. *BMC Cardiovasc Disord*. 2009;9:20

140. Fania C, Benetti E, Palatini P. Validation of the A&D BP UB-543 wrist device for home blood pressure measurement according to the European Society of Hypertension International Protocol revision 2010. *Blood Press Monit*. 2015;20(4):237–240

141. Kang Y-Y, Chen Q, Li Y, Wang JG. Validation of the SCIAN LD-735 wrist blood pressure monitor for home blood pressure monitoring according to the European Society of Hypertension International Protocol revision 2010. *Blood Press Monit*. 2016;21(4):255–258

142. Xie P, Wang Y, Xu X, Huang F, Pan J. Validation of the Pangao PG-800A11 wrist device assessed according to the European Society of Hypertension and the British Hypertension Society protocols. *Blood Press Monit*. 2015;20(2):108–111

143. Zweiker R, Schumacher M, Fruhwald FM, Watzinger N, Klein W. Comparison of wrist blood pressure measurement with conventional sphygmomanometry at a cardiology outpatient clinic. *J Hypertens*. 2000;18(8):1013–1018

144. Altunkan S, Yildiz S, Azer S. Wrist blood pressure-measuring devices: a comparative study of accuracy with a standard auscultatory method using a mercury manometer. *Blood Press Monit*. 2002;7(5):281–284

145. Palatini P, Longo D, Toffanin G, Bertolo O, Zaetta V, Pessina AC. Wrist blood pressure overestimates blood pressure measured at the upper arm. *Blood Press Monit*. 2004;9(2):77–81

146. Stergiou GS, Christodoulakis GR, Nasothimiou EG, Giovas PP, Kalogeropoulos PG. Can validated wrist devices with position sensors replace arm devices for self-home blood pressure monitoring? A randomized crossover trial using ambulatory monitoring as reference. *Am J Hypertens*. 2008;21(7):753–758

147. Khoshdel AR, Carney S, Gillies A. The impact of arm position and pulse pressure on the validation of a wrist-cuff blood pressure measurement device in a high risk population. *Int J Gen Med*. 2010;3:119–125

148. Kikuya M, Chonan K, Imai Y, Goto E, Ishii M; Research Group to Assess the Validity of Automated Blood Pressure Measurement Devices in Japan. Accuracy and reliability of wrist-cuff devices for self-measurement of blood pressure. *J Hypertens*. 2002;20(4):629–638

149. Westhoff TH, Schmidt S, Meissner R, Zidek W, van der Giet M. The impact of pulse pressure on the accuracy of wrist blood pressure measurement. *J Hum Hypertens*. 2009;23(6):391–395

150. Deutsch C, Krüger R, Saito K, et al. Comparison of the Omron RS6 wrist blood pressure monitor with the positioning sensor on or off with a standard mercury sphygmomanometer. *Blood Press Monit*. 2014;19(5):306–313

151. Yarows SA. Comparison of the Omron HEM-637 wrist monitor to the auscultation method with the wrist position sensor on or disabled. *Am J Hypertens*. 2004;17(1):54–58

152. Menezes AMB, Dumith SC, Noal RB, et al. Validity of a wrist digital monitor for blood pressure measurement in comparison to a mercury sphygmomanometer. *Arq Bras Cardiol*. 2010;94(3):345–349, 365–370

153. Wankum PC, Thurman TL, Holt SJ, Hall RA, Simpson PM, Heulitt MJ. Validation of a noninvasive blood pressure

monitoring device in normotensive and hypertensive pediatric intensive care patients. *J Clin Monit Comput*. 2004;18(4):253–263

154. Cua CL, Thomas K, Zurakowski D, Laussen PC. A comparison of the Vasotrac with invasive arterial blood pressure monitoring in children after pediatric cardiac surgery. *Anesth Analg*. 2005;100(5): 1289–1294

155. Flynn JT, Daniels SR, Hayman LL, et al; American Heart Association Atherosclerosis, Hypertension and Obesity in Youth Committee of the Council on Cardiovascular Disease in the Young. Update: ambulatory blood pressure monitoring in children and adolescents: a scientific statement from the American Heart Association. *Hypertension*. 2014;63(5): 1116–1135

156. Siu AL; U.S. Preventive Services Task Force. Screening for high blood pressure in adults: U.S. Preventive Services Task Force recommendation statement. *Ann Intern Med*. 2015;163(10):778–786

157. Díaz LN, Garin EH. Comparison of ambulatory blood pressure and Task Force criteria to identify pediatric hypertension. *Pediatr Nephrol*. 2007;22(4):554–558

158. Salice P, Ardissino G, Zanchetti A, et al. Age-dependent differences in office (OBP) vs ambulatory blood pressure monitoring (ABPM) in hypertensive children and adolescents: 8C.03. *J Hypertens*. 2010;28:e423–e424

159. Stergiou GS, Alamara CV, Salgami EV, Vaindirlis IN, Dacou-Voutetakis C, Mountokalakis TD. Reproducibility of home and ambulatory blood pressure in children and adolescents. *Blood Press Monit*. 2005;10(3):143–147

160. Li Z, Snieder H, Harshfield GA, Treiber FA, Wang X. A 15-year longitudinal study on ambulatory blood pressure tracking from childhood to early adulthood. *Hypertens Res*. 2009;32(5):404–410

161. Seeman T, Palyzová D, Dusek J, Janda J. Reduced nocturnal blood pressure dip and sustained nighttime hypertension are specific markers of secondary hypertension. *J Pediatr*. 2005;147(3):366–371

162. Bjelakovic B, Jaddoe VW, Vukomanovic V, et al. The relationship between currently recommended ambulatory systolic blood pressure measures and left ventricular mass index in pediatric hypertension. *Curr Hypertens Rep*. 2015;17(4):534

163. Brady TM, Fivush B, Flynn JT, Parekh R. Ability of blood pressure to predict left ventricular hypertrophy in children with primary hypertension. *J Pediatr*. 2008;152(1):73–78, 78.e1

164. McNiece KL, Gupta-Malhotra M, Samuels J, et al; National High Blood Pressure Education Program Working Group. Left ventricular hypertrophy in hypertensive adolescents: analysis of risk by 2004 National High Blood Pressure Education Program Working Group staging criteria. *Hypertension*. 2007;50(2):392–395

165. Richey PA, Disessa TG, Hastings MC, Somes GW, Alpert BS, Jones DP. Ambulatory blood pressure and increased left ventricular mass in children at risk for hypertension. *J Pediatr*. 2008;152(3):343–348

166. Conkar S, Yılmaz E, Hacıkara Ş, Bozabalı S, Mir S. Is daytime systolic load an important risk factor for target organ damage in pediatric hypertension? *J Clin Hypertens (Greenwich)*. 2015;17(10):760–766

167. Flynn JT. Differentiation between primary and secondary hypertension in children using ambulatory blood pressure monitoring. *Pediatrics*. 2002;110(1, pt 1):89–93

168. Dursun H, Bayazit AK, Cengiz N, et al. Ambulatory blood pressure monitoring and renal functions in children with a solitary kidney. *Pediatr Nephrol*. 2007;22(4):559–564

169. Patzer L, Seeman T, Luck C, Wühl E, Janda J, Misselwitz J. Day- and night-time blood pressure elevation in children with higher grades of renal scarring. *J Pediatr*. 2003;142(2):117–122

170. Fidan K, Kandur Y, Buyukkaragoz B, Akdemir UO, Soylemezoglu O. Hypertension in pediatric patients with renal scarring in association with vesicoureteral reflux. *Urology*. 2013;81(1):173–177

171. Basiratnia M, Esteghamati M, Ajami GH, et al. Blood pressure profile in renal transplant recipients and its relation to diastolic function: tissue Doppler echocardiographic study. *Pediatr Nephrol*. 2011;26(3):449–457

172. Chaudhuri A, Sutherland SM, Begin B, et al. Role of twenty-four-hour ambulatory blood pressure monitoring in children on dialysis. *Clin J Am Soc Nephrol*. 2011;6(4):870–876

173. Wühl E, Trivelli A, Picca S, et al; ESCAPE Trial Group. Strict blood-pressure control and progression of renal failure in children. *N Engl J Med*. 2009;361(17):1639–1650

174. Chatterjee M, Speiser PW, Pellizzarri M, et al. Poor glycemic control is associated with abnormal changes in 24-hour ambulatory blood pressure in children and adolescents with type 1 diabetes mellitus. *J Pediatr Endocrinol Metab*. 2009;22(11):1061–1067

175. Darcan S, Goksen D, Mir S, et al. Alterations of blood pressure in type 1 diabetic children and adolescents. *Pediatr Nephrol*. 2006;21(5):672–676

176. Dost A, Klinkert C, Kapellen T, et al; DPV Science Initiative. Arterial hypertension determined by ambulatory blood pressure profiles: contribution to microalbuminuria risk in a multicenter investigation in 2,105 children and adolescents with type 1 diabetes. *Diabetes Care*. 2008;31(4):720–725

177. Ettinger LM, Freeman K, DiMartino-Nardi JR, Flynn JT. Microalbuminuria and abnormal ambulatory blood pressure in adolescents with type 2 diabetes mellitus. *J Pediatr*. 2005;147(1):67–73

178. Lurbe E, Redon J, Kesani A, et al. Increase in nocturnal blood pressure and progression to microalbuminuria in type 1 diabetes. *N Engl J Med*. 2002;347(11):797–805

179. Nagasako SS, Nogueira PC, Machado PG, Pestana JO. Risk factors for hypertension 3 years after renal transplantation in children. *Pediatr Nephrol*. 2007;22(9):1363–1368

180. Roche SL, Kaufmann J, Dipchand AI, Kantor PF. Hypertension after pediatric heart transplantation is primarily associated with immunosuppressive

regimen. *J Heart Lung Transplant*. 2008;27(5):501–507

181. Paripovic D, Kostic M, Spasojevic B, Kruscic D, Peco-Antic A. Masked hypertension and hidden uncontrolled hypertension after renal transplantation. *Pediatr Nephrol*. 2010;25(9):1719–1724
182. Ferraris JR, Ghezzi L, Waisman G, Krmar RT. ABPM vs office blood pressure to define blood pressure control in treated hypertensive paediatric renal transplant recipients. *Pediatr Transplant*. 2007;11(1):24–30
183. McGlothan KR, Wyatt RJ, Ault BH, et al. Predominance of nocturnal hypertension in pediatric renal allograft recipients. *Pediatr Transplant*. 2006;10(5):558–564
184. Balzano R, Lindblad YT, Vavilis G, Jogestrand T, Berg UB, Krmar RT. Use of annual ABPM, and repeated carotid scan and echocardiography to monitor cardiovascular health over nine yr in pediatric and young adult renal transplant recipients. *Pediatr Transplant*. 2011;15(6):635–641
185. Krmar RT, Berg UB. Blood pressure control in hypertensive pediatric renal transplants: role of repeated ABPM following transplantation. *Am J Hypertens*. 2008;21(10):1093–1099
186. Ambrosi P, Kreitmann B, Habib G. Home blood pressure monitoring in heart transplant recipients: comparison with ambulatory blood pressure monitoring. *Transplantation*. 2014;97(3):363–367
187. Seeman T, Simková E, Kreisinger J, et al. Reduction of proteinuria during intensified antihypertensive therapy in children after renal transplantation. *Transplant Proc*. 2007;39(10):3150–3152
188. Seeman T, Simková E, Kreisinger J, et al. Improved control of hypertension in children after renal transplantation: results of a two-yr interventional trial. *Pediatr Transplant*. 2007;11(5):491–497
189. Lurbe E, Alvarez V, Liao Y, et al. The impact of obesity and body fat distribution on ambulatory blood pressure in children and adolescents. *Am J Hypertens*. 1998;11(4, pt 1):418–424
190. Lurbe E, Alvarez V, Redon J. Obesity, body fat distribution, and ambulatory blood pressure in children and adolescents. *J Clin Hypertens (Greenwich)*. 2001;3(6):362–367
191. Marcovecchio ML, Patricelli L, Zito M, et al. Ambulatory blood pressure monitoring in obese children: role of insulin resistance. *J Hypertens*. 2006;24(12):2431–2436
192. Shatat IF, Freeman KD, Vuguin PM, Dimartino-Nardi JR, Flynn JT. Relationship between adiponectin and ambulatory blood pressure in obese adolescents. *Pediatr Res*. 2009;65(6):691–695
193. Amin RS, Carroll JL, Jeffries JL, et al. Twenty-four-hour ambulatory blood pressure in children with sleep-disordered breathing. *Am J Respir Crit Care Med*. 2004;169(8):950–956
194. Leung LC, Ng DK, Lau MW, et al. Twenty-four-hour ambulatory BP in snoring children with obstructive sleep apnea syndrome. *Chest*. 2006;130(4):1009–1017
195. Akyürek N, Atabek ME, Eklioglu BS, Alp H. Ambulatory blood pressure and subclinical cardiovascular disease in children with turner syndrome. *Pediatr Cardiol*. 2014;35(1):57–62
196. Salgado CM, Jardim PC, Teles FB, Nunes MC. Low birth weight as a marker of changes in ambulatory blood pressure monitoring. *Arq Bras Cardiol*. 2009;92(2):107–121
197. Gimpel C, Wühl E, Arbeiter K, et al; ESCAPE Trial Group. Superior consistency of ambulatory blood pressure monitoring in children: implications for clinical trials. *J Hypertens*. 2009;27(8):1568–1574
198. Suláková T, Feber J. Should mean arterial pressure be included in the definition of ambulatory hypertension in children? *Pediatr Nephrol*. 2013;28(7):1105–1112
199. Lurbe E, Torro I, Alvarez V, et al. Prevalence, persistence, and clinical significance of masked hypertension in youth. *Hypertension*. 2005;45(4):493–498
200. Stabouli S, Kotsis V, Toumanidis S, Papamichael C, Constantopoulos A, Zakopoulos N. White-coat and masked hypertension in children: association with target-organ damage. *Pediatr Nephrol*. 2005;20(8):1151–1155
201. Furusawa ÉA, Filho UD, Junior DM, Koch VH. Home and ambulatory blood pressure to identify white coat and masked hypertension in the pediatric patient. *Am J Hypertens*. 2011;24(8):893–897
202. Wells TG, Portman R, Norman P, Haertter S, Davidai G, Fei Wang. Safety, efficacy, and pharmacokinetics of telmisartan in pediatric patients with hypertension. *Clin Pediatr (Phila)*. 2010;49(10):938–946
203. Mitsnefes M, Flynn J, Cohn S, et al; CKiD Study Group. Masked hypertension associates with left ventricular hypertrophy in children with CKD. *J Am Soc Nephrol*. 2010;21(1):137–144
204. Lurbe E, Redon J. Discrepancies in office and ambulatory blood pressure in adolescents: help or hindrance? *Pediatr Nephrol*. 2008;23(3):341–345
205. Pogue V, Rahman M, Lipkowitz M, et al; African American Study of Kidney Disease and Hypertension Collaborative Research Group. Disparate estimates of hypertension control from ambulatory and clinic blood pressure measurements in hypertensive kidney disease. *Hypertension*. 2009;53(1):20–27
206. Urbina EM, Williams RV, Alpert BS, et al; American Heart Association Atherosclerosis, Hypertension, and Obesity in Youth Committee of the Council on Cardiovascular Disease in the Young. Noninvasive assessment of subclinical atherosclerosis in children and adolescents: recommendations for standard assessment for clinical research: a scientific statement from the American Heart Association. *Hypertension*. 2009;54(5):919–950
207. Kavey RE, Kveselis DA, Atallah N, Smith FC. White coat hypertension in childhood: evidence for end-organ effect. *J Pediatr*. 2007;150(5):491–497
208. Swartz SJ, Srivaths PR, Croix B, Feig DI. Cost-effectiveness of ambulatory blood pressure monitoring in the initial evaluation of hypertension in children. *Pediatrics*. 2008;122(6):1177–1181

209. Briasoulis A, Androulakis E, Palla M, Papageorgiou N, Tousoulis D. White-coat hypertension and cardiovascular events: a meta-analysis. *J Hypertens*. 2016;34(4):593–599

210. Valent-Morić B, Zigman T, Zaja-Franulović O, Malenica M, Cuk M. The importance of ambulatory blood pressure monitoring in children and adolescents. *Acta Clin Croat*. 2012;51(1):59–64

211. Palatini P, Parati G. Blood pressure measurement in very obese patients: a challenging problem. *J Hypertens*. 2011;29(3):425–429

212. Halm MA. Arm circumference, shape, and length: how interplaying variables affect blood pressure measurement in obese persons. *Am J Crit Care*. 2014;23(2):166–170

213. Ostchega Y, Hughes JP, Prineas RJ, Zhang G, Nwankwo T, Chiappa MM. Mid-arm circumference and recommended blood pressure cuffs for children and adolescents aged between 3 and 19 years: data from the National Health and Nutrition Examination Survey, 1999-2010. *Blood Press Monit*. 2014;19(1):26–31

214. Bonso E, Saladini F, Zanier A, Benetti E, Dorigatti F, Palatini P. Accuracy of a single rigid conical cuff with standard-size bladder coupled to an automatic oscillometric device over a wide range of arm circumferences. *Hypertens Res*. 2010;33(11):1186–1191

215. Palatini P, Benetti E, Fania C, Malipiero G, Saladini F. Rectangular cuffs may overestimate blood pressure in individuals with large conical arms. *J Hypertens*. 2012;30(3):530–536

216. Aguilar A, Ostrow V, De Luca F, Suarez E. Elevated ambulatory blood pressure in a multi-ethnic population of obese children and adolescents. *J Pediatr*. 2010;156(6):930–935

217. Ostrow V, Wu S, Aguilar A, Bonner R Jr, Suarez E, De Luca F. Association between oxidative stress and masked hypertension in a multi-ethnic population of obese children and adolescents. *J Pediatr*. 2011;158(4):628–633.e1

218. Woroniecki RP, Flynn JT. How are hypertensive children evaluated and managed? A survey of North American pediatric nephrologists. *Pediatr Nephrol*. 2005;20(6):791–797

219. Mengden T, Hernandez Medina RM, Beltran B, Alvarez E, Kraft K, Vetter H. Reliability of reporting self-measured blood pressure values by hypertensive patients. *Am J Hypertens*. 1998;11(12):1413–1417

220. Palatini P, Frick GN. Techniques for self-measurement of blood pressure: limitations and needs for future research. *J Clin Hypertens (Greenwich)*. 2012;14(3):139–143

221. Stergiou GS, Karpettas N, Kapoyiannis A, Stefanidis CJ, Vazeou A. Home blood pressure monitoring in children and adolescents: a systematic review. *J Hypertens*. 2009;27(10):1941–1947

222. Stergiou GS, Nasothimiou E, Giovas P, Kapoyiannis A, Vazeou A. Diagnosis of hypertension in children and adolescents based on home versus ambulatory blood pressure monitoring. *J Hypertens*. 2008;26(8):1556–1562

223. Furusawa EA, Filho UD, Koch VH. Home blood pressure monitoring in paediatric chronic hypertension. *J Hum Hypertens*. 2009;23(7):464–469

224. Stergiou GS, Nasothimiou EG, Giovas PP, Rarra VC. Long-term reproducibility of home vs. office blood pressure in children and adolescents: the Arsakeion school study. *Hypertens Res*. 2009;32(4):311–315

225. Wühl E, Hadtstein C, Mehls O, Schaefer F; Escape Trial Group. Home, clinic, and ambulatory blood pressure monitoring in children with chronic renal failure. *Pediatr Res*. 2004;55(3):492–497

226. Stergiou GS, Karpettas N, Panagiotakos DB, Vazeou A. Comparison of office, ambulatory and home blood pressure in children and adolescents on the basis of normalcy tables. *J Hum Hypertens*. 2011;25(4):218–223

227. Stergiou GS, Alamara CV, Kalkana CB, et al. Out-of-office blood pressure in children and adolescents: disparate findings by using home or ambulatory monitoring. *Am J Hypertens*. 2004;17(10):869–875

228. Stergiou GS, Rarra VC, Yiannes NG. Changing relationship between home and office blood pressure with increasing age in children: the Arsakeion School study. *Am J Hypertens*. 2008;21(1):41–46

229. Salgado CM, Jardim PC, Viana JK, Jardim TS, Velasquez PP. Home blood pressure in children and adolescents: a comparison with office and ambulatory blood pressure measurements. *Acta Paediatr*. 2011;100(10):e163–e168

230. Stergiou GS, Ntineri A, Kollias A, Destounis A, Nasothimiou E, Roussias L. Changing relationship among clinic, home, and ambulatory blood pressure with increasing age. *J Am Soc Hypertens*. 2015;9(7):544–552

231. Stergiou GS, Yiannes NG, Rarra VC, Panagiotakos DB. Home blood pressure normalcy in children and adolescents: the Arsakeion School study. *J Hypertens*. 2007;25(7):1375–1379

232. Sorof JM, Turner J, Franco K, Portman RJ. Characteristics of hypertensive children identified by primary care referral compared with school-based screening. *J Pediatr*. 2004;144(4):485–489

233. King CA, Meadows BB, Engelke MK, Swanson M. Prevalence of elevated body mass index and blood pressure in a rural school-aged population: implications for school nurses. *J Sch Health*. 2006;76(4):145–149

234. Underwood SM, Averhart L, Dean A, et al. Clinical evaluation and follow-up of body mass and blood pressure in pre-elementary school children: program review. *J Natl Black Nurses Assoc*. 2012;23(1):8–15

235. Kapur G, Ahmed M, Pan C, Mitsnefes M, Chiang M, Mattoo TK. Secondary hypertension in overweight and stage 1 hypertensive children: a Midwest Pediatric Nephrology Consortium report. *J Clin Hypertens (Greenwich)*. 2010;12(1):34–39

236. Flynn JT, Alderman MH. Characteristics of children with primary hypertension seen at a referral center. *Pediatr Nephrol*. 2005;20(7):961–966

237. Gomes RS, Quirino IG, Pereira RM, et al. Primary versus secondary

hypertension in children followed up at an outpatient tertiary unit. *Pediatr Nephrol*. 2011;26(3):441–447

238. Welch WP, Yang W, Taylor-Zapata P, Flynn JT. Antihypertensive drug use by children: are the drugs labeled and indicated? *J Clin Hypertens (Greenwich)*. 2012;14(6):388–395

239. Flynn J, Zhang Y, Solar-Yohay S, Shi V. Clinical and demographic characteristics of children with hypertension. *Hypertension*. 2012;60(4):1047–1054

240. Baracco R, Kapur G, Mattoo T, et al. Prediction of primary vs secondary hypertension in children. *J Clin Hypertens (Greenwich)*. 2012;14(5):316–321

241. Silverstein DM, Champoux E, Aviles DH, Vehaskari VM. Treatment of primary and secondary hypertension in children. *Pediatr Nephrol*. 2006;21(6):820–827

242. Flynn JT, Meyers KEC, Neto JP, et al; Pediatric Valsartan Study Group. Efficacy and safety of the angiotensin receptor blocker valsartan in children with hypertension aged 1 to 5 years. *Hypertension*. 2008;52(2):222–228

243. Schaefer F, van de Walle J, Zurowska A, et al; Candesartan in Children with Hypertension Investigators. Efficacy, safety and pharmacokinetics of candesartan cilexetil in hypertensive children from 1 to less than 6 years of age. *J Hypertens*. 2010;28(5):1083–1090

244. Webb NJ, Wells TG, Shahinfar S, et al. A randomized, open-label, dose-response study of losartan in hypertensive children. *Clin J Am Soc Nephrol*. 2014;9(8):1441–1448

245. Coleman DM, Eliason JL, Ohye RG, Stanley JC. Long-segment thoracoabdominal aortic occlusions in childhood. *J Vasc Surg*. 2012;56(2):482–485

246. Lee MG, Kowalski R, Galati JC, et al. Twenty-four-hour ambulatory blood pressure monitoring detects a high prevalence of hypertension late after coarctation repair in patients with hypoplastic arches. *J Thorac Cardiovasc Surg*. 2012;144(5):1110–1116

247. Agnoletti G, Bonnet C, Bonnet D, Sidi D, Aggoun Y. Mid-term effects of implanting stents for relief of aortic recoarctation on systemic hypertension, carotid mechanical properties, intimal medial thickness and reflection of the pulse wave. *Cardiol Young*. 2005;15(3):245–250

248. Young WF. Endocrine hypertension. In: Melmed S, Polonsky KS, Larsen R, Kronenberg HM, eds. *Williams Textbook of Endocrinology*. 13th ed. Philadelphia, PA: Elsevier Inc; 2016:556–588

249. Bausch B, Wellner U, Bausch D, et al. Long-term prognosis of patients with pediatric pheochromocytoma. *Endocr Relat Cancer*. 2013;21(1):17–25

250. Waguespack SG, Rich T, Grubbs E, et al. A current review of the etiology, diagnosis, and treatment of pediatric pheochromocytoma and paraganglioma. *J Clin Endocrinol Metab*. 2010;95(5):2023–2037

251. Fishbein L, Merrill S, Fraker DL, Cohen DL, Nathanson KL. Inherited mutations in pheochromocytoma and paraganglioma: why all patients should be offered genetic testing. *Ann Surg Oncol*. 2013;20(5):1444–1450

252. Barontini M, Levin G, Sanso G. Characteristics of pheochromocytoma in a 4- to 20-year-old population. *Ann N Y Acad Sci*. 2006;1073:30–37

253. Welander J, Söderkvist P, Gimm O. Genetics and clinical characteristics of hereditary pheochromocytomas and paragangliomas. *Endocr Relat Cancer*. 2011;18(6):R253–R276

254. Eisenhofer G, Peitzsch M. Laboratory evaluation of pheochromocytoma and paraganglioma. *Clin Chem*. 2014;60(12):1486–1499

255. Funder JW, Carey RM, Mantero F, et al. The management of primary aldosteronism: case detection, diagnosis, and treatment: an Endocrine Society clinical practice guideline. *J Clin Endocrinol Metab*. 2016;101(5):1889–1916

256. Stowasser M, Gordon RD. Monogenic mineralocorticoid hypertension. *Best Pract Res Clin Endocrinol Metab*. 2006;20(3):401–420

257. White PC, Dupont J, New MI, Leiberman E, Hochberg Z, Rösler A. A mutation in CYP11B1 (Arg-448---His) associated with steroid 11 beta-hydroxylase deficiency in Jews of Moroccan origin. *J Clin Invest*. 1991;87(5):1664–1667

258. Parsa AA, New MI. Low-renin hypertension of childhood. *Endocrinol Metab Clin North Am*. 2011;40(2):369–377, viii

259. Parajes S, Loidi L, Reisch N, et al. Functional consequences of seven novel mutations in the CYP11B1 gene: four mutations associated with nonclassic and three mutations causing classic 11beta-hydroxylase deficiency. *J Clin Endocrinol Metab*. 2010;95(2):779–788

260. New MI, Geller DS, Fallo F, Wilson RC. Monogenic low renin hypertension. *Trends Endocrinol Metab*. 2005;16(3):92–97

261. Imai T, Yanase T, Waterman MR, Simpson ER, Pratt JJ. Canadian Mennonites and individuals residing in the Friesland region of The Netherlands share the same molecular basis of 17 alpha-hydroxylase deficiency. *Hum Genet*. 1992;89(1):95–96

262. Dhir V, Reisch N, Bleicken CM, et al. Steroid 17alpha-hydroxylase deficiency: functional characterization of four mutations (A174E, V178D, R440C, L465P) in the CYP17A1 gene. *J Clin Endocrinol Metab*. 2009;94(8):3058–3064

263. Aglony M, Martínez-Aguayo A, Carvajal CA, et al. Frequency of familial hyperaldosteronism type 1 in a hypertensive pediatric population: clinical and biochemical presentation. *Hypertension*. 2011;57(6):1117–1121

264. Speiser PW, White PC. Congenital adrenal hyperplasia. *N Engl J Med*. 2003;349(8):776–788

265. Funder JW. Genetic disorders in primary aldosteronism — familial and somatic. *J Steroid Biochem Mol Biol*. 2017;165(pt A):154–157

266. Carss KJ, Stowasser M, Gordon RD, O'Shaughnessy KM. Further study of chromosome 7p22 to identify the molecular basis of familial hyperaldosteronism type II. *J Hum Hypertens*. 2011;25(9):560–564

267. So A, Duffy DL, Gordon RD, et al. Familial hyperaldosteronism type II is linked to the chromosome 7p22 region but also shows predicted heterogeneity. *J Hypertens*. 2005;23(8):1477–1484

268. Geller DS, Zhang J, Wisgerhof MV, Shackleton C, Key Action Statementhgarian M, Lifton RP. A novel form of human mendelian hypertension featuring nonglucocorticoid-remediable aldosteronism. *J Clin Endocrinol Metab*. 2008;93(8):3117–3123

269. Boulkroun S, Beuschlein F, Rossi GP, et al. Prevalence, clinical, and molecular correlates of KCNJ5 mutations in primary aldosteronism. *Hypertension*. 2012;59(3):592–598

270. Scholl UI, Nelson-Williams C, Yue P, et al. Hypertension with or without adrenal hyperplasia due to different inherited mutations in the potassium channel KCNJ5. *Proc Natl Acad Sci USA*. 2012;109(7):2533–2538

271. Scholl UI, Goh G, Stölting G, et al. Somatic and germline CACNA1D calcium channel mutations in aldosterone-producing adenomas and primary aldosteronism. *Nat Genet*. 2013;45(9):1050–1054

272. Scholl UI, Stölting G, Nelson-Williams C, et al. Recurrent gain of function mutation in calcium channel CACNA1H causes early-onset hypertension with primary aldosteronism. *Elife*. 2015;4:e06315

273. Rothenbuhler A, Stratakis CA. Clinical and molecular genetics of Carney complex. *Best Pract Res Clin Endocrinol Metab*. 2010;24(3):389–399

274. Stratakis CA, Salpea P, Raygada M. *Carney Complex*. Seattle, WA: University of Washington; 2015

275. Lietman SA, Schwindinger WF, Levine MA. Genetic and molecular aspects of McCune-Albright syndrome. *Pediatr Endocrinol Rev*. 2007;4(suppl 4):380–385

276. Lumbroso S, Paris F, Sultan C. McCune-Albright syndrome: molecular genetics. *J Pediatr Endocrinol Metab*. 2002;15(suppl 3):875–882

277. Malchoff CD, Javier EC, Malchoff DM, et al. Primary cortisol resistance presenting as isosexual precocity. *J Clin Endocrinol Metab*. 1990;70(2):503–507

278. Nicolaides NC, Charmandari E. Chrousos syndrome: from molecular pathogenesis to therapeutic management. *Eur J Clin Invest*. 2015;45(5):504–514

279. Malchoff DM, Brufsky A, Reardon G, et al. A mutation of the glucocorticoid receptor in primary cortisol resistance. *J Clin Invest*. 1993;91(5):1918–1925

280. Ferrari P. The role of 11β-hydroxysteroid dehydrogenase type 2 in human hypertension. *Biochim Biophys Acta*. 2010;1802(12):1178–1187

281. Morineau G, Sulmont V, Salomon R, et al. Apparent mineralocorticoid excess: report of six new cases and extensive personal experience. *J Am Soc Nephrol*. 2006;17(11):3176–3184

282. Nesterov V, Krueger B, Bertog M, Dahlmann A, Palmisano R, Korbmacher C. In Liddle syndrome, epithelial sodium channel is hyperactive mainly in the early part of the aldosterone-sensitive distal nephron. *Hypertension*. 2016;67(6):1256–1262

283. Hanukoglu I, Hanukoglu A. Epithelial sodium channel (ENaC) family: Phylogeny, structure-function, tissue distribution, and associated inherited diseases. *Gene*. 2016;579(2):95–132

284. Geller DS, Farhi A, Pinkerton N, et al. Activating mineralocorticoid receptor mutation in hypertension exacerbated by pregnancy. *Science*. 2000;289(5476):119–123

285. Wilson FH, Disse-Nicodème S, Choate KA, et al. Human hypertension caused by mutations in WNK kinases. *Science*. 2001;293(5532):1107–1112

286. Boyden LM, Choi M, Choate KA, et al. Mutations in kelch-like 3 and cullin 3 cause hypertension and electrolyte abnormalities. *Nature*. 2012;482(7383):98–102

287. Stowasser M, Pimenta E, Gordon RD. Familial or genetic primary aldosteronism and Gordon syndrome. *Endocrinol Metab Clin North Am*. 2011;40(2):343–368, viii

288. Sacerdote A, Weiss K, Tran T, Rokeya Noor B, McFarlane SI. Hypertension in patients with Cushing's disease: pathophysiology, diagnosis, and management. *Curr Hypertens Rep*. 2005;7(3):212–218

289. Baid S, Nieman LK. Glucocorticoid excess and hypertension. *Curr Hypertens Rep*. 2004;6(6):493–499

290. Michalkiewicz E, Sandrini R, Figueiredo B, et al. Clinical and outcome characteristics of children with adrenocortical tumors: a report from the International Pediatric Adrenocortical Tumor Registry. *J Clin Oncol*. 2004;22(5):838–845

291. Danzi S, Klein I. Thyroid hormone and blood pressure regulation. *Curr Hypertens Rep*. 2003;5(6):513–520

292. Bahn RS, Burch HB, Cooper DS, et al; American Thyroid Association; American Association of Clinical Endocrinologists. Hyperthyroidism and other causes of thyrotoxicosis: management guidelines of the American Thyroid Association and American Association of Clinical Endocrinologists. *Endocr Pract*. 2011;17(3):456–520

293. Heyliger A, Tangpricha V, Weber C, Sharma J. Parathyroidectomy decreases systolic and diastolic blood pressure in hypertensive patients with primary hyperparathyroidism. *Surgery*. 2009;146(6):1042–1047

294. Rydberg E, Birgander M, Bondeson AG, Bondeson L, Willenheimer R. Effect of successful parathyroidectomy on 24-hour ambulatory blood pressure in patients with primary hyperparathyroidism. *Int J Cardiol*. 2010;142(1):15–21

295. Gambelunghe A, Sallsten G, Borné Y, et al. Low-level exposure to lead, blood pressure, and hypertension in a population-based cohort. *Environ Res*. 2016;149:157–163

296. Lee BK, Ahn J, Kim NS, Lee CB, Park J, Kim Y. Association of blood pressure with exposure to lead and cadmium: analysis of data from the 2008-2013 Korean National Health and Nutrition Examination Survey. *Biol Trace Elem Res*. 2016;174(1):40–51

297. Rapisarda V, Ledda C, Ferrante M, et al. Blood pressure and occupational

exposure to noise and lead (Pb): a cross-sectional study. *Toxicol Ind Health*. 2016;32(10):1729–1736

298. Hara A, Thijs L, Asayama K, et al. Blood pressure in relation to environmental lead exposure in the national health and nutrition examination survey 2003 to 2010. *Hypertension*. 2015;65(1):62–69

299. Gump BB, Reihman J, Stewart P, Lonky E, Darvill T, Matthews KA. Blood lead (Pb) levels: a potential environmental mechanism explaining the relation between socioeconomic status and cardiovascular reactivity in children. *Health Psychol*. 2007;26(3):296–304

300. Chen A, Rhoads GG, Cai B, Salganik M, Rogan WJ. The effect of chelation on blood pressure in lead-exposed children: a randomized study. *Environ Health Perspect*. 2006;114(4):579–583

301. Chen X, Zhu G, Lei L, Jin T. The association between blood pressure and blood cadmium in a Chinese population living in cadmium polluted area. *Environ Toxicol Pharmacol*. 2013;36(2):595–599

302. Tellez-Plaza M, Navas-Acien A, Crainiceanu CM, Guallar E. Cadmium exposure and hypertension in the 1999-2004 National Health and Nutrition Examination Survey (NHANES). *Environ Health Perspect*. 2008;116(1):51–56

303. Gallagher CM, Meliker JR. Blood and urine cadmium, blood pressure, and hypertension: a systematic review and meta-analysis. *Environ Health Perspect*. 2010;118(12):1676–1684

304. Swaddiwudhipong W, Mahasakpan P, Jeekeeree W, et al. Renal and blood pressure effects from environmental cadmium exposure in Thai children. *Environ Res*. 2015;136:82–87

305. Cao Y, Chen A, Radcliffe J, et al. Postnatal cadmium exposure, neurodevelopment, and blood pressure in children at 2, 5, and 7 years of age. *Environ Health Perspect*. 2009;117(10):1580–1586

306. Park JD, Zheng W. Human exposure and health effects of inorganic and elemental mercury. *J Prev Med Public Health*. 2012;45(6):344–352

307. Weidemann DK, Weaver VM, Fadrowski JJ. Toxic environmental exposures and kidney health in children. *Pediatr Nephrol*. 2016;31(11):2043–2054

308. Torres AD, Rai AN, Hardiek ML. Mercury intoxication and arterial hypertension: report of two patients and review of the literature. *Pediatrics*. 2000;105(3). Available at: www.pediatrics.org/cgi/content/full/105/3/e34

309. Brannan EH, Su S, Alverson BK. Elemental mercury poisoning presenting as hypertension in a young child. *Pediatr Emerg Care*. 2012;28(8):812–814

310. Mercer JJ, Bercovitch L, Muglia JJ. Acrodynia and hypertension in a young girl secondary to elemental mercury toxicity acquired in the home. *Pediatr Dermatol*. 2012;29(2):199–201

311. Valvi D, Casas M, Romaguera D, et al. Prenatal phthalate exposure and childhood growth and blood pressure: evidence from the Spanish INMA-Sabadell Birth Cohort Study. *Environ Health Perspect*. 2015;123(10):1022–1029

312. Trasande L, Sathyanarayana S, Spanier AJ, Trachtman H, Attina TM, Urbina EM. Urinary phthalates are associated with higher blood pressure in childhood. *J Pediatr*. 2013;163(3):747–753.e1

313. Trasande L, Attina TM. Association of exposure to di-2-ethylhexylphthalate replacements with increased blood pressure in children and adolescents. *Hypertension*. 2015;66(2):301–308

314. Saif I, Seriki D, Moore R, Woywodt A. Midaortic syndrome in neurofibromatosis type 1 resulting in bilateral renal artery stenosis. *Am J Kidney Dis*. 2010;56(6):1197–1201

315. Kimura M, Kakizaki S, Kawano K, Sato S, Kure S. Neurofibromatosis type 1 complicated by atypical coarctation of the thoracic aorta. *Case Rep Pediatr*. 2013;2013:458543

316. Malav IC, Kothari SS. Renal artery stenosis due to neurofibromatosis. *Ann Pediatr Cardiol*. 2009;2(2):167–169

317. Mavani G, Kesar V, Devita MV, Rosenstock JL, Michelis MF, Schwimmer JA. Neurofibromatosis type 1-associated hypertension secondary to coarctation of the thoracic aorta. *Clin Kidney J*. 2014;7(4):394–395

318. Duan L, Feng K, Tong A, Liang Z. Renal artery stenosis due to neurofibromatosis type 1: case report and literature review. *Eur J Med Res*. 2014;19:17

319. Srinivasan A, Krishnamurthy G, Fontalvo-Herazo L, et al. Spectrum of renal findings in pediatric fibromuscular dysplasia and neurofibromatosis type 1. *Pediatr Radiol*. 2011;41(3):308–316

320. Dubov T, Toledano-Alhadef H, Chernin G, Constantini S, Cleper R, Ben-Shachar S. High prevalence of elevated blood pressure among children with neurofibromatosis type 1. *Pediatr Nephrol*. 2016;31(1):131–136

321. Erem C, Onder Ersöz H, Ukinç K, et al. Neurofibromatosis type 1 associated with pheochromocytoma: a case report and a review of the literature. *J Endocrinol Invest*. 2007;30(1):59–64

322. Zinnamosca L, Petramala L, Cotesta D, et al. Neurofibromatosis type 1 (NF1) and pheochromocytoma: prevalence, clinical and cardiovascular aspects. *Arch Dermatol Res*. 2011;303(5):317–325

323. Nawrot TS, Den Hond E, Fagard RH, Hoppenbrouwers K, Staessen JA. Blood pressure, serum total cholesterol and contraceptive pill use in 17-year-old girls. *Eur J Cardiovasc Prev Rehabil*. 2003;10(6):438–442

324. Le-Ha C, Beilin LJ, Burrows S, et al. Oral contraceptive use in girls and alcohol consumption in boys are associated with increased blood pressure in late adolescence. *Eur J Prev Cardiol*. 2013;20(6):947–955

325. Du Y, Rosner BM, Knopf H, Schwarz S, Dören M, Scheidt-Nave C. Hormonal contraceptive use among adolescent girls in Germany in relation to health behavior and biological cardiovascular risk factors. *J Adolesc Health*. 2011;48(4):331–337

326. Samuels JA, Franco K, Wan F, Sorof JM. Effect of stimulants on 24-h ambulatory blood pressure in children with ADHD: a double-blind, randomized, cross-over trial. *Pediatr Nephrol*. 2006;21(1):92–95

327. Covar RA, Leung DY, McCormick D, Steelman J, Zeitler P, Spahn JD. Risk

factors associated with glucocorticoid-induced adverse effects in children with severe asthma. *J Allergy Clin Immunol*. 2000;106(4):651–659

328. Vehaskari VM. Heritable forms of hypertension. *Pediatr Nephrol*. 2009;24(10):1929–1937

329. Halperin F, Dluhy RG. Glucocorticoid-remediable aldosteronism. *Endocrinol Metab Clin North Am*. 2011;40(2):333–341, viii

330. Staley JR, Bradley J, Silverwood RJ, et al. Associations of blood pressure in pregnancy with offspring blood pressure trajectories during childhood and adolescence: findings from a prospective study. *J Am Heart Assoc*. 2015;4(5):e001422

331. Daniels SD, Meyer RA, Loggie JM. Determinants of cardiac involvement in children and adolescents with essential hypertension. *Circulation*. 1990;82(4):1243–1248

332. Yang Q, Zhang Z, Kuklina EV, et al. Sodium intake and blood pressure among US children and adolescents. *Pediatrics*. 2012;130(4):611–619

333. He FJ, MacGregor GA. Importance of salt in determining blood pressure in children: meta-analysis of controlled trials. *Hypertension*. 2006;48(5):861–869

334. Aeberli I, Spinas GA, Lehmann R, l'Allemand D, Molinari L, Zimmermann MB. Diet determines features of the metabolic syndrome in 6- to 14-year-old children. *Int J Vitam Nutr Res*. 2009;79(1):14–23

335. Colín-Ramírez E, Castillo-Martínez L, Orea-Tejeda A, Villa Romero AR, Vergara Castañeda A, Asensio Lafuente E. Waist circumference and fat intake are associated with high blood pressure in Mexican children aged 8 to 10 years. *J Am Diet Assoc*. 2009;109(6):996–1003

336. Niinikoski H, Jula A, Viikari J, et al. Blood pressure is lower in children and adolescents with a low-saturated-fat diet since infancy: the special turku coronary risk factor intervention project. *Hypertension*. 2009;53(6):918–924

337. Institute of Medicine. *Strategies to Reduce Sodium Intake in the United States*. Washington, DC: National Academies Press; 2010

338. Adler AJ, Taylor F, Martin N, Gottlieb S, Taylor RS, Ebrahim S. Reduced dietary salt for the prevention of cardiovascular disease. *Cochrane Database Syst Rev*. 2014;(12):CD009217

339. Rebholz CM, Gu D, Chen J, et al; GenSalt Collaborative Research Group. Physical activity reduces salt sensitivity of blood pressure: the Genetic Epidemiology Network of Salt Sensitivity study. *Am J Epidemiol*. 2012;176(suppl 7):S106–S113

340. Torrance B, McGuire KA, Lewanczuk R, McGavock J. Overweight, physical activity and high blood pressure in children: a review of the literature. *Vasc Health Risk Manag*. 2007;3(1):139–149

341. Chen HH, Chen YL, Huang CY, Lee SD, Chen SC, Kuo CH. Effects of one-year swimming training on blood pressure and insulin sensitivity in mild hypertensive young patients. *Chin J Physiol*. 2010;53(3):185–189

342. Farpour-Lambert NJ, Aggoun Y, Marchand LM, Martin XE, Herrmann FR, Beghetti M. Physical activity reduces systemic blood pressure and improves early markers of atherosclerosis in pre-pubertal obese children. *J Am Coll Cardiol*. 2009;54(25):2396–2406

343. Cai L, Wu Y, Cheskin LJ, Wilson RF, Wang Y. Effect of childhood obesity prevention programmes on blood lipids: a systematic review and meta-analysis. *Obes Rev*. 2014;15(12):933–944

344. Kelley GA, Kelley KS, Tran ZV. The effects of exercise on resting blood pressure in children and adolescents: a meta-analysis of randomized controlled trials. *Prev Cardiol*. 2003;6(1):8–16

345. van Dijk AE, van Eijsden M, Stronks K, Gemke RJ, Vrijkotte TG. The association between prenatal psychosocial stress and blood pressure in the child at age 5-7 years. *PLoS One*. 2012;7(8):e43548

346. Stein DJ, Scott K, Haro Abad JM, et al. Early childhood adversity and later hypertension: data from the World Mental Health Survey. *Ann Clin Psychiatry*. 2010;22(1):19–28

347. Halonen JI, Stenholm S, Pentti J, et al. Childhood psychosocial adversity and adult neighborhood disadvantage as predictors of cardiovascular disease: a cohort study. *Circulation*. 2015;132(5):371–379

348. Maggio AB, Martin XE, Saunders Gasser C, et al. Medical and non-medical complications among children and adolescents with excessive body weight. *BMC Pediatr*. 2014;14:232

349. Yun M, Li S, Sun D, et al. Tobacco smoking strengthens the association of elevated blood pressure with arterial stiffness: the Bogalusa Heart Study. *J Hypertens*. 2015;33(2):266–274

350. Priest JR, Nead KT, Wehner MR, Cooke JP, Leeper NJ. Self-reported history of childhood smoking is associated with an increased risk for peripheral arterial disease independent of lifetime smoking burden. *PLoS One*. 2014;9(2):e88972

351. Hagan JFSJ, Duncan PM. *Bright Futures: Guidelines for Health Supervision of Infants, Children, and Adolescents*. 3rd ed. Elk Grove Village, IL: American Academy of Pediatrics; 2008

352. Benson L, Baer HJ, Greco PJ, Kaelber DC. When is family history obtained? - Lack of timely documentation of family history among overweight and hypertensive paediatric patients. *J Paediatr Child Health*. 2010;46(10):600–605

353. Flynn JT. Evaluation and management of hypertension in childhood. *Prog Pediatr Cardiol*. 2001;12(2):177–188

354. Wiesen J, Adkins M, Fortune S, et al. Evaluation of pediatric patients with mild-to-moderate hypertension: yield of diagnostic testing. *Pediatrics*. 2008;122(5). Available at: www.pediatrics.org/cgi/content/full/122/5/e988

355. Yoon EY, Cohn L, Rocchini A, et al. Use of diagnostic tests in adolescents with essential hypertension. *Arch Pediatr Adolesc Med*. 2012;166(9):857–862

356. Killian L, Simpson JM, Savis A, Rawlins D, Sinha MD. Electrocardiography is a poor screening test to detect left ventricular hypertrophy in children. *Arch Dis Child*. 2010;95(10):832–836

357. Ramaswamy P, Patel E, Fahey M, Mahgerefteh J, Lytrivi ID, Kupferman JC. Electrocardiographic predictors of left ventricular hypertrophy in pediatric hypertension. *J Pediatr*. 2009;154(1):106–110

358. Rijnbeek PR, van Herpen G, Kapusta L, Ten Harkel AD, Witsenburg M, Kors JA. Electrocardiographic criteria for left ventricular hypertrophy in children. *Pediatr Cardiol*. 2008;29(5):923–928

359. Grossman A, Prokupetz A, Koren-Morag N, Grossman E, Shamiss A. Comparison of usefulness of Sokolow and Cornell criteria for left ventricular hypertrophy in subjects aged <20 years versus >30 years. *Am J Cardiol*. 2012;110(3):440–444

360. Caselli S, Maron MS, Urbano-Moral JA, Pandian NG, Maron BJ, Pelliccia A. Differentiating left ventricular hypertrophy in athletes from that in patients with hypertrophic cardiomyopathy. *Am J Cardiol*. 2014;114(9):1383–1389

361. Urbina EM, Gidding SS, Bao W, Pickoff AS, Berdusis K, Berenson GS. Effect of body size, ponderosity, and blood pressure on left ventricular growth in children and young adults in the Bogalusa Heart Study. *Circulation*. 1995;91(9):2400–2406

362. Kuznetsova T, Haddad F, Tikhonoff V, et al; European Project On Genes in Hypertension (EPOGH) Investigators. Impact and pitfalls of scaling of left ventricular and atrial structure in population-based studies. *J Hypertens*. 2016;34(6):1186–1194

363. Armstrong AC, Gidding S, Gjesdal O, Wu C, Bluemke DA, Lima JA. LV mass assessed by echocardiography and CMR, cardiovascular outcomes, and medical practice. *JACC Cardiovasc Imaging*. 2012;5(8):837–848

364. Armstrong AC, Jacobs DR Jr, Gidding SS, et al. Framingham score and LV mass predict events in young adults: CARDIA study. *Int J Cardiol*. 2014;172(2):350–355

365. Gidding SS, Palermo RA, DeLoach SS, Keith SW, Falkner B. Associations of cardiac structure with obesity, blood pressure, inflammation, and insulin resistance in African-American adolescents. *Pediatr Cardiol*. 2014;35(2):307–314

366. Hanevold C, Waller J, Daniels S, Portman R, Sorof J; International Pediatric Hypertension Association. The effects of obesity, gender, and ethnic group on left ventricular hypertrophy and geometry in hypertensive children: a collaborative study of the International Pediatric Hypertension Association. *Pediatrics*. 2004;113(2):328–333

367. Daniels SR, Loggie JM, Khoury P, Kimball TR. Left ventricular geometry and severe left ventricular hypertrophy in children and adolescents with essential hypertension. *Circulation*. 1998;97(19):1907–1911

368. Devereux RB, Wachtell K, Gerdts E, et al. Prognostic significance of left ventricular mass change during treatment of hypertension. *JAMA*. 2004;292(19):2350–2356

369. Lang RM, Badano LP, Mor-Avi V, et al. Recommendations for cardiac chamber quantification by echocardiography in adults: an update from the American Society of Echocardiography and the European Association of Cardiovascular Imaging.*J Am Soc Echocardiogr*. 2015;28(1):1–39.e14

370. Daniels SR, Kimball TR, Morrison JA, Khoury P, Witt S, Meyer RA. Effect of lean body mass, fat mass, blood pressure, and sexual maturation on left ventricular mass in children and adolescents. Statistical, biological, and clinical significance. *Circulation*. 1995;92(11):3249–3254

371. Lopez L, Colan SD, Frommelt PC, et al. Recommendations for quantification methods during the performance of a pediatric echocardiogram: a report from the Pediatric Measurements Writing Group of the American Society of Echocardiography Pediatric and Congenital Heart Disease Council. *J Am Soc Echocardiogr*. 2010;23(5):465–495, quiz 576–577

372. Foster BJ, Khoury PR, Kimball TR, Mackie AS, Mitsnefes M. New reference centiles for left ventricular mass relative to lean body mass in children. *J Am Soc Echocardiogr*. 2016;29(5):441–447.e2

373. Khoury PR, Mitsnefes M, Daniels SR, Kimball TR. Age-specific reference intervals for indexed left ventricular mass in children. *J Am Soc Echocardiogr*. 2009;22(6):709–714

374. Lipshultz SE, Easley KA, Orav EJ, et al. Reliability of multicenter pediatric echocardiographic measurements of left ventricular structure and function: the prospective P(2)C(2) HIV study. *Circulation*. 2001;104(3):310–316

375. Urbina EM. Abnormalities of vascular structure and function in pediatric hypertension. *Pediatr Nephrol*. 2016;31(7):1061–1070

376. Elmenhorst J, Hulpke-Wette M, Barta C, Dalla Pozza R, Springer S, Oberhoffer R. Percentiles for central blood pressure and pulse wave velocity in children and adolescents recorded with an oscillometric device. *Atherosclerosis*. 2015;238(1):9–16

377. Hidvégi EV, Illyés M, Benczúr B, et al. Reference values of aortic pulse wave velocity in a large healthy population aged between 3 and 18 years. *J Hypertens*. 2012;30(12):2314–2321

378. Miyai N, Utsumi M, Gowa Y, et al. Age-specific nomogram of brachial-ankle pulse wave velocity in Japanese adolescents. *Clin Exp Hypertens*. 2013;35(2):95–101

379. Urbina EM, Khoury PR, McCoy CE, Dolan LM, Daniels SR, Kimball TR. Triglyceride to HDL-C ratio and increased arterial stiffness in children, adolescents, and young adults [published correction appears in *Pediatrics*. 2013;132(4):780]. *Pediatrics*. 2013;131(4). Available at: www.pediatrics.org/cgi/content/full/131/4/e1082

380. Lurbe E, Torro I, Garcia-Vicent C, Alvarez J, Fernández-Fornoso JA, Redon J. Blood pressure and obesity exert independent influences on pulse wave velocity in youth. *Hypertension*. 2012;60(2):550–555

381. Zhu H, Yan W, Ge D, et al. Relationships of cardiovascular phenotypes with healthy weight, at risk of overweight, and overweight in US youths. *Pediatrics*. 2008;121(1):115–122

382. Charakida M, Jones A, Falaschetti E, et al. Childhood obesity and vascular

phenotypes: a population study. *J Am Coll Cardiol*. 2012;60(25):2643–2650

383. Doyon A, Kracht D, Bayazit AK, et al; 4C Study Consortium. Carotid artery intima-media thickness and distensibility in children and adolescents: reference values and role of body dimensions. *Hypertension*. 2013;62(3):550–556

384. Urbina EM, Kimball TR, McCoy CE, Khoury PR, Daniels SR, Dolan LM. Youth with obesity and obesity-related type 2 diabetes mellitus demonstrate abnormalities in carotid structure and function. *Circulation*. 2009;119(22):2913–2919

385. Keehn L, Milne L, McNeill K, Chowienczyk P, Sinha MD. Measurement of pulse wave velocity in children: comparison of volumetric and tonometric sensors, brachial-femoral and carotid-femoral pathways. *J Hypertens*. 2014;32(7):1464–1469, discussion 1469

386. Kis E, Cseprekál O, Kerti A, et al. Measurement of pulse wave velocity in children and young adults: a comparative study using three different devices. *Hypertens Res*. 2011;34(11):1197–1202

387. Chhadia S, Cohn RA, Vural G, Donaldson JS. Renal Doppler evaluation in the child with hypertension: a reasonable screening discriminator? *Pediatr Radiol*. 2013;43(12):1549–1556

388. Castelli PK, Dillman JR, Kershaw DB, Khalatbari S, Stanley JC, Smith EA. Renal sonography with Doppler for detecting suspected pediatric renin-mediated hypertension - is it adequate? *Pediatr Radiol*. 2014;44(1):42–49

389. Rountas C, Vlychou M, Vassiou K, et al. Imaging modalities for renal artery stenosis in suspected renovascular hypertension: prospective intraindividual comparison of color Doppler US, CT angiography, GD-enhanced MR angiography, and digital substraction angiography. *Ren Fail*. 2007;29(3):295–302

390. Marks SD, Tullus K. Update on imaging for suspected renovascular hypertension in children and adolescents. *Curr Hypertens Rep*. 2012;14(6):591–595

391. Lagomarsino E, Orellana P, Muñoz J, Velásquez C, Cavagnaro F, Valdés F. Captopril scintigraphy in the study of arterial hypertension in pediatrics. *Pediatr Nephrol*. 2004;19(1):66–70

392. Abdulsamea S, Anderson P, Biassoni L, et al. Pre- and postcaptopril renal scintigraphy as a screening test for renovascular hypertension in children. *Pediatr Nephrol*. 2010;25(2):317–322

393. Günay EC, Oztürk MH, Ergün EL, et al. Losartan renography for the detection of renal artery stenosis: comparison with captopril renography and evaluation of dose and timing. *Eur J Nucl Med Mol Imaging*. 2005;32(9):1064–1074

394. Reusz GS, Kis E, Cseprekál O, Szabó AJ, Kis E. Captopril-enhanced renal scintigraphy in the diagnosis of pediatric hypertension. *Pediatr Nephrol*. 2010;25(2):185–189

395. Loeffler LF, Navas-Acien A, Brady TM, Miller ER III, Fadrowski JJ. Uric acid level and elevated blood pressure in US adolescents: National Health and Nutrition Examination Survey, 1999-2006. *Hypertension*. 2012;59(4):811–817

396. Shatat IF, Abdallah RT, Sas DJ, Hailpern SM. Serum uric acid in U.S. adolescents: distribution and relationship to demographic characteristics and cardiovascular risk factors. *Pediatr Res*. 2012;72(1):95–100

397. Viazzi F, Antolini L, Giussani M, et al. Serum uric acid and blood pressure in children at cardiovascular risk. *Pediatrics*. 2013;132(1). Available at: www.pediatrics.org/cgi/content/full/132/1/e93

398. Reschke LD, Miller ER III, Fadrowski JJ, et al. Elevated uric acid and obesity-related cardiovascular disease risk factors among hypertensive youth. *Pediatr Nephrol*. 2015;30(12):2169–2176

399. Alper AB Jr, Chen W, Yau L, Srinivasan SR, Berenson GS, Hamm LL. Childhood uric acid predicts adult blood pressure: the Bogalusa Heart Study. *Hypertension*. 2005;45(1):34–38

400. Soletsky B, Feig DI. Uric acid reduction rectifies prehypertension in obese adolescents. *Hypertension*. 2012;60(5):1148–1156

401. Feig DI, Soletsky B, Johnson RJ. Effect of allopurinol on blood pressure of adolescents with newly diagnosed essential hypertension: a randomized trial. *JAMA*. 2008;300(8):924–932

402. Assadi F. Allopurinol enhances the blood pressure lowering effect of enalapril in children with hyperuricemic essential hypertension. *J Nephrol*. 2014;27(1):51–56

403. Feig DI, Nakagawa T, Karumanchi SA, et al. Hypothesis: uric acid, nephron number, and the pathogenesis of essential hypertension. *Kidney Int*. 2004;66(1):281–287

404. Viazzi F, Rebora P, Giussani M, et al. Increased serum uric acid levels blunt the antihypertensive efficacy of lifestyle modifications in children at cardiovascular risk. *Hypertension*. 2016;67(5):934–940

405. Klausen K, Borch-Johnsen K, Feldt-Rasmussen B, et al. Very low levels of microalbuminuria are associated with increased risk of coronary heart disease and death independently of renal function, hypertension, and diabetes. *Circulation*. 2004;110(1):32–35

406. Bigazzi R, Bianchi S, Baldari D, Campese VM. Microalbuminuria predicts cardiovascular events and renal insufficiency in patients with essential hypertension. *J Hypertens*. 1998;16(9):1325–1333

407. Chugh A, Bakris GL. Microalbuminuria: what is it? Why is it important? What should be done about it? An update. *J Clin Hypertens (Greenwich)*. 2007;9(3):196–200

408. Flynn JT. Microalbuminuria in children with primary hypertension. *J Clin Hypertens (Greenwich)*. 2016;18(10):962–965

409. Radhakishun NN, van Vliet M, von Rosenstiel IA, Beijnen JH, Diamant M. Limited value of routine microalbuminuria assessment in multi-ethnic obese children. *Pediatr Nephrol*. 2013;28(7):1145–1149

410. Tsioufis C, Mazaraki A, Dimitriadis K, Stefanidis CJ, Stefanadis C. Microalbuminuria in the paediatric age: current knowledge and

emerging questions. *Acta Paediatr*. 2011;100(9):1180–1184

411. Seeman T, Pohl M, Palyzova D, John U. Microalbuminuria in children with primary and white-coat hypertension. *Pediatr Nephrol*. 2012;27(3):461–467

412. Sanad M, Gharib A. Evaluation of microalbuminuria in obese children and its relation to metabolic syndrome. *Pediatr Nephrol*. 2011;26(12):2193–2199

413. Assadi F. Effect of microalbuminuria lowering on regression of left ventricular hypertrophy in children and adolescents with essential hypertension. *Pediatr Cardiol*. 2007;28(1):27–33

414. Niemirska A, Litwin M, Feber J, Jurkiewicz E. Blood pressure rhythmicity and visceral fat in children with hypertension. *Hypertension*. 2013;62(4):782–788

415. Kupferman JC, Paterno K, Mahgerefteh J, et al. Improvement of left ventricular mass with antihypertensive therapy in children with hypertension. *Pediatr Nephrol*. 2010;25(8):1513–1518

416. Falkner B, DeLoach S, Keith SW, Gidding SS. High risk blood pressure and obesity increase the risk for left ventricular hypertrophy in African-American adolescents. *J Pediatr*. 2013;162(1):94–100

417. Stabouli S, Kotsis V, Rizos Z, et al. Left ventricular mass in normotensive, prehypertensive and hypertensive children and adolescents. *Pediatr Nephrol*. 2009;24(8):1545–1551

418. Tirosh A, Afek A, Rudich A, et al. Progression of normotensive adolescents to hypertensive adults: a study of 26,980 teenagers. *Hypertension*. 2010;56(2):203–209

419. Chobanian AV, Bakris GL, Black HR; National Heart, Lung, and Blood Institute Joint National Committee on Prevention, Detection, Evaluation, and Treatment of High Blood Pressure; National High Blood Pressure Education Program Coordinating Committee. The seventh report of the Joint National Committee on prevention, detection, evaluation, and treatment of high blood pressure: the JNC 7 report [published correction appears in *JAMA*. 2003;290(2):197]. *JAMA*. 2003;289(19):2560–2571

420. Moreno-Luna R, Muñoz-Hernandez R, Miranda ML, et al. Olive oil polyphenols decrease blood pressure and improve endothelial function in young women with mild hypertension. *Am J Hypertens*. 2012;25(12):1299–1304

421. Damasceno MM, de Araújo MF, de Freitas RW, de Almeida PC, Zanetti ML. The association between blood pressure in adolescents and the consumption of fruits, vegetables and fruit juice--an exploratory study. *J Clin Nurs*. 2011;20(11–12):1553–1560

422. Juonala M, Viikari JS, Kähönen M, et al. Life-time risk factors and progression of carotid atherosclerosis in young adults: the Cardiovascular Risk in Young Finns study. *Eur Heart J*. 2010;31(14):1745–1751

423. Yuan WL, Kakinami L, Gray-Donald K, Czernichow S, Lambert M, Paradis G. Influence of dairy product consumption on children's blood pressure: results from the QUALITY cohort. *J Acad Nutr Diet*. 2013;113(7):936–941

424. Moore LL, Bradlee ML, Singer MR, Qureshi MM, Buendia JR, Daniels SR. Dietary approaches to stop hypertension (DASH) eating pattern and risk of elevated blood pressure in adolescent girls. *Br J Nutr*. 2012;108(9):1678–1685

425. Günther AL, Liese AD, Bell RA, et al. Association between the dietary approaches to hypertension diet and hypertension in youth with diabetes mellitus. *Hypertension*. 2009;53(1):6–12

426. Couch SC, Saelens BE, Levin L, Dart K, Falciglia G, Daniels SR. The efficacy of a clinic-based behavioral nutrition intervention emphasizing a DASH-type diet for adolescents with elevated blood pressure. *J Pediatr*. 2008;152(4):494–501

427. Davis JN, Ventura EE, Cook LT, Gyllenhammer LE, Gatto NMLA. LA Sprouts: a gardening, nutrition, and cooking intervention for Latino youth improves diet and reduces obesity. *J Am Diet Assoc*. 2011;111(8):1224–1230

428. Saneei P, Hashemipour M, Kelishadi R, Rajaei S, Esmaillzadeh A. Effects of recommendations to follow the dietary approaches to stop hypertension (DASH) diet v. usual dietary advice on childhood metabolic syndrome: a randomised cross-over clinical trial. *Br J Nutr*. 2013;110(12):2250–2259

429. Barnes TL, Crandell JL, Bell RA, Mayer-Davis EJ, Dabelea D, Liese AD. Change in DASH diet score and cardiovascular risk factors in youth with type 1 and type 2 diabetes mellitus: the SEARCH for Diabetes in Youth study. *Nutr Diabetes*. 2013;3:e91

430. Rao M, Afshin A, Singh G, Mozaffarian D. Do healthier foods and diet patterns cost more than less healthy options? A systematic review and meta-analysis. *BMJ Open*. 2013;3(12):e004277

431. Monzavi R, Dreimane D, Geffner ME, et al. Improvement in risk factors for metabolic syndrome and insulin resistance in overweight youth who are treated with lifestyle intervention. *Pediatrics*. 2006;117(6). Available at: www.pediatrics.org/cgi/content/full/117/6/e1111

432. Asghari G, Yuzbashian E, Mirmiran P, Hooshmand F, Najafi R, Azizi F. Dietary approaches to stop hypertension (DASH) dietary pattern is associated with reduced incidence of metabolic syndrome in children and adolescents. *J Pediatr*. 2016;174:178–184.e1

433. Pacifico L, Anania C, Martino F, et al. Management of metabolic syndrome in children and adolescents. *Nutr Metab Cardiovasc Dis*. 2011;21(6):455–466

434. Puri M, Flynn JT. Management of hypertension in children and adolescents with the metabolic syndrome. *J Cardiometab Syndr*. 2006;1(4):259–268

435. Davis MM, Gance-Cleveland B, Hassink S, Johnson R, Paradis G, Resnicow K. Recommendations for prevention of childhood obesity. *Pediatrics*. 2007;120(suppl 4):S229–S253

436. Ogedegbe G, Chaplin W, Schoenthaler A, et al. A practice-based trial of motivational interviewing and adherence in hypertensive African Americans. *Am J Hypertens*. 2008;21(10):1137–1143

437. Bosworth HB, Olsen MK, Neary A, et al. Take Control of Your Blood Pressure (TCYB) study: a multifactorial tailored behavioral and educational intervention for achieving blood pressure control. *Patient Educ Couns*. 2008;70(3):338–347

438. Resnicow K, McMaster F, Bocian A, et al. Motivational interviewing and dietary counseling for obesity in primary care: an RCT. *Pediatrics*. 2015;135(4):649–657

439. Davoli AM, Broccoli S, Bonvicini L, et al. Pediatrician-led motivational interviewing to treat overweight children: an RCT. *Pediatrics*. 2013;132(5). Available at: www.pediatrics.org/cgi/content/full/132/5/e1236

440. Broccoli S, Davoli AM, Bonvicini L, et al. Motivational interviewing to treat overweight children: 24-month follow-up of a randomized controlled trial. *Pediatrics*. 2016;137(1):e20151979

441. Flattum C, Friend S, Neumark-Sztainer D, Story M. Motivational interviewing as a component of a school-based obesity prevention program for adolescent girls. *J Am Diet Assoc*. 2009;109(1):91–94

442. Schwartz RP, Hamre R, Dietz WH, et al. Office-based motivational interviewing to prevent childhood obesity: a feasibility study. *Arch Pediatr Adolesc Med*. 2007;161(5):495–501

443. Döring N, Ghaderi A, Bohman B, et al. Motivational interviewing to prevent childhood obesity: a cluster RCT. *Pediatrics*. 2016;137(5):1–10

444. Spear BA, Barlow SE, Ervin C, et al. Recommendations for treatment of child and adolescent overweight and obesity. *Pediatrics*. 2007;120(4, suppl 4):S254–S288

445. Kabat-Zinn J, Hanh TN. *Full Catastrophe Living: Using the Wisdom of Your Body and Mind to Face Stress, Pain, and Illness*. New York, NY: Delta; 1990

446. Gregoski MJ, Barnes VA, Tingen MS, Harshfield GA, Treiber FA. Breathing awareness meditation and LifeSkills Training programs influence upon ambulatory blood pressure and sodium excretion among African American adolescents. *J Adolesc Health*. 2011;48(1):59–64

447. Barnes VA, Kapuku GK, Treiber FA. Impact of transcendental meditation on left ventricular mass in African American adolescents.*Evid Based Complement Alternat Med*. 2012;2012:923153

448. Sieverdes JC, Mueller M, Gregoski MJ, et al. Effects of Hatha yoga on blood pressure, salivary α-amylase, and cortisol function among normotensive and prehypertensive youth. *J Altern Complement Med*. 2014;20(4):241–250

449. Sorof JM, Cargo P, Graepel J, et al. β-blocker/thiazide combination for treatment of hypertensive children: a randomized double-blind, placebo-controlled trial. *Pediatr Nephrol*. 2002;17(5):345–350

450. Trachtman H, Hainer JW, Sugg J, Teng R, Sorof JM, Radcliffe J; Candesartan in Children with Hypertension (CINCH) Investigators. Efficacy, safety, and pharmacokinetics of candesartan cilexetil in hypertensive children aged 6 to 17 years. *J Clin Hypertens (Greenwich)*. 2008;10(10):743–750

451. Herder SD, Weber E, Winkemann A, Herder C, Morck H. Efficacy and safety of angiotensin II receptor type 1 antagonists in children and adolescents. *Pediatr Nephrol*. 2010;25(5):801–811

452. Schaefer F, Litwin M, Zachwieja J, et al. Efficacy and safety of valsartan compared to enalapril in hypertensive children: a 12-week, randomized, double-blind, parallel-group study. *J Hypertens*. 2011;29(12):2484–2490

453. Gartenmann AC, Fossali E, von Vigier RO, et al. Better renoprotective effect of angiotensin II antagonist compared to dihydropyridine calcium channel blocker in childhood. *Kidney Int*. 2003;64(4):1450–1454

454. Chaturvedi S, Lipszyc DH, Licht C, Craig JC, Parekh R. Pharmacological interventions for hypertension in children. *Evid Based Child Health*. 2014;9(3):498–580

455. Flynn JT. Efficacy and safety of prolonged amlodipine treatment in hypertensive children. *Pediatr Nephrol*. 2005;20(5):631–635

456. Schaefer F, Coppo R, Bagga A, et al. Efficacy and safety of valsartan in hypertensive children 6 months to 5 years of age. *J Hypertens*. 2013;31(5):993–1000

457. Batisky DL, Sorof JM, Sugg J, et al; Toprol-XL Pediatric Hypertension Investigators. Efficacy and safety of extended release metoprolol succinate in hypertensive children 6 to 16 years of age: a clinical trial experience. *J Pediatr*. 2007;150(2):134–139, 139.e1

458. Wells T, Blumer J, Meyers KE, et al; Valsartan Pediatric Hypertension Study Group. Effectiveness and safety of valsartan in children aged 6 to 16 years with hypertension. *J Clin Hypertens (Greenwich)*. 2011;13(5):357–365

459. Trachtman H, Frank R, Mahan JD, et al. Clinical trial of extended-release felodipine in pediatric essential hypertension. *Pediatr Nephrol*. 2003;18(6):548–553

460. Shahinfar S, Cano F, Soffer BA, et al. A double-blind, dose-response study of losartan in hypertensive children. *Am J Hypertens*. 2005;18(2, pt 1):183–190

461. Hazan L, Hernández Rodriguez OA, Bhorat AE, Miyazaki K, Tao B, Heyrman R; Assessment of Efficacy and Safety of Olmesartan in Pediatric Hypertension Study Group. A double-blind, dose-response study of the efficacy and safety of olmesartan medoxomil in children and adolescents with hypertension. *Hypertension*. 2010;55(6):1323–1330

462. Flynn JT, Newburger JW, Daniels SR, et al; PATH-1 Investigators. A randomized, placebo-controlled trial of amlodipine in children with hypertension. *J Pediatr*. 2004;145(3):353–359

463. Simonetti GD, Rizzi M, Donadini R, Bianchetti MG. Effects of antihypertensive drugs on blood pressure and proteinuria in childhood. *J Hypertens*. 2007;25(12):2370–2376

464. Seeman T, Dusek J, Vondrák K, Flögelová H, Geier P, Janda J. Ramipril in the treatment of hypertension and proteinuria in children with chronic kidney diseases. *Am J Hypertens*. 2004;17(5, pt 1):415–420

465. Hammer GB, Verghese ST, Drover DR, Yaster M, Tobin JR. Pharmacokinetics and pharmacodynamics of fenoldopam mesylate for blood pressure control

in pediatric patients. *BMC Anesthesiol*. 2008;8:6

466. Blowey DL. Update on the pharmacologic treatment of hypertension in pediatrics. *J Clin Hypertens (Greenwich)*. 2012;14(6):383–387

467. Li JS, Flynn JT, Portman R, et al. The efficacy and safety of the novel aldosterone antagonist eplerenone in children with hypertension: a randomized, double-blind, dose-response study. *J Pediatr*. 2010;157(2):282–287

468. U.S. Food and Drug Administration. Pediatric product development. Available at: www.fda.gov/Drugs/DevelopmentApprovalProcess/DevelopmentResources/ucm049867.htm. Accessed February 6, 2017

469. Croxtall JD. Valsartan: in children and adolescents with hypertension. *Paediatr Drugs*. 2012;14(3):201–207

470. Menon S, Berezny KY, Kilaru R, et al. Racial differences are seen in blood pressure response to fosinopril in hypertensive children. *Am Heart J*. 2006;152(2):394–399

471. Li JS, Baker-Smith CM, Smith PB, et al. Racial differences in blood pressure response to angiotensin-converting enzyme inhibitors in children: a meta-analysis. *Clin Pharmacol Ther*. 2008;84(3):315–319

472. Seeman T, Dostálek L, Gilík J. Control of hypertension in treated children and its association with target organ damage. *Am J Hypertens*. 2012;25(3):389–395

473. Redwine K, Howard L, Simpson P, et al; Network of Pediatric Pharmacology Research Units. Effect of placebo on ambulatory blood pressure monitoring in children. *Pediatr Nephrol*. 2012;27(10):1937–1942

474. Halbach SM, Hamman R, Yonekawa K, Hanevold C. Utility of ambulatory blood pressure monitoring in the evaluation of elevated clinic blood pressures in children. *J Am Soc Hypertens*. 2016;10(5):406–412

475. White WB, Turner JR, Sica DA, et al. Detection, evaluation, and treatment of severe and resistant hypertension: proceedings from an American Society of Hypertension Interactive forum held in Bethesda, MD, U.S.A., October 10th, 2013. *J Am Soc Hypertens*. 2014;8(10):743–757

476. Narayan H, Webb DJ. New evidence supporting the use of mineralocorticoid receptor blockers in drug-resistant hypertension. *Curr Hypertens Rep*. 2016;18(5):34

477. Williams B, MacDonald TM, Morant S, et al; British Hypertension Society's PATHWAY Studies Group. Spironolactone versus placebo, bisoprolol, and doxazosin to determine the optimal treatment for drug-resistant hypertension (PATHWAY-2): a randomised, double-blind, crossover trial. *Lancet*. 2015;386(10008):2059–2068

478. Mitsnefes M, Ho PL, McEnery PT. Hypertension and progression of chronic renal insufficiency in children: a report of the North American Pediatric Renal Transplant Cooperative Study (NAPRTCS). *J Am Soc Nephrol*. 2003;14(10):2618–2622

479. Dionne JM. Evidence-based guidelines for the management of hypertension in children with chronic kidney disease. *Pediatr Nephrol*. 2015;30(11):1919–1927

480. VanDeVoorde RG, Mitsnefes MM. Hypertension and CKD. *Adv Chronic Kidney Dis*. 2011;18(5):355–361

481. Mitsnefes MM, Kimball TR, Kartal J, et al. Progression of left ventricular hypertrophy in children with early chronic kidney disease: 2-year follow-up study. *J Pediatr*. 2006;149(5):671–675

482. Wright JT Jr, Williamson JD, Whelton PK, et al; SPRINT Research Group. A randomized trial of intensive versus standard blood-pressure control. *N Engl J Med*. 2015;373(22):2103–2116

483. Wong H, Mylrea K, Feber J, Drukker A, Filler G. Prevalence of complications in children with chronic kidney disease according to KDOQI. *Kidney Int*. 2006;70(3):585–590

484. Simonetti GD, von Vigier RO, Konrad M, Rizzi M, Fossali E, Bianchetti MG. Candesartan cilexetil in children with hypertension or proteinuria: preliminary data. *Pediatr Nephrol*. 2006;21(10):1480–1482

485. White CT, Macpherson CF, Hurley RM, Matsell DG. Antiproteinuric effects of enalapril and losartan: a pilot study. *Pediatr Nephrol*. 2003;18(10):1038–1043

486. Webb NJ, Lam C, Loeys T, et al. Randomized, double-blind, controlled study of losartan in children with proteinuria. *Clin J Am Soc Nephrol*. 2010;5(3):417–424

487. Webb NJ, Shahinfar S, Wells TG, et al. Losartan and enalapril are comparable in reducing proteinuria in children. *Kidney Int*. 2012;82(7):819–826

488. Wühl E, Mehls O, Schaefer F; ESCAPE Trial Group. Antihypertensive and antiproteinuric efficacy of ramipril in children with chronic renal failure. *Kidney Int*. 2004;66(2):768–776

489. Eppens MC, Craig ME, Cusumano J, et al. Prevalence of diabetes complications in adolescents with type 2 compared with type 1 diabetes. *Diabetes Care*. 2006;29(6):1300–1306

490. Mayer-Davis EJ, Ma B, Lawson A, et al; SEARCH for Diabetes in Youth Study Group. Cardiovascular disease risk factors in youth with type 1 and type 2 diabetes: implications of a factor analysis of clustering. *Metab Syndr Relat Disord*. 2009;7(2):89–95

491. Margeirsdottir HD, Larsen JR, Brunborg C, Overby NC, Dahl-Jørgensen K; Norwegian Study Group for Childhood Diabetes. High prevalence of cardiovascular risk factors in children and adolescents with type 1 diabetes: a population-based study. *Diabetologia*. 2008;51(4):554–561

492. Orchard TJ, Forrest KY, Kuller LH, Becker DJ; Pittsburgh Epidemiology of Diabetes Complications Study. Lipid and blood pressure treatment goals for type 1 diabetes: 10-year incidence data from the Pittsburgh Epidemiology of Diabetes Complications Study. *Diabetes Care*. 2001;24(6):1053–1059

493. Copeland KC, Zeitler P, Geffner M, et al; TODAY Study Group. Characteristics of adolescents and youth with recent-onset type 2 diabetes: the TODAY cohort at baseline. *J Clin Endocrinol Metab*. 2011;96(1):159–167

494. Klingensmith GJ, Connor CG, Ruedy KJ, et al; Pediatric Diabetes Consortium. Presentation of youth with type 2

diabetes in the Pediatric Diabetes Consortium. *Pediatr Diabetes*. 2016;17(4):266–273

495. Shah AS, Dolan LM, Gao Z, Kimball TR, Urbina EM. Racial differences in arterial stiffness among adolescents and young adults with type 2 diabetes. *Pediatr Diabetes*. 2012;13(2):170–175

496. TODAY Study Group. Rapid rise in hypertension and nephropathy in youth with type 2 diabetes: the TODAY clinical trial. *Diabetes Care*. 2013;36(6):1735–1741

497. Shah AS, Khoury PR, Dolan LM, et al. The effects of obesity and type 2 diabetes mellitus on cardiac structure and function in adolescents and young adults. *Diabetologia*. 2011;54(4):722–730

498. Nambam B, DuBose SN, Nathan BM, et al; T1D Exchange Clinic Network. Therapeutic inertia: underdiagnosed and undertreated hypertension in children participating in the T1D Exchange Clinic Registry. *Pediatr Diabetes*. 2016;17(1):15–20

499. American Diabetes Association. Supplemental issue: standards of medical care in diabetes - 2016. *Diabetes Care*. 2016;39(suppl 1):S1–S2

500. Donaghue KC, Chiarelli F, Trotta D, Allgrove J, Dahl-Jorgensen K. Microvascular and macrovascular complications associated with diabetes in children and adolescents. *Pediatr Diabetes*. 2009;10(suppl 12): 195–203

501. Expert Panel on Integrated Guidelines for Cardiovascular Health and Risk Reduction in Children and Adolescents; National Heart, Lung, and Blood Institute. Expert panel on integrated guidelines for cardiovascular health and risk reduction in children and adolescents: summary report. *Pediatrics*. 2011;128(suppl 5):S213–S256

502. Stern MP. Diabetes and cardiovascular disease. The "common soil" hypothesis. *Diabetes*. 1995;44(4):369–374

503. Martino F, Puddu PE, Pannarale G, et al. Hypertension in children and adolescents attending a lipid clinic. *Eur J Pediatr*. 2013;172(12):1573–1579

504. Rodríguez-Morán M, Guerrero-Romero F, Aradillas-García C, et al. Atherogenic indices and prehypertension in obese and non-obese children. *Diab Vasc Dis Res*. 2013;10(1):17–24

505. Li J, Motsko SP, Goehring EL Jr, Vendiola R, Maneno M, Jones JK. Longitudinal study on pediatric dyslipidemia in population-based claims database. *Pharmacoepidemiol Drug Saf*. 2010;19(1):90–98

506. Liao CC, Su TC, Chien KL, et al. Elevated blood pressure, obesity, and hyperlipidemia.*J Pediatr*. 2009;155(1):79–83, 83.e1

507. Marcus CL, Brooks LJ, Draper KA, et al; American Academy of Pediatrics. Diagnosis and management of childhood obstructive sleep apnea syndrome. *Pediatrics*. 2012;130(3). Available at: www.pediatrics.org/cgi/content/full/130/3/e714

508. Kuo YL, Kang KT, Chiu SN, Weng WC, Lee PL, Hsu WC. Blood pressure after surgery among obese and nonobese children with obstructive sleep apnea. *Otolaryngol Head Neck Surg*. 2015;152(5):931–940

509. Lande MB, Adams HR, Kupferman JC, Hooper SR, Szilagyi PG, Batisky DL. A multicenter study of neurocognition in children with hypertension: methods, challenges, and solutions. *J Am Soc Hypertens*. 2013;7(5):353–362

510. Lande MB, Adams H, Falkner B, et al. Parental assessments of internalizing and externalizing behavior and executive function in children with primary hypertension. *J Pediatr*. 2009;154(2):207–212

511. Adams HR, Szilagyi PG, Gebhardt L, Lande MB. Learning and attention problems among children with pediatric primary hypertension. *Pediatrics*. 2010;126(6). Available at: www.pediatrics.org/cgi/content/full/126/6/e1425

512. Settakis G, Páll D, Molnár C, Katona E, Bereczki D, Fülesdi B. Hyperventilation-induced cerebrovascular reactivity among hypertensive and healthy adolescents. *Kidney Blood Press Res*. 2006;29(5):306–311

513. Wong LJ, Kupferman JC, Prohovnik I, et al. Hypertension impairs vascular reactivity in the pediatric brain. *Stroke*. 2011;42(7):1834–1838

514. Lande MB, Kupferman JC, Adams HR. Neurocognitive alterations in hypertensive children and adolescents. *J Clin Hypertens (Greenwich)*. 2012;14(6):353–359

515. Ostrovskaya MA, Rojas M, Kupferman JC, et al. Executive function and cerebrovascular reactivity in pediatric hypertension. *J Child Neurol*. 2015;30(5):543–546

516. Ong KL, Cheung BM, Man YB, Lau CP, Lam KS. Prevalence, awareness, treatment, and control of hypertension among United States adults 1999-2004. *Hypertension*. 2007;49(1):69–75

517. Guo F, He D, Zhang W, Walton RG. Trends in prevalence, awareness, management, and control of hypertension among United States adults, 1999 to 2010. *J Am Coll Cardiol*. 2012;60(7):599–606

518. Hajjar I, Kotchen TA. Trends in prevalence, awareness, treatment, and control of hypertension in the United States, 1988-2000. *JAMA*. 2003;290(2):199–206

519. Daniels SR, McMahon RP, Obarzanek E, et al. Longitudinal correlates of change in blood pressure in adolescent girls. *Hypertension*. 1998;31(1):97–103

520. Wang X, Poole JC, Treiber FA, Harshfield GA, Hanevold CD, Snieder H. Ethnic and gender differences in ambulatory blood pressure trajectories: results from a 15-year longitudinal study in youth and young adults. *Circulation*. 2006;114(25):2780–2787

521. Rosner B, Cook N, Portman R, Daniels S, Falkner B. Blood pressure differences by ethnic group among United States children and adolescents. *Hypertension*. 2009;54(3):502–508

522. Peacock WF IV, Hilleman DE, Levy PD, Rhoney DH, Varon J. A systematic review of nicardipine vs labetalol for the management of hypertensive crises. *Am J Emerg Med*. 2012;30(6):981–993

523. Wiest DB, Garner SS, Uber WE, Sade RM. Esmolol for the management of pediatric hypertension after cardiac operations. *J Thorac Cardiovasc Surg*. 1998;115(4):890–897

524. Flynn JT, Mottes TA, Brophy PD, Kershaw DB, Smoyer WE, Bunchman TE. Intravenous nicardipine for treatment of severe hypertension in children. *J Pediatr*. 2001;139(1):38–43

525. Tabbutt S, Nicolson SC, Adamson PC, et al. The safety, efficacy, and pharmacokinetics of esmolol for blood pressure control immediately after repair of coarctation of the aorta in infants and children: a multicenter, double-blind, randomized trial. *J Thorac Cardiovasc Surg*. 2008;136(2):321–328

526. Miyashita Y, Peterson D, Rees JM, Flynn JT. Isradipine for treatment of acute hypertension in hospitalized children and adolescents. *J Clin Hypertens (Greenwich)*. 2010;12(11):850–855

527. Thomas CA, Moffett BS, Wagner JL, Mott AR, Feig DI. Safety and efficacy of intravenous labetalol for hypertensive crisis in infants and small children. *Pediatr Crit Care Med*. 2011;12(1):28–32

528. Kako H, Gable A, Martin D, et al. A prospective, open-label trial of clevidipine for controlled hypotension during posterior spinal fusion. *J Pediatr Pharmacol Ther*. 2015;20(1):54–60

529. Hammer GB, Lewandowski A, Drover DR, et al. Safety and efficacy of sodium nitroprusside during prolonged infusion in pediatric patients. *Pediatr Crit Care Med*. 2015;16(5):397–403

530. Flynn JT, Bradford MC, Harvey EM. Intravenous hydralazine in hospitalized children and adolescents with hypertension. *J Pediatr*. 2016;168:88–92

531. Yang WC, Zhao LL, Chen CY, Wu YK, Chang YJ, Wu HP. First-attack pediatric hypertensive crisis presenting to the pediatric emergency department. *BMC Pediatr*. 2012;12:200

532. Baracco R, Mattoo TK. Pediatric hypertensive emergencies. *Curr Hypertens Rep*. 2014;16(8):456

533. Flynn JT, Tullus K. Severe hypertension in children and adolescents: pathophysiology and treatment [published correction appears in *Pediatr Nephrol*. 2012;27(3):503–504]. *Pediatr Nephrol*. 2009;24(6):1101–1112

534. Patel NH, Romero SK, Kaelber DC. Evaluation and management of pediatric hypertensive crises: hypertensive urgency and hypertensive emergencies. *Open Access Emerg Med*. 2012;4:85–92

535. Chen YL, Liu YF, Huang CY, et al. Normalization effect of sports training on blood pressure in hypertensives. *J Sports Sci*. 2010;28(4):361–367

536. Hupin D, Roche F, Gremeaux V, et al. Even a low-dose of moderate-to-vigorous physical activity reduces mortality by 22% in adults aged ≥60 years: a systematic review and meta-analysis. *Br J Sports Med*. 2015;49(19):1262–1267

537. Di Paolo FM, Schmied C, Zerguini YA, et al. The athlete's heart in adolescent Africans: an electrocardiographic and echocardiographic study. *J Am Coll Cardiol*. 2012;59(11):1029–1036

538. McCambridge TM, Benjamin HJ, Brenner JS, et al; Council on Sports Medicine and Fitness. Athletic participation by children and adolescents who have systemic hypertension. *Pediatrics*. 2010;125(6):1287–1294

539. Black HR, Sica D, Ferdinand K, White WB. Eligibility and disqualification recommendations for competitive athletes with cardiovascular abnormalities: Task Force 6: hypertension: a scientific statement from the American Heart Association and the American College of Cardiology. *J Am Coll Cardiol*. 2015;66(21):2393–2397

540. Tainio J, Qvist E, Miettinen J, et al. Blood pressure profiles 5 to 10 years after transplant in pediatric solid organ recipients. *J Clin Hypertens (Greenwich)*. 2015;17(2):154–161

541. Seeman T, Simková E, Kreisinger J, et al. Control of hypertension in children after renal transplantation. *Pediatr Transplant*. 2006;10(3):316–322

542. Gülhan B, Topaloğlu R, Karabulut E, et al. Post-transplant hypertension in pediatric kidney transplant recipients. *Pediatr Nephrol*. 2014;29(6):1075–1080

543. Arbeiter K, Pichler A, Stemberger R, et al. ACE inhibition in the treatment of children after renal transplantation. *Pediatr Nephrol*. 2004;19(2):222–226

544. Suszynski TM, Rizzari MD, Gillingham KJ, et al. Antihypertensive pharmacotherapy and long-term outcomes in pediatric kidney transplantation. *Clin Transplant*. 2013;27(3):472–480

545. Sakallı H, Baskın E, Bayrakcı US, Moray G, Haberal M. Acidosis and hyperkalemia caused by losartan and enalapril in pediatric kidney transplant recipients. *Exp Clin Transplant*. 2014;12(4):310–313

546. Cooley WC, Sagerman PJ; American Academy of Pediatrics; American Academy of Family Physicians; American College of Physicians; Transitions Clinical Report Authoring Group. Supporting the health care transition from adolescence to adulthood in the medical home. *Pediatrics*. 2011;128(1):182–200

547. Julius S, Nesbitt SD, Egan BM, et al; Trial of Preventing Hypertension (TROPHY) Study Investigators. Feasibility of treating prehypertension with an angiotensin-receptor blocker. *N Engl J Med*. 2006;354(16):1685–1697

548. Kurioka S, Horie S, Inoue A, Mafune K, Tsuda Y, Otsuji Y. Risk of progression to hypertension in nonhypertensive Japanese workers aged 20-64 years. *J Hypertens*. 2014;32(2):236–244

549. Stabouli S, Papakatsika S, Kotsis V. The role of obesity, salt and exercise on blood pressure in children and adolescents. *Expert Rev Cardiovasc Ther*. 2011;9(6):753–761

550. Holm JC, Gamborg M, Neland M, et al. Longitudinal changes in blood pressure during weight loss and regain of weight in obese boys and girls. *J Hypertens*. 2012;30(2):368–374

551. Gillman MW, Ellison RC. Childhood prevention of essential hypertension. *Pediatr Clin North Am*. 1993;40(1):179–194

552. Krousel-Wood MA, Muntner P, He J, Whelton PK. Primary prevention of essential hypertension. *Med Clin North Am*. 2004;88(1):223–238

553. Whelton PK, He J, Appel LJ, et al; National High Blood Pressure Education Program Coordinating Committee. Primary prevention of

hypertension: clinical and public health advisory from the National High Blood Pressure Education Program. *JAMA*. 2002;288(15):1882–1888

554. Kim N, Seo DC, King MH, Lederer AM, Sovinski D. Long-term predictors of blood pressure among adolescents during an 18-month school-based obesity prevention intervention. *J Adolesc Health*. 2014;55(4):521–527

555. Aburto NJ, Ziolkovska A, Hooper L, Elliott P, Cappuccio FP, Meerpohl JJ. Effect of lower sodium intake on health: systematic review and meta-analyses. *BMJ*. 2013;346:f1326

556. American Academy of Pediatrics. EQIPP: hypertension recognition and management. Available at: http://shop.aap.org/eqipp-hypertension-identification-and-management. Accessed February 6, 2017

557. American Academy of Pediatrics, Council on Quality Improvement and Patient Safety. Implementation guide. Available at: https://www.aap.org/en-us/about-the-aap/Committees-Councils-Sections/coqips/Pages/Implementation-Guide.aspx. Accessed July 28, 2017

558. Wang YC, Cheung AM, Bibbins-Domingo K, et al. Effectiveness and cost-effectiveness of blood pressure screening in adolescents in the United States. *J Pediatr*. 2011;158(2):257–264. e1–e7

559. Davis ML, Ferguson MA, Zachariah JP. Clinical predictors and impact of ambulatory blood pressure monitoring in pediatric hypertension referrals. *J Am Soc Hypertens*. 2014;8(9):660–667

560. Leu MG, Austin E, Foti JL, et al. A framework for evaluating value of new clinical recommendations. *Hosp Pediatr*. 2016;6(10):578–586

561. Bradshaw B. The role of the family in managing therapy in minority children with type 2 diabetes mellitus. *J Pediatr Endocrinol Metab*. 2002;15(suppl 1):547–551

562. Pinhas-Hamiel O, Standiford D, Hamiel D, Dolan LM, Cohen R, Zeitler PS. The type 2 family: a setting for development and treatment of adolescent type 2 diabetes mellitus. *Arch Pediatr Adolesc Med*. 1999;153(10):1063–1067

563. Mulvaney SA, Schlundt DG, Mudasiru E, et al. Parent perceptions of caring for adolescents with type 2 diabetes. *Diabetes Care*. 2006;29(5):993–997

564. Summerbell CD, Ashton V, Campbell KJ, Edmunds L, Kelly S, Waters E. Interventions for treating obesity in children. *Cochrane Database Syst Rev*. 2003;(3):CD001872

565. Skinner AC, Weinberger M, Mulvaney S, Schlundt D, Rothman RL. Accuracy of perceptions of overweight and relation to self-care behaviors among adolescents with type 2 diabetes and their parents. *Diabetes Care*. 2008;31(2):227–229

566. Thompson M, Dana T, Bougatsos C, Blazina I, Norris SL. Screening for hypertension in children and adolescents to prevent cardiovascular disease. *Pediatrics*. 2013;131(3):490–525

567. Urbina EM, de Ferranti S, Steinberger J. Observational studies may be more important than randomized clinical trials: weaknesses in US Preventive Services Task Force recommendation on blood pressure screening in youth. *Hypertension*. 2014;63(4):638–640

568. Flynn JT. Ambulatory blood pressure monitoring in children: imperfect yet essential. *Pediatr Nephrol*. 2011;26(12):2089–2094

569. Juonala M, Magnussen CG, Venn A, et al. Influence of age on associations between childhood risk factors and carotid intima-media thickness in adulthood: the Cardiovascular Risk in Young Finns Study, the Childhood Determinants of Adult Health Study, the Bogalusa Heart Study, and the Muscatine Study for the International Childhood Cardiovascular Cohort (i3C) Consortium. *Circulation*. 2010;122(24):2514–2520

570. Muntner P, Becker RC, Calhoun D, et al. Introduction to the American Heart Association's hypertension strategically focused research network. *Hypertension*. 2016;67(4):674–680

High Blood Pressure Clinical Practice Guideline Quick Reference Tools

- Action Statement Summary
  — Clinical Practice Guideline for Screening and Management of High Blood Pressure in Children and Adolescents
- *ICD-10-CM* Coding Quick Reference for High Blood Pressure

Action Statement Summary

Clinical Practice Guideline for Screening and Management of High Blood Pressure in Children and Adolescents

Key Action Statement 1

BP should be measured annually in children and adolescents ≥3 years of age (grade C, moderate recommendation).

Key Action Statement 2

BP should be checked in all children and adolescents ≥3 years of age at every health care encounter if they have obesity, are taking medications known to increase BP, have renal disease, a history of aortic arch obstruction or coarctation, or diabetes (grade C, moderate recommendation).

Key Action Statement 3

Trained health care professionals in the office setting should make a diagnosis of HTN if a child or adolescent has auscultatory-confirmed BP readings ≥95th percentile on 3 different visits (grade C, moderate recommendation).

Key Action Statement 4

Organizations with EHRs used in an office setting should consider including flags for abnormal BP values both when the values are being entered and when they are being viewed (grade C, weak recommendation).

Key Action Statement 5

Oscillometric devices may be used for BP screening in children and adolescents. When doing so, providers should use a device that has been validated in the pediatric age group. If elevated BP is suspected on the basis of oscillometric readings, confirmatory measurements should be obtained by auscultation (grade B, strong recommendation).

Key Action Statement 6

ABPM should be performed for the confirmation of HTN in children and adolescents with office BP measurements in the elevated BP category for 1 year or more or with stage 1 HTN over 3 clinic visits (grade C, moderate recommendation).

Key Action Statement 7

The routine performance of ABPM should be strongly considered in children and adolescents with high-risk conditions to assess HTN severity and determine if abnormal circadian BP patterns are present, which may indicate increased risk for target organ damage (grade B, moderate recommendation).

Key Action Statement 8

ABPM should be performed by using a standardized approach with monitors that have been validated in a pediatric population, and studies should be interpreted by using pediatric normative data (grade C, moderate recommendation).

Key Action Statement 9

Children and adolescents with suspected WCH should undergo ABPM. Diagnosis is based on the presence of mean SBP and DBP <95th percentile and SBP and DBP load <25% (grade B, strong recommendation).

Key Action Statement 10

Home BP monitoring should not be used to diagnose HTN, MH, or WCH but may be a useful adjunct to office and ambulatory BP measurement after HTN has been diagnosed (grade C, moderate recommendation).

Key Action Statement 11

Children and adolescents ≥6 years of age do not require an extensive evaluation for secondary causes of HTN if they have a positive family history of HTN, are overweight or obese, and/or do not have history or physical examination findings suggestive of a secondary cause of HTN (grade C, moderate recommendation).

Key Action Statement 12

Children and adolescents who have undergone coarctation repair should undergo ABPM for the detection of HTN (including MH) (grade B, strong recommendation).

Key Action Statement 13

In children and adolescents being evaluated for high BP, the provider should obtain a perinatal history, appropriate nutritional history, physical activity history, psychosocial history, and family history and perform a physical examination to identify findings suggestive of secondary causes of HTN (grade B, strong recommendation).

Key Action Statement 14

Clinicians should not perform electrocardiography in hypertensive children and adolescents being evaluated for LVH (grade B, strong recommendation).

Key Action Statement 15

1. It is recommended that echocardiography be performed to assess for cardiac target organ damage (LV mass, geometry, and function) at the time of consideration of pharmacologic treatment of HTN;
2. LVH should be defined as LV mass >51 g/m$^{2.7}$ (boys and girls) for children and adolescents older than 8 years and defined by LV mass >115 g/BSA for boys and LV mass >95 g/BSA for girls;
3. Repeat echocardiography may be performed to monitor improvement or progression of target organ damage at 6- to 12-month intervals. Indications to repeat echocardiography include persistent HTN despite treatment, concentric LV hypertrophy, or reduced LV ejection fraction; and
4. In patients without LV target organ injury at initial echocardiographic assessment, repeat echocardiography at yearly intervals may be considered in those with stage 2 HTN, secondary HTN, or chronic stage 1 HTN incompletely treated (noncompliance or drug resistance) to assess for the development of worsening LV target organ injury (grade C, moderate recommendation).

Key Action Statement 16

Doppler renal ultrasonography may be used as a noninvasive screening study for the evaluation of possible RAS in normal-weight children and adolescents ≥8 years of age who are suspected of having renovascular HTN and who will cooperate with the procedure (grade C, moderate recommendation).

Key Action Statement 17

In children and adolescents suspected of having RAS, either CTA or MRA may be performed as a noninvasive imaging study. Nuclear renography is less useful in pediatrics and should generally be avoided (grade D, weak recommendation).

Key Action Statement 18

Routine testing for MA is not recommended for children and adolescents with primary HTN (grade C, moderate recommendation).

Key Action Statement 19

In children and adolescents diagnosed with HTN, the treatment goal with nonpharmacologic and pharmacologic therapy should be a reduction in SBP and DBP to <90th percentile and <130/80 mm Hg in adolescents ≥13 years of age (grade C, moderate recommendation).

Key Action Statement 20

At the time of diagnosis of elevated BP or HTN in a child or adolescent, clinicians should provide advice on the DASH diet and recommend moderate to vigorous physical activity at least 3 to 5 days per week (30–60 minutes per session) to help reduce BP (grade C, weak recommendation).

Key Action Statement 21

In hypertensive children and adolescents who have failed lifestyle modifications (particularly those who have LV hypertrophy on echocardiography, symptomatic HTN, or stage 2 HTN without a clearly modifiable factor [eg, obesity]), clinicians should initiate pharmacologic treatment with an ACE inhibitor, ARB, long-acting calcium channel blocker, or thiazide diuretic (grade B, moderate recommendation).

Key Action Statement 22

ABPM may be used to assess treatment effectiveness in children and adolescents with HTN, especially when clinic and/or home BP measurements indicate insufficient BP response to treatment (grade B, moderate recommendation).

Key Action Statement 23

1. Children and adolescents with CKD should be evaluated for HTN at each medical encounter;
2. Children or adolescents with both CKD and HTN should be treated to lower 24-hour MAP to <50th percentile by ABPM; and
3. Regardless of apparent control of BP with office measures, children and adolescents with CKD and a history of HTN should have BP assessed by ABPM at least yearly to screen for MH (grade B, strong recommendation).

Key Action Statement 24

Children and adolescents with CKD and HTN should be evaluated for proteinuria (grade B, strong recommendation).

Key Action Statement 25

Children and adolescents with CKD, HTN, and proteinuria should be treated with an ACE inhibitor or ARB (grade B, strong recommendation).

Key Action Statement 26

Children and adolescents with T1DM or T2DM should be evaluated for HTN at each medical encounter and treated if BP is ≥95th percentile or >130/80 mm Hg in adolescents ≥13 years of age (grade C, moderate recommendation).

Key Action Statement 27

In children and adolescents with acute severe HTN and life-threatening symptoms, immediate treatment with short-acting antihypertensive medication should be initiated, and BP should be reduced by no more than 25% of the planned reduction over the first 8 hours (grade expert opinion D, weak recommendation).

Key Action Statement 28

Children and adolescents with HTN may participate in competitive sports once hypertensive target organ effects and risk have been assessed (grade C, moderate recommendation).

Key Action Statement 29

Children and adolescents with HTN should receive treatment to lower BP below stage 2 thresholds before participating in competitive sports (grade C, weak recommendation).

Key Action Statement 30

Adolescents with elevated BP or HTN (whether they are receiving antihypertensive treatment) should typically have their care transitioned to an appropriate adult care provider by 22 years of age (recognizing that there may be individual cases in which this upper age limit is exceeded, particularly in the case of youth with special health care needs). There should be a transfer of information regarding HTN etiology and past manifestations and complications of the patient's HTN (grade X, strong recommendation).

Coding Quick Reference for High Blood Pressure

ICD-10-CM		
I10	**Essential (primary) hypertension**	
I11.9	Hypertensive heart disease without heart failure	
I12.0	Hypertensive chronic kidney disease with stage 5 chronic kidney disease or end stage renal disease*	
I12.9	Hypertensive chronic kidney disease with stage 1 through stage 4 chronic kidney disease, or unspecified chronic kidney disease*	
I15.0 **I15.1** **I15.2** **I15.8** **I15.9**	Renovascular hypertension [secondary] Hypertension secondary to other renal disorders Hypertension secondary to endocrine disorders Other secondary hypertension Secondary hypertension, unspecified	Underlying cause coded in addition*
R03.0	Elevated blood-pressure reading, without diagnosis of hypertension	
P29.2	Neonatal hypertension	
***Underlying Causes**		
E25.0	Congenital adrenogenital disorders associated with enzyme deficiency	
E26.02	Glucocorticoid-remediable aldosteronism	
N18.1	Chronic kidney disease, stage 1	
N18.2	Chronic kidney disease, stage 2 (mild)	
N18.3	Chronic kidney disease, stage 3 (moderate)	
N18.4	Chronic kidney disease, stage 4 (severe)	
N18.5	Chronic kidney disease, stage 5	
N18.9	Chronic kidney disease, unspecified	
Q25.1	Coarctation of aorta	
Q25.71	Coarctation of pulmonary artery	
Q27.1	Congenital renal artery stenosis	
Q85.00	Neurofibromatosis, unspecified	
Q85.01	Neurofibromatosis, type 1	
Z83.49	Family history of other endocrine, nutritional and metabolic diseases [hyperaldosteronism]	
Z87.74	Personal history of (corrected) congenital malformations of heart and circulatory system [coarctation repair]	

Coding Quick Reference for High Blood Pressure, continued	
Z77.011	Contact with and (suspected) exposure to lead
Z77.018	Contact with and (suspected) exposure to other hazardous metals
Z79.3	Long term (current) use of hormonal contraceptives
Z79.51	Long term (current) use of inhaled steroids
Z79.52	Long term (current) use of systemic steroids
Z79.899	Other long term (current) drug therapy [CNS stimulant]

Management of Hyperbilirubinemia in the Newborn Infant 35 or More Weeks of Gestation

- *Clinical Practice Guideline*

AMERICAN ACADEMY OF PEDIATRICS

CLINICAL PRACTICE GUIDELINE

Subcommittee on Hyperbilirubinemia

Management of Hyperbilirubinemia in the Newborn Infant 35 or More Weeks of Gestation

ABSTRACT. Jaundice occurs in most newborn infants. Most jaundice is benign, but because of the potential toxicity of bilirubin, newborn infants must be monitored to identify those who might develop severe hyperbilirubinemia and, in rare cases, acute bilirubin encephalopathy or kernicterus. The focus of this guideline is to reduce the incidence of severe hyperbilirubinemia and bilirubin encephalopathy while minimizing the risks of unintended harm such as maternal anxiety, decreased breastfeeding, and unnecessary costs or treatment. Although kernicterus should almost always be preventable, cases continue to occur. These guidelines provide a framework for the prevention and management of hyperbilirubinemia in newborn infants of 35 or more weeks of gestation. In every infant, we recommend that clinicians 1) promote and support successful breastfeeding; 2) perform a systematic assessment before discharge for the risk of severe hyperbilirubinemia; 3) provide early and focused follow-up based on the risk assessment; and 4) when indicated, treat newborns with phototherapy or exchange transfusion to prevent the development of severe hyperbilirubinemia and, possibly, bilirubin encephalopathy (kernicterus). *Pediatrics* 2004; 114:297–316; *hyperbilirubinemia, newborn, kernicterus, bilirubin encephalopathy, phototherapy*.

ABBREVIATIONS. AAP, American Academy of Pediatrics; TSB, total serum bilirubin; TcB, transcutaneous bilirubin; G6PD, glucose-6-phosphate dehydrogenase; $ETCO_c$, end-tidal carbon monoxide corrected for ambient carbon monoxide; B/A, bilirubin/albumin; UB, unbound bilirubin.

BACKGROUND

In October 1994, the Provisional Committee for Quality Improvement and Subcommittee on Hyperbilirubinemia of the American Academy of Pediatrics (AAP) produced a practice parameter dealing with the management of hyperbilirubinemia in the healthy term newborn.[1] The current guideline represents a consensus of the committee charged by the AAP with reviewing and updating the existing guideline and is based on a careful review of the evidence, including a comprehensive literature review by the New England Medical Center Evidence-Based Practice Center.[2] (See "An Evidence-Based Review of Important Issues Concerning Neonatal Hyperbilirubinemia"[3] for a description of the methodology, questions addressed, and conclusions of this report.) This guideline is intended for use by hospitals and pediatricians, neonatologists, family physicians, physician assistants, and advanced practice nurses who treat newborn infants in the hospital and as outpatients. A list of frequently asked questions and answers for parents is available in English and Spanish at www.aap.org/family/jaundicefaq.htm.

The recommendations in this guideline do not indicate an exclusive course of treatment or serve as a standard of medical care. Variations, taking into account individual circumstances, may be appropriate.

DEFINITION OF RECOMMENDATIONS

The evidence-based approach to guideline development requires that the evidence in support of a policy be identified, appraised, and summarized and that an explicit link between evidence and recommendations be defined. Evidence-based recommendations are based on the quality of evidence and the balance of benefits and harms that is anticipated when the recommendation is followed. This guideline uses the definitions for quality of evidence and balance of benefits and harms established by the AAP Steering Committee on Quality Improvement Management.[4] See Appendix 1 for these definitions.

The draft practice guideline underwent extensive peer review by committees and sections within the AAP, outside organizations, and other individuals identified by the subcommittee as experts in the field. Liaison representatives to the subcommittee were invited to distribute the draft to other representatives and committees within their specialty organizations. The resulting comments were reviewed by the subcommittee and, when appropriate, incorporated into the guideline.

BILIRUBIN ENCEPHALOPATHY AND KERNICTERUS

Although originally a pathologic diagnosis characterized by bilirubin staining of the brainstem nuclei and cerebellum, the term "kernicterus" has come to be used interchangeably with both the acute and chronic findings of bilirubin encephalopathy. Bilirubin encephalopathy describes the clinical central nervous system findings caused by bilirubin toxicity to the basal ganglia and various brainstem nuclei. To avoid confusion and encourage greater consistency in the literature, the committee recommends that in infants the term "acute bilirubin encephalopathy" be used to describe the acute manifestations of bilirubin

toxicity seen in the first weeks after birth and that the term "kernicterus" be reserved for the chronic and permanent clinical sequelae of bilirubin toxicity.

See Appendix 1 for the clinical manifestations of acute bilirubin encephalopathy and kernicterus.

FOCUS OF GUIDELINE

The overall aim of this guideline is to promote an approach that will reduce the frequency of severe neonatal hyperbilirubinemia and bilirubin encephalopathy and minimize the risk of unintended harm such as increased anxiety, decreased breastfeeding, or unnecessary treatment for the general population and excessive cost and waste. Recent reports of kernicterus indicate that this condition, although rare, is still occurring.[2,5–10]

Analysis of these reported cases of kernicterus suggests that if health care personnel follow the recommendations listed in this guideline, kernicterus would be largely preventable.

These guidelines emphasize the importance of universal systematic assessment for the risk of severe hyperbilirubinemia, close follow-up, and prompt intervention when indicated. The recommendations apply to the care of infants at 35 or more weeks of gestation. These recommendations seek to further the aims defined by the Institute of Medicine as appropriate for health care:[11] safety, effectiveness, efficiency, timeliness, patient-centeredness, and equity. They specifically emphasize the principles of patient safety and the key role of timeliness of interventions to prevent adverse outcomes resulting from neonatal hyperbilirubinemia.

The following are the key elements of the recommendations provided by this guideline. Clinicians should:

1. Promote and support successful breastfeeding.
2. Establish nursery protocols for the identification and evaluation of hyperbilirubinemia.
3. Measure the total serum bilirubin (TSB) or transcutaneous bilirubin (TcB) level on infants jaundiced in the first 24 hours.
4. Recognize that visual estimation of the degree of jaundice can lead to errors, particularly in darkly pigmented infants.
5. Interpret all bilirubin levels according to the infant's age in hours.
6. Recognize that infants at less than 38 weeks' gestation, particularly those who are breastfed, are at higher risk of developing hyperbilirubinemia and require closer surveillance and monitoring.
7. Perform a systematic assessment on all infants before discharge for the risk of severe hyperbilirubinemia.
8. Provide parents with written and verbal information about newborn jaundice.
9. Provide appropriate follow-up based on the time of discharge and the risk assessment.
10. Treat newborns, when indicated, with phototherapy or exchange transfusion.

PRIMARY PREVENTION

In numerous policy statements, the AAP recommends breastfeeding for all healthy term and near-term newborns. This guideline strongly supports this general recommendation.

RECOMMENDATION 1.0: Clinicians should advise mothers to nurse their infants at least 8 to 12 times per day for the first several days[12] (evidence quality C: benefits exceed harms).

Poor caloric intake and/or dehydration associated with inadequate breastfeeding may contribute to the development of hyperbilirubinemia.[6,13,14] Increasing the frequency of nursing decreases the likelihood of subsequent significant hyperbilirubinemia in breastfed infants.[15–17] Providing appropriate support and advice to breastfeeding mothers increases the likelihood that breastfeeding will be successful.

Additional information on how to assess the adequacy of intake in a breastfed newborn is provided in Appendix 1.

RECOMMENDATION 1.1: The AAP recommends against routine supplementation of nondehydrated breastfed infants with water or dextrose water (evidence quality B and C: harms exceed benefits).

Supplementation with water or dextrose water will not prevent hyperbilirubinemia or decrease TSB levels.[18,19]

SECONDARY PREVENTION

RECOMMENDATION 2.0: Clinicians should perform ongoing systematic assessments during the neonatal period for the risk of an infant developing severe hyperbilirubinemia.

Blood Typing

RECOMMENDATION 2.1: All pregnant women should be tested for ABO and Rh (D) blood types and have a serum screen for unusual isoimmune antibodies (evidence quality B: benefits exceed harms).

RECOMMENDATION 2.1.1: If a mother has not had prenatal blood grouping or is Rh-negative, a direct antibody test (or Coombs' test), blood type, and an Rh (D) type on the infant's (cord) blood are strongly recommended (evidence quality B: benefits exceed harms).

RECOMMENDATION 2.1.2: If the maternal blood is group O, Rh-positive, it is an option to test the cord blood for the infant's blood type and direct antibody test, but it is not required provided that there is appropriate surveillance, risk assessment before discharge, and follow-up[20] (evidence quality C: benefits exceed harms).

Clinical Assessment

RECOMMENDATION 2.2: Clinicians should ensure that all infants are routinely monitored for the development of jaundice, and nurseries should have established protocols for the assessment of jaundice. Jaundice should be assessed whenever the infant's vital signs are measured but no less than every 8 to 12 hours (evidence quality D: benefits versus harms exceptional).

In newborn infants, jaundice can be detected by blanching the skin with digital pressure, revealing the underlying color of the skin and subcutaneous tissue. The assessment of jaundice must be per-

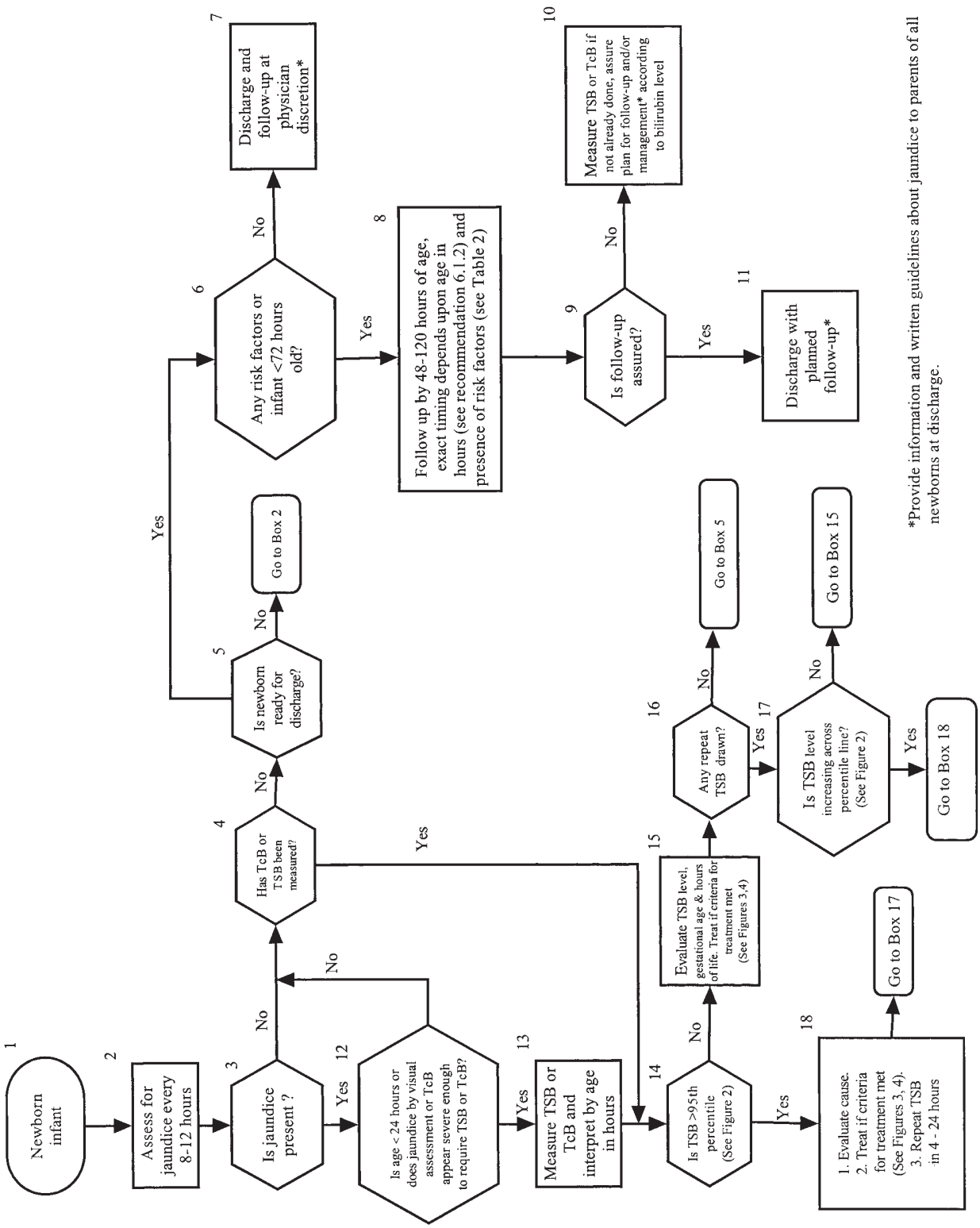


Fig 1. Algorithm for the management of jaundice in the newborn nursery.

formed in a well-lit room or, preferably, in daylight at a window. Jaundice is usually seen first in the face and progresses caudally to the trunk and extremities,[21] but visual estimation of bilirubin levels from the degree of jaundice can lead to errors.[22–24] In most infants with TSB levels of less than 15 mg/dL (257 μmol/L), noninvasive TcB-measurement devices can provide a valid estimate of the TSB level.[2,25–29] See Appendix 1 for additional information on the clinical evaluation of jaundice and the use of TcB measurements.

RECOMMENDATION 2.2.1: Protocols for the assessment of jaundice should include the circumstances in which nursing staff can obtain a TcB level or order a TSB measurement (evidence quality D: benefits versus harms exceptional).

Laboratory Evaluation

RECOMMENDATION 3.0: A TcB and/or TSB measurement should be performed on every infant who is jaundiced in the first 24 hours after birth (Fig 1 and Table 1)[30] (evidence quality C: benefits exceed harms). The need for and timing of a repeat TcB or TSB measurement will depend on the zone in which the TSB falls (Fig 2),[25,31] the age of the infant, and the evolution of the hyperbilirubinemia. Recommendations for TSB measurements after the age of 24 hours are provided in Fig 1 and Table 1.

See Appendix 1 for capillary versus venous bilirubin levels.

RECOMMENDATION 3.1: A TcB and/or TSB measurement should be performed if the jaundice appears excessive for the infant's age (evidence quality D: benefits versus harms exceptional). If there is any doubt about the degree of jaundice, the TSB or TcB should be measured. Visual estimation of bilirubin levels from the degree of jaundice can lead to errors, particularly in darkly pigmented infants (evidence quality C: benefits exceed harms).

RECOMMENDATION 3.2: All bilirubin levels should be interpreted according to the infant's age in hours (Fig 2) (evidence quality C: benefits exceed harms).

Cause of Jaundice

RECOMMENDATION 4.1: The possible cause of jaundice should be sought in an infant receiving phototherapy or whose TSB level is rising rapidly (ie, crossing percentiles [Fig 2]) and is not explained by the history and physical examination (evidence quality D: benefits versus harms exceptional).

RECOMMENDATION 4.1.1: Infants who have an elevation of direct-reacting or conjugated bilirubin should have a urinalysis and urine culture.[32] Additional laboratory evaluation for sepsis should be performed if indicated by history and physical examination (evidence quality C: benefits exceed harms).

See Appendix 1 for definitions of abnormal levels of direct-reacting and conjugated bilirubin.

RECOMMENDATION 4.1.2: Sick infants and those who are jaundiced at or beyond 3 weeks should have a measurement of total and direct or conjugated bilirubin to identify cholestasis (Table 1) (evidence quality D: benefit versus harms exceptional). The results of the newborn thyroid and galactosemia screen should also be checked in these infants (evidence quality D: benefits versus harms exceptional).

RECOMMENDATION 4.1.3: If the direct-reacting or conjugated bilirubin level is elevated, additional evaluation for the causes of cholestasis is recommended (evidence quality C: benefits exceed harms).

RECOMMENDATION 4.1.4: Measurement of the glucose-6-phosphate dehydrogenase (G6PD) level is recommended for a jaundiced infant who is receiving phototherapy and whose family history or ethnic or geographic origin suggest the likelihood of G6PD deficiency or for an infant in whom the response to phototherapy is poor (Fig 3) (evidence quality C: benefits exceed harms).

G6PD deficiency is widespread and frequently unrecognized, and although it is more common in the populations around the Mediterranean and in the Middle East, Arabian peninsula, Southeast Asia, and Africa, immigration and intermarriage have transformed G6PD deficiency into a global problem.[33,34]

TABLE 1. Laboratory Evaluation of the Jaundiced Infant of 35 or More Weeks' Gestation

Indications	Assessments
Jaundice in first 24 h	Measure TcB and/or TSB
Jaundice appears excessive for infant's age	Measure TcB and/or TSB
Infant receiving phototherapy or TSB rising rapidly (ie, crossing percentiles [Fig 2]) and unexplained by history and physical examination	Blood type and Coombs' test, if not obtained with cord blood Complete blood count and smear Measure direct or conjugated bilirubin It is an option to perform reticulocyte count, G6PD, and $ETCO_c$, if available Repeat TSB in 4–24 h depending on infant's age and TSB level
TSB concentration approaching exchange levels or not responding to phototherapy	Perform reticulocyte count, G6PD, albumin, $ETCO_c$, if available
Elevated direct (or conjugated) bilirubin level	Do urinalysis and urine culture. Evaluate for sepsis if indicated by history and physical examination
Jaundice present at or beyond age 3 wk, or sick infant	Total and direct (or conjugated) bilirubin level If direct bilirubin elevated, evaluate for causes of cholestasis Check results of newborn thyroid and galactosemia screen, and evaluate infant for signs or symptoms of hypothyroidism

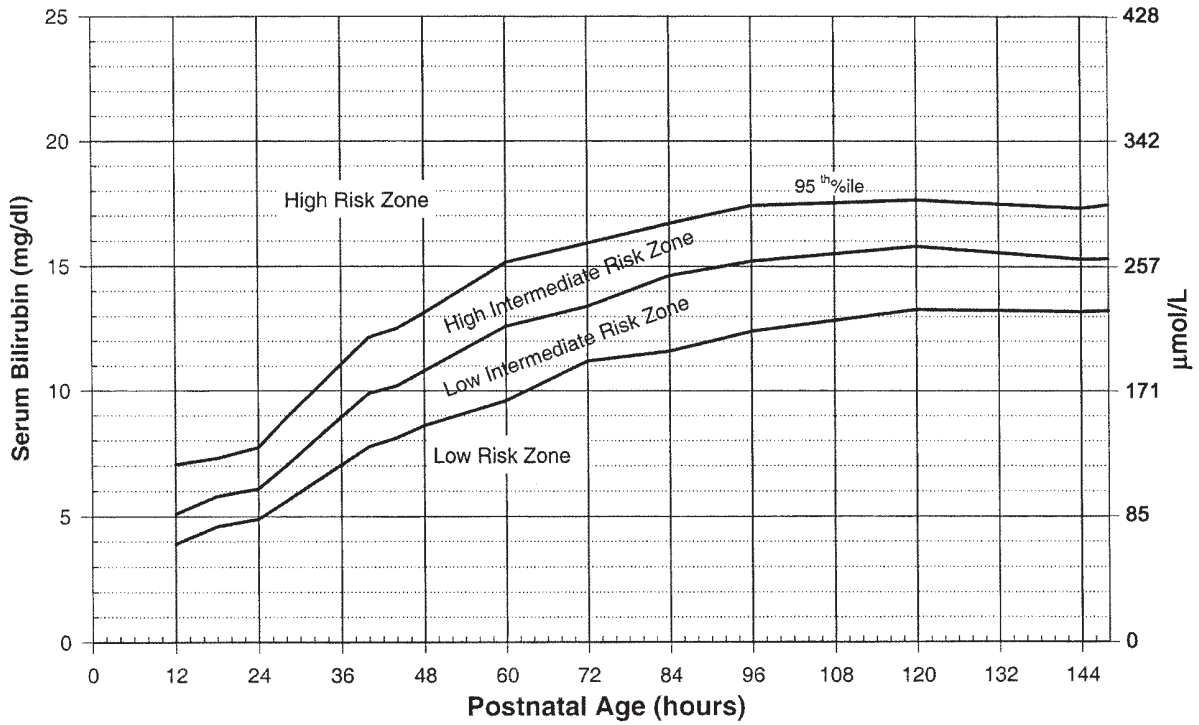


Fig 2. Nomogram for designation of risk in 2840 well newborns at 36 or more weeks' gestational age with birth weight of 2000 g or more or 35 or more weeks' gestational age and birth weight of 2500 g or more based on the hour-specific serum bilirubin values. The serum bilirubin level was obtained before discharge, and the zone in which the value fell predicted the likelihood of a subsequent bilirubin level exceeding the 95th percentile (high-risk zone) as shown in Appendix 1, Table 4. Used with permission from Bhutani et al.[31] See Appendix 1 for additional information about this nomogram, which should not be used to represent the natural history of neonatal hyperbilirubinemia.

Furthermore, G6PD deficiency occurs in 11% to 13% of African Americans, and kernicterus has occurred in some of these infants.[5,33] In a recent report, G6PD deficiency was considered to be the cause of hyperbilirubinemia in 19 of 61 (31.5%) infants who developed kernicterus.[5] (See Appendix 1 for additional information on G6PD deficiency.)

Risk Assessment Before Discharge

RECOMMENDATION 5.1: Before discharge, every newborn should be assessed for the risk of developing severe hyperbilirubinemia, and all nurseries should establish protocols for assessing this risk. Such assessment is particularly important in infants who are discharged before the age of 72 hours (evidence quality C: benefits exceed harms).

RECOMMENDATION 5.1.1: The AAP recommends 2 clinical options used individually or in combination for the systematic assessment of risk: predischarge measurement of the bilirubin level using TSB or TcB and/or assessment of clinical risk factors. Whether either or both options are used, appropriate follow-up after discharge is essential (evidence quality C: benefits exceed harms).

The best documented method for assessing the risk of subsequent hyperbilirubinemia is to measure the TSB or TcB level[25,31,35–38] and plot the results on a nomogram (Fig 2). A TSB level can be obtained at the time of the routine metabolic screen, thus obviating the need for an additional blood sample. Some authors have suggested that a TSB measurement should be part of the routine screening of all newborns.[5,31] An infant whose predischarge TSB is in the low-risk zone (Fig 2) is at very low risk of developing severe hyperbilirubinemia.[5,38]

Table 2 lists those factors that are clinically signif-

TABLE 2. Risk Factors for Development of Severe Hyperbilirubinemia in Infants of 35 or More Weeks' Gestation (in Approximate Order of Importance)

Major risk factors
Predischarge TSB or TcB level in the high-risk zone (Fig 2)[25,31]
Jaundice observed in the first 24 h[30]
Blood group incompatibility with positive direct antiglobulin test, other known hemolytic disease (eg, G6PD deficiency), elevated $ETCO_c$
Gestational age 35–36 wk[39,40]
Previous sibling received phototherapy[40,41]
Cephalohematoma or significant bruising[39]
Exclusive breastfeeding, particularly if nursing is not going well and weight loss is excessive[39,40]
East Asian race[39]*
Minor risk factors
Predischarge TSB or TcB level in the high intermediate-risk zone[25,31]
Gestational age 37–38 wk[39,40]
Jaundice observed before discharge[40]
Previous sibling with jaundice[40,41]
Macrosomic infant of a diabetic mother[42,43]
Maternal age ≥25 y[39]
Male gender[39,40]
Decreased risk (these factors are associated with decreased risk of significant jaundice, listed in order of decreasing importance)
TSB or TcB level in the low-risk zone (Fig 2)[25,31]
Gestational age ≥41 wk[39]
Exclusive bottle feeding[39,40]
Black race[38]*
Discharge from hospital after 72 h[40,44]

* Race as defined by mother's description.

icant and most frequently associated with an increase in the risk of severe hyperbilirubinemia. But, because these risk factors are common and the risk of hyperbilirubinemia is small, individually the factors are of limited use as predictors of significant hyperbilirubinemia.[39] Nevertheless, if no risk factors are present, the risk of severe hyperbilirubinemia is extremely low, and the more risk factors present, the greater the risk of severe hyperbilirubinemia.[39] The important risk factors most frequently associated with severe hyperbilirubinemia are breastfeeding, gestation below 38 weeks, significant jaundice in a previous sibling, and jaundice noted before discharge.[39,40] A formula-fed infant of 40 or more weeks' gestation is at very low risk of developing severe hyperbilirubinemia.[39]

Hospital Policies and Procedures

RECOMMENDATION 6.1: All hospitals should provide written and verbal information for parents at the time of discharge, which should include an explanation of jaundice, the need to monitor infants for jaundice, and advice on how monitoring should be done (evidence quality D: benefits versus harms exceptional).

An example of a parent-information handout is available in English and Spanish at www.aap.org/family/jaundicefaq.htm.

Follow-up

RECOMMENDATION 6.1.1: All infants should be examined by a qualified health care professional in the first few days after discharge to assess infant well-being and the presence or absence of jaundice. The timing and location of this assessment will be determined by the length of stay in the nursery, presence or absence of risk factors for hyperbilirubinemia (Table 2 and Fig 2), and risk of other neonatal problems (evidence quality C: benefits exceed harms).

Timing of Follow-up

RECOMMENDATION 6.1.2: Follow-up should be provided as follows:

Infant Discharged	Should Be Seen by Age
Before age 24 h	72 h
Between 24 and 47.9 h	96 h
Between 48 and 72 h	120 h

For some newborns discharged before 48 hours, 2 follow-up visits may be required, the first visit between 24 and 72 hours and the second between 72 and 120 hours. Clinical judgment should be used in determining follow-up. Earlier or more frequent follow-up should be provided for those who have risk factors for hyperbilirubinemia (Table 2), whereas those discharged with few or no risk factors can be seen after longer intervals (evidence quality C: benefits exceed harms).

RECOMMENDATION 6.1.3: If appropriate follow-up cannot be ensured in the presence of elevated risk for developing severe hyperbilirubinemia, it may be necessary to delay discharge either until appropriate follow-up can be ensured or the period of greatest risk has passed (72-96 hours) (evidence quality D: benefits versus harms exceptional).

Follow-up Assessment

RECOMMENDATION 6.1.4: The follow-up assessment should include the infant's weight and percent change from birth weight, adequacy of intake, the pattern of voiding and stooling, and the presence or absence of jaundice (evidence quality C: benefits exceed harms). Clinical judgment should be used to determine the need for a bilirubin measurement. If there is any doubt about the degree of jaundice, the TSB or TcB level should be measured. Visual estimation of bilirubin levels can lead to errors, particularly in darkly pigmented infants (evidence quality C: benefits exceed harms).

See Appendix 1 for assessment of the adequacy of intake in breastfeeding infants.

TREATMENT

Phototherapy and Exchange Transfusion

RECOMMENDATION 7.1: Recommendations for treatment are given in Table 3 and Figs 3 and 4 (evidence quality C: benefits exceed harms). If the TSB does not fall or continues to rise despite intensive phototherapy, it is very likely that hemolysis is occurring. The committee's recommendations for discontinuing phototherapy can be found in Appendix 2.

RECOMMENDATION 7.1.1: In using the guidelines for phototherapy and exchange transfusion (Figs 3 and 4), the direct-reacting (or conjugated) bilirubin level should not be subtracted from the total (evidence quality D: benefits versus harms exceptional).

In unusual situations in which the direct bilirubin level is 50% or more of the total bilirubin, there are no good data to provide guidance for therapy, and consultation with an expert in the field is recommended.

RECOMMENDATION 7.1.2: If the TSB is at a level at which exchange transfusion is recommended (Fig 4) or if the TSB level is 25 mg/dL (428 μmol/L) or higher at any time, it is a medical emergency and the infant should be admitted immediately and directly to a hospital pediatric service for intensive phototherapy. These infants should not be referred to the emergency department, because it delays the initiation of treatment[54] (evidence quality C: benefits exceed harms).

RECOMMENDATION 7.1.3: Exchange transfusions should be performed only by trained personnel in a neonatal intensive care unit with full monitoring and resuscitation capabilities (evidence quality D: benefits versus harms exceptional).

RECOMMENDATION 7.1.4: In isoimmune hemolytic disease, administration of intravenous γ-globulin (0.5-1 g/kg over 2 hours) is recommended if the TSB is rising despite intensive phototherapy or the TSB level is within 2 to 3 mg/dL (34-51 μmol/L) of the exchange level (Fig 4).[55] If necessary, this dose can be repeated in 12 hours (evidence quality B: benefits exceed harms).

Intravenous γ-globulin has been shown to reduce the need for exchange transfusions in Rh and ABO hemolytic disease.[55–58] Although data are limited, it is reasonable to assume that intravenous γ-globulin will also be helpful in the other types of Rh hemolytic disease such as anti-C and anti-E.

TABLE 3. Example of a Clinical Pathway for Management of the Newborn Infant Readmitted for Phototherapy or Exchange Transfusion

Treatment
Use intensive phototherapy and/or exchange transfusion as indicated in Figs 3 and 4 (see Appendix 2 for details of phototherapy use)
Laboratory tests
TSB and direct bilirubin levels
Blood type (ABO, Rh)
Direct antibody test (Coombs')
Serum albumin
Complete blood cell count with differential and smear for red cell morphology
Reticulocyte count
$ETCO_c$ (if available)
G6PD if suggested by ethnic or geographic origin or if poor response to phototherapy
Urine for reducing substances
If history and/or presentation suggest sepsis, perform blood culture, urine culture, and cerebrospinal fluid for protein, glucose, cell count, and culture
Interventions
If TSB ≥25 mg/dL (428 μmol/L) or ≥20 mg/dL (342 μmol/L) in a sick infant or infant <38 wk gestation, obtain a type and crossmatch, and request blood in case an exchange transfusion is necessary
In infants with isoimmune hemolytic disease and TSB level rising in spite of intensive phototherapy or within 2–3 mg/dL (34–51 μmol/L) of exchange level (Fig 4), administer intravenous immunoglobulin 0.5–1 g/kg over 2 h and repeat in 12 h if necessary
If infant's weight loss from birth is >12% or there is clinical or biochemical evidence of dehydration, recommend formula or expressed breast milk. If oral intake is in question, give intravenous fluids.
For infants receiving intensive phototherapy
Breastfeed or bottle-feed (formula or expressed breast milk) every 2–3 h
If TSB ≥25 mg/dL (428 μmol/L), repeat TSB within 2–3 h
If TSB 20–25 mg/dL (342–428 μmol/L), repeat within 3–4 h. If TSB <20 mg/dL (342 μmol/L), repeat in 4–6 h. If TSB continues to fall, repeat in 8–12 h
If TSB is not decreasing or is moving closer to level for exchange transfusion or the TSB/albumin ratio exceeds levels shown in Fig 4, consider exchange transfusion (see Fig 4 for exchange transfusion recommendations)
When TSB is <13–14 mg/dL (239 μmol/L), discontinue phototherapy
Depending on the cause of the hyperbilirubinemia, it is an option to measure TSB 24 h after discharge to check for rebound

Serum Albumin Levels and the Bilirubin/Albumin Ratio

RECOMMENDATION 7.1.5: It is an option to measure the serum albumin level and consider an albumin level of less than 3.0 g/dL as one risk factor for lowering the threshold for phototherapy use (see Fig 3) (evidence quality D: benefits versus risks exceptional.).

RECOMMENDATION 7.1.6: If an exchange transfusion is being considered, the serum albumin level should be measured and the bilirubin/albumin (B/A) ratio used in conjunction with the TSB level and other factors in determining the need for exchange transfusion (see Fig 4) (evidence quality D: benefits versus harms exceptional).

The recommendations shown above for treating hyperbilirubinemia are based primarily on TSB levels and other factors that affect the risk of bilirubin encephalopathy. This risk might be increased by a prolonged (rather than a brief) exposure to a certain TSB level.[59,60] Because the published data that address this issue are limited, however, it is not possible to provide specific recommendations for intervention based on the duration of hyperbilirubinemia.

See Appendix 1 for the basis for recommendations 7.1 through 7.1.6 and for the recommendations provided in Figs 3 and 4. Appendix 1 also contains a discussion of the risks of exchange transfusion and the use of B/A binding.

Acute Bilirubin Encephalopathy

RECOMMENDATION 7.1.7: Immediate exchange transfusion is recommended in any infant who is jaundiced and manifests the signs of the intermediate to advanced stages of acute bilirubin encephalopathy[61,62] (hypertonia, arching, retrocollis, opisthotonos, fever, high-pitched cry) even if the TSB is falling (evidence quality D: benefits versus risks exceptional).

Phototherapy

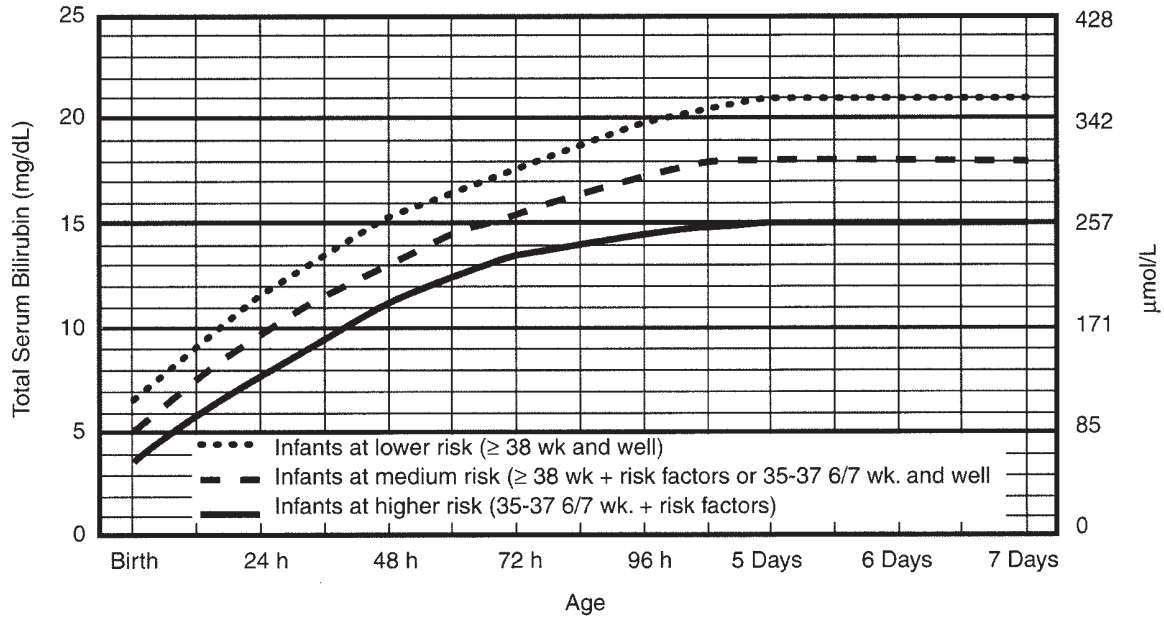
RECOMMENDATION 7.2: All nurseries and services treating infants should have the necessary equipment to provide intensive phototherapy (see Appendix 2) (evidence quality D: benefits exceed risks).

Outpatient Management of the Jaundiced Breastfed Infant

RECOMMENDATION 7.3: In breastfed infants who require phototherapy (Fig 3), the AAP recommends that, if possible, breastfeeding should be continued (evidence quality C: benefits exceed harms). It is also an option to interrupt temporarily breastfeeding and substitute formula. This can reduce bilirubin levels and/or enhance the efficacy of phototherapy[63–65] (evidence quality B: benefits exceed harms). In breastfed infants receiving phototherapy, supplementation with expressed breast milk or formula is appropriate if the infant's intake seems inadequate, weight loss is excessive, or the infant seems dehydrated.

IMPLEMENTATION STRATEGIES

The Institute of Medicine[11] recommends a dramatic change in the way the US health care system



- Use total bilirubin. Do not subtract direct reacting or conjugated bilirubin.
- Risk factors = isoimmune hemolytic disease, G6PD deficiency, asphyxia, significant lethargy, temperature instability, sepsis, acidosis, or albumin < 3.0g/dL (if measured)
- For well infants 35-37 6/7 wk can adjust TSB levels for intervention around the medium risk line. It is an option to intervene at lower TSB levels for infants closer to 35 wks and at higher TSB levels for those closer to 37 6/7 wk.
- It is an option to provide conventional phototherapy in hospital or at home at TSB levels 2-3 mg/dL (35-50mmol/L) below those shown but home phototherapy should not be used in any infant with risk factors.

Fig 3. Guidelines for phototherapy in hospitalized infants of 35 or more weeks' gestation.

Note: These guidelines are based on limited evidence and the levels shown are approximations. The guidelines refer to the use of intensive phototherapy which should be used when the TSB exceeds the line indicated for each category. Infants are designated as "higher risk" because of the potential negative effects of the conditions listed on albumin binding of bilirubin,[45–47] the blood-brain barrier,[48] and the susceptibility of the brain cells to damage by bilirubin.[48]

"Intensive phototherapy" implies irradiance in the blue-green spectrum (wavelengths of approximately 430–490 nm) of at least 30 $\mu W/cm^2$ per nm (measured at the infant's skin directly below the center of the phototherapy unit) and delivered to as much of the infant's surface area as possible. Note that irradiance measured below the center of the light source is much greater than that measured at the periphery. Measurements should be made with a radiometer specified by the manufacturer of the phototherapy system.

See Appendix 2 for additional information on measuring the dose of phototherapy, a description of intensive phototherapy, and of light sources used. If total serum bilirubin levels approach or exceed the exchange transfusion line (Fig 4), the sides of the bassinet, incubator, or warmer should be lined with aluminum foil or white material.[50] This will increase the surface area of the infant exposed and increase the efficacy of phototherapy.[51]

If the total serum bilirubin does not decrease or continues to rise in an infant who is receiving intensive phototherapy, this strongly suggests the presence of hemolysis.

Infants who receive phototherapy and have an elevated direct-reacting or conjugated bilirubin level (cholestatic jaundice) may develop the bronze-baby syndrome. See Appendix 2 for the use of phototherapy in these infants.

ensures the safety of patients. The perspective of safety as a purely individual responsibility must be replaced by the concept of safety as a property of systems. Safe systems are characterized by a shared knowledge of the goal, a culture emphasizing safety, the ability of each person within the system to act in a manner that promotes safety, minimizing the use of memory, and emphasizing the use of standard procedures (such as checklists), and the involvement of patients/families as partners in the process of care.

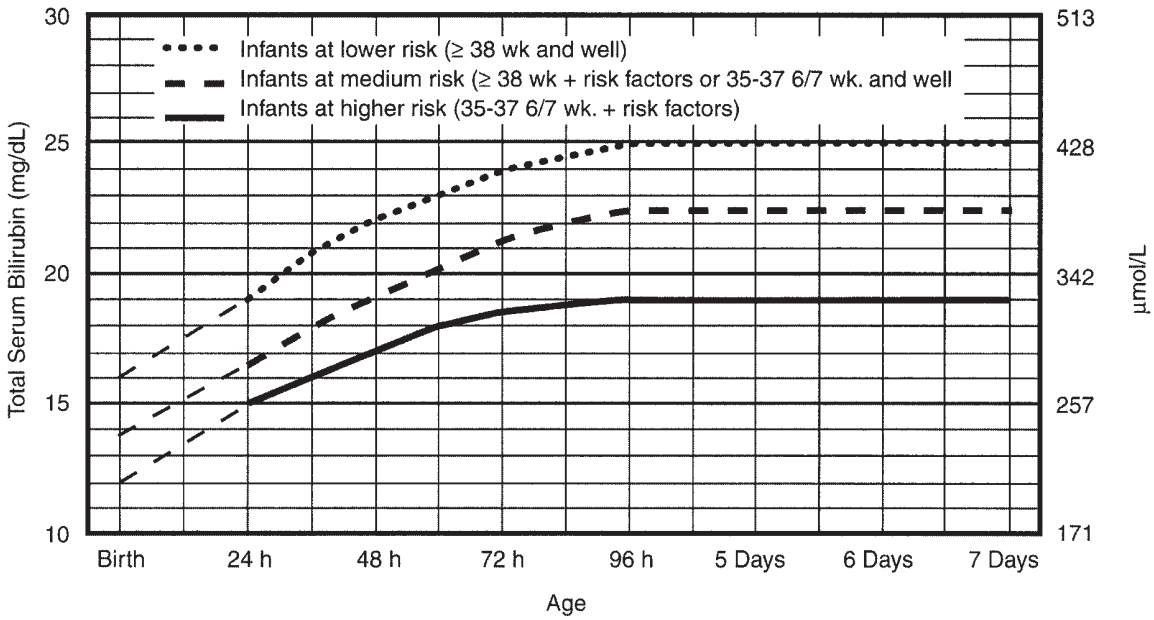
These principles can be applied to the challenge of preventing severe hyperbilirubinemia and kernicterus. A systematic approach to the implementation of these guidelines should result in greater safety. Such approaches might include

- The establishment of standing protocols for nursing assessment of jaundice, including testing TcB and TSB levels, without requiring physician orders.
- Checklists or reminders associated with risk factors, age at discharge, and laboratory test results that provide guidance for appropriate follow-up.
- Explicit educational materials for parents (a key component of all AAP guidelines) concerning the identification of newborns with jaundice.

FUTURE RESEARCH

Epidemiology of Bilirubin-Induced Central Nervous System Damage

There is a need for appropriate epidemiologic data to document the incidence of kernicterus in the newborn population, the incidence of other adverse effects attributable to hyperbilirubinemia and its management, and the number of infants whose TSB levels exceed 25 or 30 mg/dL (428-513 μmol/L). Organizations such as the Centers for Disease Control and Prevention should implement strategies for appropriate data gathering to identify the number of



- The dashed lines for the first 24 hours indicate uncertainty due to a wide range of clinical circumstances and a range of responses to phototherapy.
- Immediate exchange transfusion is recommended if infant shows signs of acute bilirubin encephalopathy (hypertonia, arching, retrocollis, opisthotonos, fever, high pitched cry) or if TSB is ≥5 mg/dL (85 µmol/L) above these lines.
- Risk factors - isoimmune hemolytic disease, G6PD deficiency, asphyxia, significant lethargy, temperature instability, sepsis, acidosis.
- Measure serum albumin and calculate B/A ratio (See legend)
- Use total bilirubin. Do not subtract direct reacting or conjugated bilirubin
- If infant is well and 35-37 6/7 wk (median risk) can individualize TSB levels for exchange based on actual gestational age.

Fig 4. Guidelines for exchange transfusion in infants 35 or more weeks' gestation.

Note that these suggested levels represent a consensus of most of the committee but are based on limited evidence, and the levels shown are approximations. See ref. 3 for risks and complications of exchange transfusion. During birth hospitalization, exchange transfusion is recommended if the TSB rises to these levels despite intensive phototherapy. For readmitted infants, if the TSB level is above the exchange level, repeat TSB measurement every 2 to 3 hours and consider exchange if the TSB remains above the levels indicated after intensive phototherapy for 6 hours.

The following B/A ratios can be used together with but in not in lieu of the TSB level as an additional factor in determining the need for exchange transfusion[52]:

Risk Category	B/A Ratio at Which Exchange Transfusion Should be Considered	
	TSB mg/dL/Alb, g/dL	TSB µmol/L/Alb, µmol/L
Infants ≥38 0/7 wk	8.0	0.94
Infants 35 0/7–36 6/7 wk and well or ≥38 0/7 wk if higher risk or isoimmune hemolytic disease or G6PD deficiency	7.2	0.84
Infants 35 0/7–37 6/7 wk if higher risk or isoimmune hemolytic disease or G6PD deficiency	6.8	0.80

If the TSB is at or approaching the exchange level, send blood for immediate type and crossmatch. Blood for exchange transfusion is modified whole blood (red cells and plasma) crossmatched against the mother and compatible with the infant.[53]

infants who develop serum bilirubin levels above 25 or 30 mg/dL (428-513 µmol/L) and those who develop acute and chronic bilirubin encephalopathy. This information will help to identify the magnitude of the problem; the number of infants who need to be screened and treated to prevent 1 case of kernicterus; and the risks, costs, and benefits of different strategies for prevention and treatment of hyperbilirubinemia. In the absence of these data, recommendations for intervention cannot be considered definitive.

Effect of Bilirubin on the Central Nervous System

The serum bilirubin level by itself, except when it is extremely high and associated with bilirubin encephalopathy, is an imprecise indicator of long-term neurodevelopmental outcome.[2] Additional studies are needed on the relationship between central nervous system damage and the duration of hyperbilirubinemia, the binding of bilirubin to albumin, and changes seen in the brainstem auditory evoked response. These studies could help to better identify

risk, clarify the effect of bilirubin on the central nervous system, and guide intervention.

Identification of Hemolysis

Because of their poor specificity and sensitivity, the standard laboratory tests for hemolysis (Table 1) are frequently unhelpful.[66,67] However, end-tidal carbon monoxide, corrected for ambient carbon monoxide ($ETCO_c$), levels can confirm the presence or absence of hemolysis, and measurement of $ETCO_c$ is the only clinical test that provides a direct measurement of the rate of heme catabolism and the rate of bilirubin production.[68,69] Thus, $ETCO_c$ may be helpful in determining the degree of surveillance needed and the timing of intervention. It is not yet known, however, how $ETCO_c$ measurements will affect management.

Nomograms and the Measurement of Serum and TcB

It would be useful to develop an age-specific (by hour) nomogram for TSB in populations of newborns that differ with regard to risk factors for hyperbilirubinemia. There is also an urgent need to improve the precision and accuracy of the measurement of TSB in the clinical laboratory.[70,71] Additional studies are also needed to develop and validate noninvasive (transcutaneous) measurements of serum bilirubin and to understand the factors that affect these measurements. These studies should also assess the cost-effectiveness and reproducibility of TcB measurements in clinical practice.[2]

Pharmacologic Therapy

There is now evidence that hyperbilirubinemia can be effectively prevented or treated with tin-mesoporphyrin,[72–75] a drug that inhibits the production of heme oxygenase. Tin-mesoporphyrin is not approved by the US Food and Drug Administration. If approved, tin-mesoporphyrin could find immediate application in preventing the need for exchange transfusion in infants who are not responding to phototherapy.[75]

Dissemination and Monitoring

Research should be directed toward methods for disseminating the information contained in this guideline to increase awareness on the part of physicians, residents, nurses, and parents concerning the issues of neonatal hyperbilirubinemia and strategies for its management. In addition, monitoring systems should be established to identify the impact of these guidelines on the incidence of acute bilirubin encephalopathy and kernicterus and the use of phototherapy and exchange transfusions.

CONCLUSIONS

Kernicterus is still occurring but should be largely preventable if health care personnel follow the recommendations listed in this guideline. These recommendations emphasize the importance of universal, systematic assessment for the risk of severe hyperbilirubinemia, close follow-up, and prompt intervention, when necessary.

Subcommittee on Hyperbilirubinemia
M. Jeffrey Maisels, MB, BCh, Chairperson
Richard D. Baltz, MD
Vinod K. Bhutani, MD
Thomas B. Newman, MD, MPH
Heather Palmer, MB, BCh
Warren Rosenfeld, MD
David K. Stevenson, MD
Howard B. Weinblatt, MD

Consultant
Charles J. Homer, MD, MPH, Chairperson
American Academy of Pediatrics Steering Committee on Quality Improvement and Management

Staff
Carla T. Herrerias, MPH

ACKNOWLEDGMENTS

M.J.M. received grant support from Natus Medical, Inc, for multinational study of ambient carbon monoxide; WellSpring Pharmaceutical Corporation for study of Stannsoporfin (tin-mesoporphyrin); and Minolta, Inc, for study of the Minolta/Hill-Rom Air-Shields transcutaneous jaundice meter model JM-103. V.K.B. received grant support from WellSpring Pharmaceutical Corporation for study of Stannsoporfin (tin-mesoporphyrin) and Natus Medical, Inc, for multinational study of ambient carbon monoxide and is a consultant (volunteer) to SpectrX (BiliChek transcutaneous bilirubinometer). D.K.S. is a consultant to and holds stock options through Natus Medical, Inc.

The American Academy of Pediatrics Subcommittee on Hyperbilirubinemia gratefully acknowledges the help of the following organizations, committees, and individuals who reviewed drafts of this guideline and provided valuable criticisms and commentary: American Academy of Pediatrics Committee on Nutrition; American Academy of Pediatrics Committee on Practice and Ambulatory Medicine; American Academy of Pediatrics Committee on Child Health Financing; American Academy of Pediatrics Committee on Medical Liability; American Academy of Pediatrics Committee on Fetus and Newborn; American Academy of Pediatrics Section on Perinatal Pediatrics; Centers for Disease Control and Prevention; Parents of Infants and Children With Kernicterus (PICK); Charles Ahlfors, MD; Daniel Batton, MD; Thomas Bojko, MD; Sarah Clune, MD; Sudhakar Ezhuthachan, MD; Lawrence Gartner, MD; Cathy Hammerman, MD; Thor Hansen, MD; Lois Johnson, MD; Michael Kaplan, MB, ChB; Tony McDonagh, PhD; Gerald Merenstein, MD; Mary O'Shea, MD; Max Perlman, MD; Ronald Poland, MD; Alex Robertson, MD; Firmino Rubaltelli, MD; Steven Shapiro, MD; Stanford Singer, MD; Ann Stark, MD; Gautham Suresh, MD; Margot VandeBor, MD; Hank Vreman, PhD; Philip Walson, MD; Jon Watchko, MD; Richard Wennberg, MD; and Chap-Yung Yeung, MD.

REFERENCES

1. American Academy of Pediatrics, Provisional Committee for Quality Improvement and Subcommittee on Hyperbilirubinemia. Practice parameter: management of hyperbilirubinemia in the healthy term newborn. *Pediatrics.* 1994;94:558–562
2. Ip S, Glicken S, Kulig J, Obrien R, Sege R, Lau J. *Management of Neonatal Hyperbilirubinemia*. Rockville, MD: US Department of Health and Human Services, Agency for Healthcare Research and Quality; 2003. AHRQ Publication 03-E011
3. Ip S, Chung M, Kulig J. et al. An evidence-based review of important issues concerning neonatal hyperbilirubinemia. *Pediatrics.* 2004;113(6). Available at: www.pediatrics.org/cgi/content/full/113/6/e644
4. American Academy of Pediatrics, Steering Committee on Quality Improvement and Management. A taxonomy of recommendations. *Pediatrics.* 2004; In press
5. Johnson LH, Bhutani VK, Brown AK. System-based approach to management of neonatal jaundice and prevention of kernicterus. *J Pediatr.* 2002;140:396–403

6. Maisels MJ, Newman TB. Kernicterus in otherwise healthy, breast-fed term newborns. *Pediatrics.* 1995;96:730–733
7. MacDonald M. Hidden risks: early discharge and bilirubin toxicity due to glucose-6-phosphate dehydrogenase deficiency. *Pediatrics.* 1995;96: 734–738
8. Penn AA, Enzman DR, Hahn JS, Stevenson DK. Kernicterus in a full term infant. *Pediatrics.* 1994;93:1003–1006
9. Washington EC, Ector W, Abboud M, Ohning B, Holden K. Hemolytic jaundice due to G6PD deficiency causing kernicterus in a female newborn. *South Med J.* 1995;88:776–779
10. Ebbesen F. Recurrence of kernicterus in term and near-term infants in Denmark. *Acta Paediatr.* 2000;89:1213–1217
11. Institue of Medicine. *Crossing the Quality Chasm: A New Health System for the 21st Century*. Washington, DC: National Academy Press; 2001
12. American Academy of Pediatrics, American College of Obstetricians and Gynecologists. *Guidelines for Perinatal Care*. 5th ed. Elk Grove Village, IL: American Academy of Pediatrics; 2002:220–224
13. Bertini G, Dani C, Trochin M, Rubaltelli F. Is breastfeeding really favoring early neonatal jaundice? *Pediatrics.* 2001;107(3). Available at: www.pediatrics.org/cgi/content/full/107/3/e41
14. Maisels MJ, Gifford K. Normal serum bilirubin levels in the newborn and the effect of breast-feeding. *Pediatrics.* 1986;78:837–843
15. Yamauchi Y, Yamanouchi I. Breast-feeding frequency during the first 24 hours after birth in full-term neonates. *Pediatrics.* 1990;86:171–175
16. De Carvalho M, Klaus MH, Merkatz RB. Frequency of breastfeeding and serum bilirubin concentration. *Am J Dis Child.* 1982;136:737–738
17. Varimo P, Similä S, Wendt L, Kolvisto M. Frequency of breast feeding and hyperbilirubinemia [letter]. *Clin Pediatr (Phila).* 1986;25:112
18. De Carvalho M, Holl M, Harvey D. Effects of water supplementation on physiological jaundice in breast-fed babies. *Arch Dis Child.* 1981;56: 568–569
19. Nicoll A, Ginsburg R, Tripp JH. Supplementary feeding and jaundice in newborns. *Acta Paediatr Scand.* 1982;71:759–761
20. Madlon-Kay DJ. Identifying ABO incompatibility in newborns: selective vs automatic testing. *J Fam Pract.* 1992;35:278–280
21. Kramer LI. Advancement of dermal icterus in the jaundiced newborn. *Am J Dis Child.* 1969;118:454–458
22. Moyer VA, Ahn C, Sneed S. Accuracy of clinical judgment in neonatal jaundice. *Arch Pediatr Adolesc Med.* 2000;154:391–394
23. Davidson LT, Merritt KK, Weech AA. Hyperbilirubinemia in the newborn. *Am J Dis Child.* 1941;61:958–980
24. Tayaba R, Gribetz D, Gribetz I, Holzman IR. Noninvasive estimation of serum bilirubin. *Pediatrics.* 1998;102(3). Available at: www.pediatrics.org/cgi/content/full/102/3/e28
25. Bhutani V, Gourley GR, Adler S, Kreamer B, Dalman C, Johnson LH. Noninvasive measurement of total serum bilirubin in a multiracial predischarge newborn population to assess the risk of severe hyperbilirubinemia. *Pediatrics.* 2000;106(2). Available at: www.pediatrics.org/cgi/content/full/106/2/e17
26. Yasuda S, Itoh S, Isobe K, et al. New transcutaneous jaundice device with two optical paths. *J Perinat Med.* 2003;31:81–88
27. Maisels MJ, Ostrea EJ Jr, Touch S, et al. Evaluation of a new transcutaneous bilirubinometer. *Pediatrics.* 2004;113:1638–1645
28. Ebbesen F, Rasmussen LM, Wimberley PD. A new transcutaneous bilirubinometer, bilicheck, used in the neonatal intensive care unit and the maternity ward. *Acta Paediatr.* 2002;91:203–211
29. Rubaltelli FF, Gourley GR, Loskamp N, et al. Transcutaneous bilirubin measurement: a multicenter evaluation of a new device. *Pediatrics.* 2001;107:1264–1271
30. Newman TB, Liljestrand P, Escobar GJ. Jaundice noted in the first 24 hours after birth in a managed care organization. *Arch Pediatr Adolesc Med.* 2002;156:1244–1250
31. Bhutani VK, Johnson L, Sivieri EM. Predictive ability of a predischarge hour-specific serum bilirubin for subsequent significant hyperbilirubinemia in healthy term and near-term newborns. *Pediatrics.* 1999;103: 6–14
32. Garcia FJ, Nager AL. Jaundice as an early diagnostic sign of urinary tract infection in infancy. *Pediatrics.* 2002;109:846–851
33. Kaplan M, Hammerman C. Severe neonatal hyperbilirubinemia: a potential complication of glucose-6-phosphate dehydrogenase deficiency. *Clin Perinatol.* 1998;25:575–590
34. Valaes T. Severe neonatal jaundice associated with glucose-6-phosphate dehydrogenase deficiency: pathogenesis and global epidemiology. *Acta Paediatr Suppl.* 1994;394:58–76
35. Alpay F, Sarici S, Tosuncuk HD, Serdar MA, Inanç N, Gökçay E. The value of first-day bilirubin measurement in predicting the development of significant hyperbilirubinemia in healthy term newborns. *Pediatrics.* 2000;106(2). Available at: www.pediatrics.org/cgi/content/full/106/2/e16
36. Carbonell X, Botet F, Figueras J, Riu-Godo A. Prediction of hyperbilirubinaemia in the healthy term newborn. *Acta Paediatr.* 2001;90:166–170
37. Kaplan M, Hammerman C, Feldman R, Brisk R. Predischarge bilirubin screening in glucose-6-phosphate dehydrogenase-deficient neonates. *Pediatrics.* 2000;105:533–537
38. Stevenson DK, Fanaroff AA, Maisels MJ, et al. Prediction of hyperbilirubinemia in near-term and term infants. *Pediatrics.* 2001;108:31–39
39. Newman TB, Xiong B, Gonzales VM, Escobar GJ. Prediction and prevention of extreme neonatal hyperbilirubinemia in a mature health maintenance organization. *Arch Pediatr Adolesc Med.* 2000;154:1140–1147
40. Maisels MJ, Kring EA. Length of stay, jaundice, and hospital readmission. *Pediatrics.* 1998;101:995–998
41. Gale R, Seidman DS, Dollberg S, Stevenson DK. Epidemiology of neonatal jaundice in the Jerusalem population. *J Pediatr Gastroenterol Nutr.* 1990;10:82–86
42. Berk MA, Mimouni F, Miodovnik M, Hertzberg V, Valuck J. Macrosomia in infants of insulin-dependent diabetic mothers. *Pediatrics.* 1989; 83:1029–1034
43. Peevy KJ, Landaw SA, Gross SJ. Hyperbilirubinemia in infants of diabetic mothers. *Pediatrics.* 1980;66:417–419
44. Soskolne El, Schumacher R, Fyock C, Young ML, Schork A. The effect of early discharge and other factors on readmission rates of newborns. *Arch Pediatr Adolesc Med.* 1996;150:373–379
45. Ebbesen F, Brodersen R. Risk of bilirubin acid precipitation in preterm infants with respiratory distress syndrome: considerations of blood/brain bilirubin transfer equilibrium. *Early Hum Dev.* 1982;6:341–355
46. Cashore WJ, Oh W, Brodersen R. Reserve albumin and bilirubin toxicity index in infant serum. *Acta Paediatr Scand.* 1983;72:415–419
47. Cashore WJ. Free bilirubin concentrations and bilirubin-binding affinity in term and preterm infants. *J Pediatr.* 1980;96:521–527
48. Bratlid D. How bilirubin gets into the brain. *Clin Perinatol.* 1990;17: 449–465
49. Wennberg RP. Cellular basis of bilirubin toxicity. *N Y State J Med.* 1991;91:493–496
50. Eggert P, Stick C, Schroder H. On the distribution of irradiation intensity in phototherapy. Measurements of effective irradiance in an incubator. *Eur J Pediatr.* 1984;142:58–61
51. Maisels MJ. Why use homeopathic doses of phototherapy? *Pediatrics.* 1996;98:283–287
52. Ahlfors CE. Criteria for exchange transfusion in jaundiced newborns. *Pediatrics.* 1994;93:488–494
53. American Association of Blood Banks Technical Manual Committee. Perinatal issues in transfusion practice. In: Brecher M, ed. *Technical Manual*. Bethesda, MD: American Association of Blood Banks; 2002: 497–515
54. Garland JS, Alex C, Deacon JS, Raab K. Treatment of infants with indirect hyperbilirubinemia. Readmission to birth hospital vs nonbirth hospital. *Arch Pediatr Adolesc Med.* 1994;148:1317–1321
55. Gottstein R, Cooke R. Systematic review of intravenous immunoglobulin in haemolytic disease of the newborn. *Arch Dis Child Fetal Neonatal Ed.* 2003;88:F6–F10
56. Sato K, Hara T, Kondo T, Iwao H, Honda S, Ueda K. High-dose intravenous gammaglobulin therapy for neonatal immune haemolytic jaundice due to blood group incompatibility. *Acta Paediatr Scand.* 1991; 80:163–166
57. Rubo J, Albrecht K, Lasch P, et al. High-dose intravenous immune globulin therapy for hyperbilirubinemia caused by Rh hemolytic disease. *J Pediatr.* 1992;121:93–97
58. Hammerman C, Kaplan M, Vreman HJ, Stevenson DK. Intravenous immune globulin in neonatal ABO isoimmunization: factors associated with clinical efficacy. *Biol Neonate.* 1996;70:69–74
59. Johnson L, Boggs TR. Bilirubin-dependent brain damage: incidence and indications for treatment. In: Odell GB, Schaffer R, Simopoulos AP, eds. *Phototherapy in the Newborn: An Overview*. Washington, DC: National Academy of Sciences; 1974:122–149
60. Ozmert E, Erdem G, Topcu M. Long-term follow-up of indirect hyperbilirubinemia in full-term Turkish infants. *Acta Paediatr.* 1996;85: 1440–1444
61. Volpe JJ. *Neurology of the Newborn*. 4th ed. Philadelphia, PA: W. B. Saunders; 2001
62. Harris M, Bernbaum J, Polin J, Zimmerman R, Polin RA. Developmental follow-up of breastfed term and near-term infants with marked hyperbilirubinemia. *Pediatrics.* 2001;107:1075–1080
63. Osborn LM, Bolus R. Breast feeding and jaundice in the first week of life. *J Fam Pract.* 1985;20:475–480

64. Martinez JC, Maisels MJ, Otheguy L, et al. Hyperbilirubinemia in the breast-fed newborn: a controlled trial of four interventions. *Pediatrics.* 1993;91:470–473
65. Amato M, Howald H, von Muralt G. Interruption of breast-feeding versus phototherapy as treatment of hyperbilirubinemia in full-term infants. *Helv Paediatr Acta.* 1985;40:127–131
66. Maisels MJ, Gifford K, Antle CE, Leib GR. Jaundice in the healthy newborn infant: a new approach to an old problem. *Pediatrics.* 1988;81: 505–511
67. Newman TB, Easterling MJ. Yield of reticulocyte counts and blood smears in term infants. *Clin Pediatr (Phila).* 1994;33:71–76
68. Herschel M, Karrison T, Wen M, Caldarelli L, Baron B. Evaluation of the direct antiglobulin (Coombs') test for identifying newborns at risk for hemolysis as determined by end-tidal carbon monoxide concentration (ETCOc); and comparison of the Coombs' test with ETCOc for detecting significant jaundice. *J Perinatol.* 2002;22:341–347
69. Stevenson DK, Vreman HJ. Carbon monoxide and bilirubin production in neonates. *Pediatrics.* 1997;100:252–254
70. Vreman HJ, Verter J, Oh W, et al. Interlaboratory variability of bilirubin measurements. *Clin Chem.* 1996;42:869–873
71. Lo S, Doumas BT, Ashwood E. Performance of bilirubin determinations in US laboratories—revisited. *Clin Chem.* 2004;50:190–194
72. Kappas A, Drummond GS, Henschke C, Valaes T. Direct comparison of Sn-mesoporphyrin, an inhibitor of bilirubin production, and phototherapy in controlling hyperbilirubinemia in term and near-term newborns. *Pediatrics.* 1995;95:468–474
73. Martinez JC, Garcia HO, Otheguy L, Drummond GS, Kappas A. Control of severe hyperbilirubinemia in full-term newborns with the inhibitor of bilirubin production Sn-mesoporphyrin. *Pediatrics.* 1999;103:1–5
74. Suresh G, Martin CL, Soll R. Metalloporphyrins for treatment of unconjugated hyperbilirubinemia in neonates. *Cochrane Database Syst Rev.* 2003;2:CD004207
75. Kappas A, Drummond GS, Munson DP, Marshall JR. Sn-mesoporphyrin interdiction of severe hyperbilirubinemia in Jehovah's Witness newborns as an alternative to exchange transfusion. *Pediatrics.* 2001;108: 1374–1377

APPENDIX 1: Additional Notes

Definitions of Quality of Evidence and Balance of Benefits and Harms

The Steering Committee on Quality Improvement and Management categorizes evidence quality in 4 levels:

1. Well-designed, randomized, controlled trials or diagnostic studies on relevant populations
2. Randomized, controlled trials or diagnostic studies with minor limitations; overwhelming, consistent evidence from observational studies
3. Observational studies (case-control and cohort design)
4. Expert opinion, case reports, reasoning from first principles

The AAP defines evidence-based recommendations as follows:[1]

- Strong recommendation: the committee believes that the benefits of the recommended approach clearly exceed the harms of that approach and that the quality of the supporting evidence is either excellent or impossible to obtain. Clinicians should follow these recommendations unless a clear and compelling rationale for an alternative approach is present.
- Recommendation: the committee believes that the benefits exceed the harms, but the quality of evidence on which this recommendation is based is not as strong. Clinicians should also generally follow these recommendations but should be alert to new information and sensitive to patient preferences. In this guideline, the term "should" implies a recommendation by the committee.
- Option: either the quality of the evidence that exists is suspect or well-performed studies have shown little clear advantage to one approach over another. Patient preference should have a substantial role in influencing clinical decision-making when a policy is described as an option.
- No recommendation: there is a lack of pertinent evidence and the anticipated balance of benefits and harms is unclear.

Anticipated Balance Between Benefits and Harms

The presence of clear benefits or harms supports stronger statements for or against a course of action. In some cases, however, recommendations are made when analysis of the balance of benefits and harms provides an exceptional dysequilibrium and it would be unethical or impossible to perform clinical trials to "prove" the point. In these cases the balance of benefit and harm is termed "exceptional."

Clinical Manifestations of Acute Bilirubin Encephalopathy and Kernicterus

Acute Bilirubin Encephalopathy

In the early phase of acute bilirubin encephalopathy, severely jaundiced infants become lethargic and hypotonic and suck poorly.[2,3] The intermediate phase is characterized by moderate stupor, irritability, and hypertonia. The infant may develop a fever and high-pitched cry, which may alternate with drowsiness and hypotonia. The hypertonia is manifested by backward arching of the neck (retrocollis) and trunk (opisthotonos). There is anecdotal evidence that an emergent exchange transfusion at this stage, in some cases, might reverse the central nervous system changes.[4] The advanced phase, in which central nervous system damage is probably irreversible, is characterized by pronounced retrocollis-opisthotonos, shrill cry, no feeding, apnea, fever, deep stupor to coma, sometimes seizures, and death.[2,3,5]

Kernicterus

In the chronic form of bilirubin encephalopathy, surviving infants may develop a severe form of athetoid cerebral palsy, auditory dysfunction, dental-enamel dysplasia, paralysis of upward gaze, and, less often, intellectual and other handicaps. Most infants who develop kernicterus have manifested some or all of the signs listed above in the acute phase of bilirubin encephalopathy. However, occasionally there are infants who have developed very high bilirubin levels and, subsequently, the signs of kernicterus but have exhibited few, if any, antecedent clinical signs of acute bilirubin encephalopathy.[3,5,6]

Clinical Evaluation of Jaundice and TcB Measurements

Jaundice is usually seen in the face first and progresses caudally to the trunk and extremities,[7] but because visual estimation of bilirubin levels from the degree of jaundice can lead to errors,[8–10] a low threshold should be used for measuring the TSB.

Devices that provide a noninvasive TcB measurement have proven very useful as screening tools,[11] and newer instruments give measurements that provide a valid estimate of the TSB level.[12–17] Studies using the new TcB-measurement instruments are limited, but the data published thus far suggest that in most newborn populations, these instruments generally provide measurements within 2 to 3 mg/dL (34–51 μmol/L) of the TSB and can replace a measurement of serum bilirubin in many circumstances, particularly for TSB levels less than 15 mg/dL (257 μmol/L).[12–17] Because phototherapy "bleaches" the skin, both visual assessment of jaundice and TcB measurements in infants undergoing phototherapy are not reliable. In addition, the ability of transcutaneous instruments to provide accurate measurements in different racial groups requires additional study.[18,19] The limitations of the accuracy and reproducibility of TSB measurements in the clinical laboratory[20–22] must also be recognized and are discussed in the technical report.[23]

Capillary Versus Venous Serum Bilirubin Measurement

Almost all published data regarding the relationship of TSB levels to kernicterus or developmental outcome are based on capillary blood TSB levels. Data regarding the differences between capillary and venous TSB levels are conflicting.[24,25] In 1 study the capillary TSB levels were higher, but in another they were lower than venous TSB levels.[24,25] Thus, obtaining a venous sample to "confirm" an elevated capillary TSB level is not recommended, because it will delay the initiation of treatment.

Direct-Reacting and Conjugated Bilirubin

Although commonly used interchangeably, direct-reacting bilirubin is not the same as conjugated bilirubin. Direct-reacting bilirubin is the bilirubin that reacts directly (without the addition of an accelerating agent) with diazotized sulfanilic acid. Conjugated bilirubin is bilirubin made water soluble by binding with glucuronic acid in the liver. Depending on the technique used, the clinical laboratory will report total and direct-reacting or unconjugated and conjugated bilirubin levels. In this guideline and for clinical purposes, the terms may be used interchangeably.

Abnormal Direct and Conjugated Bilirubin Levels

Laboratory measurement of direct bilirubin is not precise,[26] and values between laboratories can vary widely. If the TSB is at or below 5 mg/dL (85 μmol/L), a direct or conjugated bilirubin of more than 1.0 mg/dL (17.1 μmol/L) is generally considered abnormal. For TSB values higher than 5 mg/dL (85 μmol/L), a direct bilirubin of more than 20% of the TSB is considered abnormal. If the hospital laboratory measures conjugated bilirubin using the Vitros (formerly Ektachem) system (Ortho-Clinical Diagnostics, Raritan, NJ), any value higher than 1 mg/dL is considered abnormal.

Assessment of Adequacy of Intake in Breastfeeding Infants

The data from a number of studies[27–34] indicate that unsupplemented, breastfed infants experience their maximum weight loss by day 3 and, on average, lose 6.1% ± 2.5% (SD) of their birth weight. Thus, ~5% to 10% of fully breastfed infants lose 10% or more of their birth weight by day 3, suggesting that adequacy of intake should be evaluated and the infant monitored if weight loss is more than 10%.[35] Evidence of adequate intake in breastfed infants also includes 4 to 6 thoroughly wet diapers in 24 hours and the passage of 3 to 4 stools per day by the fourth day. By the third to fourth day, the stools in adequately breastfed infants should have changed from meconium to a mustard yellow, mushy stool.[36] The above assessment will also help to identify breastfed infants who are at risk for dehydration because of inadequate intake.

Nomogram for Designation of Risk

Note that this nomogram (Fig 2) does not describe the natural history of neonatal hyperbilirubinemia, particularly after 48 to 72 hours, for which, because of sampling bias, the lower zones are spuriously elevated.[37] This bias, however, will have much less effect on the high-risk zone (95th percentile in the study).[38]

G6PD Dehydrogenase Deficiency

It is important to look for G6PD deficiency in infants with significant hyperbilirubinemia, because some may develop a sudden increase in the TSB. In addition, G6PD-deficient infants require intervention at lower TSB levels (Figs 3 and 4). It should be noted also that in the presence of hemolysis, G6PD levels can be elevated, which may obscure the diagnosis in the newborn period so that a normal level in a hemolyzing neonate does not rule out G6PD deficiency.[39] If G6PD deficiency is strongly suspected, a repeat level should be measured when the infant is 3 months old. It is also recognized that immediate laboratory determination of G6PD is generally not available in most US hospitals, and thus translating the above information into clinical practice is cur-

TABLE 4. Risk Zone as a Predictor of Hyperbilirubinemia[39]

TSB Before Discharge	Newborns (Total = 2840), *n* (%)	Newborns Who Subsequently Developed a TSB Level >95th Percentile, *n* (%)
High-risk zone (>95th percentile)	172 (6.0)	68 (39.5)
High intermediate-risk zone	356 (12.5)	46 (12.9)
Low intermediate-risk zone	556 (19.6)	12 (2.26)
Low-risk zone	1756 (61.8)	0

rently difficult. Nevertheless, practitioners are reminded to consider the diagnosis of G6PD deficiency in infants with severe hyperbilirubinemia, particularly if they belong to the population groups in which this condition is prevalent. This is important in the African American population, because these infants, as a group, have much lower TSB levels than white or Asian infants.[40,41] Thus, severe hyperbilirubinemia in an African American infant should always raise the possibility of G6PD deficiency.

Basis for the Recommendations 7.1.1 Through 7.1.6 and Provided in Figs 3 and 4

Ideally, recommendations for when to implement phototherapy and exchange transfusions should be based on estimates of when the benefits of these interventions exceed their risks and cost. The evidence for these estimates should come from randomized trials or systematic observational studies. Unfortunately, there is little such evidence on which to base these recommendations. As a result, treatment guidelines must necessarily rely on more uncertain estimates and extrapolations. For a detailed discussion of this question, please see "An Evidence-Based Review of Important Issues Concerning Neonatal Hyperbilirubinemia."[23]

The recommendations for phototherapy and exchange transfusion are based on the following principles:

- The main demonstrated value of phototherapy is that it reduces the risk that TSB levels will reach a level at which exchange transfusion is recommended.[42–44] Approximately 5 to 10 infants with TSB levels between 15 and 20 mg/dL (257–342 μmol/L) will receive phototherapy to prevent the TSB in 1 infant from reaching 20 mg/dL (the number needed to treat).[12] Thus, 8 to 9 of every 10 infants with these TSB levels will not reach 20 mg/dL (342 μmol/L) even if they are not treated. Phototherapy has proven to be a generally safe procedure, although rare complications can occur (see Appendix 2).
- Recommended TSB levels for exchange transfusion (Fig 4) are based largely on the goal of keeping TSB levels below those at which kernicterus has been reported.[12,45–48] In almost all cases, exchange transfusion is recommended only after phototherapy has failed to keep the TSB level below the exchange transfusion level (Fig 4).
- The recommendations to use phototherapy and exchange transfusion at lower TSB levels for infants of lower gestation and those who are sick are based on limited observations suggesting that sick infants (particularly those with the risk factors listed in Figs 3 and 4)[49–51] and those of lower gestation[51–54] are at greater risk for developing kernicterus at lower bilirubin levels than are well infants of more than 38 6/7 weeks' gestation. Nevertheless, other studies have not confirmed all of these associations.[52,55,56] There is no doubt, however, that infants at 35 to 37 6/7 weeks' gestation are at a much greater risk of developing very high TSB levels.[57,58] Intervention for these infants is based on this risk as well as extrapolations from more premature, lower birth-weight infants who do have a higher risk of bilirubin toxicity.[52,53]
- For all newborns, treatment is recommended at lower TSB levels at younger ages because one of the primary goals of treatment is to prevent additional increases in the TSB level.

Subtle Neurologic Abnormalities Associated With Hyperbilirubinemia

There are several studies demonstrating measurable transient changes in brainstem-evoked potentials, behavioral patterns, and the infant's cry[59–63] associated with TSB levels of 15 to 25 mg/dL (257–428 μmol/L). In these studies, the abnormalities identified were transient and disappeared when the serum bilirubin levels returned to normal with or without treatment.[59,60,62,63]

A few cohort studies have found an association between hyperbilirubinemia and long-term adverse neurodevelopmental effects that are more subtle than kernicterus.[64–67] Current studies, however, suggest that although phototherapy lowers the TSB levels, it has no effect on these long-term neurodevelopmental outcomes.[68–70]

Risks of Exchange Transfusion

Because exchange transfusions are now rarely performed, the risks of morbidity and mortality associated with the procedure are difficult to quantify. In addition, the complication rates listed below may not be generalizable to the current era if, like most procedures, frequency of performance is an important determinant of risk. Death associated with exchange transfusion has been reported in approximately 3 in 1000 procedures,[71,72] although in otherwise well infants of 35 or more weeks' gestation, the risk is probably much lower.[71–73] Significant morbidity (apnea, bradycardia, cyanosis, vasospasm, thrombosis, necrotizing enterocolitis) occurs in as many as 5% of exchange transfusions,[71] and the risks associated with the use of blood products must always be considered.[74] Hypoxic-ischemic encephalopathy and acquired immunodeficiency syndrome have occurred in otherwise healthy infants receiving exchange transfusions.[73,75]

Serum Albumin Levels and the B/A Ratio

The legends to Figs 3 and 4 and recommendations 7.1.5 and 7.1.6 contain references to the serum albumin level and the B/A ratio as factors that can be considered in the decision to initiate phototherapy (Fig 3) or perform an exchange transfusion (Fig 4). Bilirubin is transported in the plasma tightly bound to albumin, and the portion that is unbound or loosely bound can more readily leave the intravascular space and cross the intact blood-brain barrier.[76] Elevations of unbound bilirubin (UB) have been associated with kernicterus in sick preterm newborns.[77,78] In addition, elevated UB concentrations are more closely associated than TSB levels with transient abnormalities in the audiometric brainstem response in term[79] and preterm[80] infants. Long-term

studies relating B/A binding in infants to developmental outcome are limited and conflicting.[69,81,82] In addition, clinical laboratory measurement of UB is not currently available in the United States.

The ratio of bilirubin (mg/dL) to albumin (g/dL) does correlate with measured UB in newborns[83] and can be used as an approximate surrogate for the measurement of UB. It must be recognized, however, that both albumin levels and the ability of albumin to bind bilirubin vary significantly between newborns.[83,84] Albumin binding of bilirubin is impaired in sick infants,[84–86] and some studies show an increase in binding with increasing gestational[86,87] and postnatal[87,88] age, but others have not found a significant effect of gestational age on binding.[89] Furthermore, the risk of bilirubin encephalopathy is unlikely to be a simple function of the TSB level or the concentration of UB but is more likely a combination of both (ie, the total amount of bilirubin available [the miscible pool of bilirubin] as well as the tendency of bilirubin to enter the tissues [the UB concentration]).[83] An additional factor is the possible susceptibility of the cells of the central nervous system to damage by bilirubin.[90] It is therefore a clinical option to use the B/A ratio together with, but not in lieu of, the TSB level as an additional factor in determining the need for exchange transfusion[83] (Fig 4).

REFERENCES

1. American Academy of Pediatrics, Steering Committee on Quality Improvement and Management. Classification of recommendations for clinical practice guidelines. *Pediatrics.* 2004; In press
2. Johnson LH, Bhutani VK, Brown AK. System-based approach to management of neonatal jaundice and prevention of kernicterus. *J Pediatr*. 2002;140:396–403
3. Volpe JJ. *Neurology of the Newborn*. 4th ed. Philadelphia, PA: W. B. Saunders; 2001
4. Harris M, Bernbaum J, Polin J, Zimmerman R, Polin RA. Developmental follow-up of breastfed term and near-term infants with marked hyperbilirubinemia. *Pediatrics*. 2001;107:1075–1080
5. Van Praagh R. Diagnosis of kernicterus in the neonatal period. *Pediatrics*. 1961;28:870–876
6. Jones MH, Sands R, Hyman CB, Sturgeon P, Koch FP. Longitudinal study of incidence of central nervous system damage following erythroblastosis fetalis. *Pediatrics*. 1954;14:346–350
7. Kramer LI. Advancement of dermal icterus in the jaundiced newborn. *Am J Dis Child*. 1969;118:454–458
8. Moyer VA, Ahn C, Sneed S. Accuracy of clinical judgment in neonatal jaundice. *Arch Pediatr Adolesc Med*. 2000;154:391–394
9. Davidson LT, Merritt KK, Weech AA. Hyperbilirubinemia in the newborn. *Am J Dis Child*. 1941;61:958–980
10. Tayaba R, Gribetz D, Gribetz I, Holzman IR. Noninvasive estimation of serum bilirubin. *Pediatrics*. 1998;102(3). Available at: www.pediatrics.org/cgi/content/full/102/3/e28
11. Maisels MJ, Kring E. Transcutaneous bilirubinometry decreases the need for serum bilirubin measurements and saves money. *Pediatrics*. 1997;99:599–601
12. Ip S, Glicken S, Kulig J, Obrien R, Sege R, Lau J. *Management of Neonatal Hyperbilirubinemia.* Rockville, MD: US Department of Health and Human Services, Agency for Healthcare Research and Quality; 2003. AHRQ Publication 03-E011
13. Bhutani V, Gourley GR, Adler S, Kreamer B, Dalman C, Johnson LH. Noninvasive measurement of total serum bilirubin in a multiracial predischarge newborn population to assess the risk of severe hyperbilirubinemia. *Pediatrics*. 2000;106(2). Available at: www.pediatrics.org/cgi/content/full/106/2/e17
14. Yasuda S, Itoh S, Isobe K, et al. New transcutaneous jaundice device with two optical paths. *J Perinat Med*. 2003;31:81–88
15. Maisels MJ, Ostrea EJ Jr, Touch S, et al. Evaluation of a new transcutaneous bilirubinometer. *Pediatrics*. 2004;113:1638–1645
16. Ebbesen F, Rasmussen LM, Wimberley PD. A new transcutaneous bilirubinometer, bilicheck, used in the neonatal intensive care unit and the maternity ward. *Acta Paediatr*. 2002;91:203–211
17. Rubaltelli FF, Gourley GR, Loskamp N, et al. Transcutaneous bilirubin measurement: a multicenter evaluation of a new device. *Pediatrics*. 2001;107:1264–1271
18. Engle WD, Jackson GL, Sendelbach D, Manning D, Frawley W. Assessment of a transcutaneous device in the evaluation of neonatal hyperbilirubinemia in a primarily Hispanic population. *Pediatrics*. 2002;110:61–67
19. Schumacher R. Transcutaneous bilirubinometry and diagnostic tests: "the right job for the tool." *Pediatrics*. 2002;110:407–408
20. Vreman HJ, Verter J, Oh W, et al. Interlaboratory variability of bilirubin measurements. *Clin Chem*. 1996;42:869–873
21. Doumas BT, Eckfeldt JH. Errors in measurement of total bilirubin: a perennial problem. *Clin Chem*. 1996;42:845–848
22. Lo S, Doumas BT, Ashwood E. Performance of bilirubin determinations in US laboratories—revisited. *Clin Chem*. 2004;50:190–194
23. Ip S, Chung M, Kulig J. et al. An evidence-based review of important issues concerning neonatal hyperbilirubinemia. *Pediatrics*. 2004;113(6). Available at: www.pediatrics.org/cgi/content/full/113/6/e644
24. Leslie GI, Philips JB, Cassady G. Capillary and venous bilirubin values: are they really different? *Am J Dis Child*. 1987;141:1199–1200
25. Eidelman AI, Schimmel MS, Algur N, Eylath U. Capillary and venous bilirubin values: they are different—and how [letter]! *Am J Dis Child*. 1989;143:642
26. Watkinson LR, St John A, Penberthy LA. Investigation into paediatric bilirubin analyses in Australia and New Zealand. *J Clin Pathol*. 1982;35:52–58
27. Bertini G, Dani C, Trochin M, Rubaltelli F. Is breastfeeding really favoring early neonatal jaundice? *Pediatrics*. 2001;107(3). Available at: www.pediatrics.org/cgi/content/full/107/3/e41
28. De Carvalho M, Klaus MH, Merkatz RB. Frequency of breastfeeding and serum bilirubin concentration. *Am J Dis Child*. 1982;136:737–738
29. De Carvalho M, Holl M, Harvey D. Effects of water supplementation on physiological jaundice in breast-fed babies. *Arch Dis Child*. 1981;56:568–569
30. Nicoll A, Ginsburg R, Tripp JH. Supplementary feeding and jaundice in newborns. *Acta Paediatr Scand*. 1982;71:759–761
31. Butler DA, MacMillan JP. Relationship of breast feeding and weight loss to jaundice in the newborn period: review of the literature and results of a study. *Cleve Clin Q.* 1983;50:263–268
32. De Carvalho M, Robertson S, Klaus M. Fecal bilirubin excretion and serum bilirubin concentration in breast-fed and bottle-fed infants. *J Pediatr*. 1985;107:786–790
33. Gourley GR, Kreamer B, Arend R. The effect of diet on feces and jaundice during the first three weeks of life. *Gastroenterology*. 1992;103:660–667
34. Maisels MJ, Gifford K. Breast-feeding, weight loss, and jaundice. *J Pediatr*. 1983;102:117–118
35. Laing IA, Wong CM. Hypernatraemia in the first few days: is the incidence rising? *Arch Dis Child Fetal Neonatal Ed*. 2002;87:F158–F162
36. Lawrence RA. Management of the mother-infant nursing couple. In: *A Breastfeeding Guide for the Medical Profession*. 4th ed. St Louis, MO: Mosby-Year Book, Inc; 1994:215-277
37. Maisels MJ, Newman TB. Predicting hyperbilirubinemia in newborns: the importance of timing. *Pediatrics*. 1999;103:493–495
38. Bhutani VK, Johnson L, Sivieri EM. Predictive ability of a predischarge hour-specific serum bilirubin for subsequent significant hyperbilirubinemia in healthy term and near-term newborns. *Pediatrics*. 1999;103:6–14
39. Beutler E. Glucose-6-phosphate dehydrogenase deficiency. *Blood*. 1994;84:3613–3636
40. Linn S, Schoenbaum SC, Monson RR, Rosner B, Stubblefield PG, Ryan KJ. Epidemiology of neonatal hyperbilirubinemia. *Pediatrics*. 1985;75:770–774
41. Newman TB, Easterling MJ, Goldman ES, Stevenson DK. Laboratory evaluation of jaundiced newborns: frequency, cost and yield. *Am J Dis Child*. 1990;144:364–368
42. Martinez JC, Maisels MJ, Otheguy L, et al. Hyperbilirubinemia in the breast-fed newborn: a controlled trial of four interventions. *Pediatrics*. 1993;91:470–473
43. Maisels MJ. Phototherapy—traditional and nontraditional. *J Perinatol.* 2001;21(suppl 1):S93–S97
44. Brown AK, Kim MH, Wu PY, Bryla DA. Efficacy of phototherapy in prevention and management of neonatal hyperbilirubinemia. *Pediatrics.* 1985;75:393–400

45. Armitage P, Mollison PL. Further analysis of controlled trials of treatment of hemolytic disease of the newborn. *J Obstet Gynaecol Br Emp*. 1953;60:602–605
46. Mollison PL, Walker W. Controlled trials of the treatment of haemolytic disease of the newborn. *Lancet*. 1952;1:429–433
47. Hsia DYY, Allen FH, Gellis SS, Diamond LK. Erythroblastosis fetalis. VIII. Studies of serum bilirubin in relation to kernicterus. *N Engl J Med*. 1952;247:668–671
48. Newman TB, Maisels MJ. Does hyperbilirubinemia damage the brain of healthy full-term infants? *Clin Perinatol*. 1990;17:331–358
49. Ozmert E, Erdem G, Topcu M. Long-term follow-up of indirect hyperbilirubinemia in full-term Turkish infants. *Acta Paediatr*. 1996;85: 1440–1444
50. Perlman JM, Rogers B, Burns D. Kernicterus findings at autopsy in 2 sick near-term infants. *Pediatrics*. 1997;99:612–615
51. Gartner LM, Snyder RN, Chabon RS, Bernstein J. Kernicterus: high incidence in premature infants with low serum bilirubin concentration. *Pediatrics*. 1970;45:906–917
52. Watchko JF, Oski FA. Kernicterus in preterm newborns: past, present, and future. *Pediatrics*. 1992;90:707–715
53. Watchko J, Claassen D. Kernicterus in premature infants: current prevalence and relationship to NICHD Phototherapy Study exchange criteria. *Pediatrics*. 1994;93(6 Pt 1):996–999
54. Stern L, Denton RL. Kernicterus in small, premature infants. *Pediatrics*. 1965;35:486–485
55. Turkel SB, Guttenberg ME, Moynes DR, Hodgman JE. Lack of identifiable risk factors for kernicterus. *Pediatrics*. 1980;66:502–506
56. Kim MH, Yoon JJ, Sher J, Brown AK. Lack of predictive indices in kernicterus. A comparison of clinical and pathologic factors in infants with or without kernicterus. *Pediatrics*. 1980;66:852–858
57. Newman TB, Xiong B, Gonzales VM, Escobar GJ. Prediction and prevention of extreme neonatal hyperbilirubinemia in a mature health maintenance organization. *Arch Pediatr Adolesc Med*. 2000;154:1140–1147
58. Newman TB, Escobar GJ, Gonzales VM, Armstrong MA, Gardner MN, Folck BF. Frequency of neonatal bilirubin testing and hyperbilirubinemia in a large health maintenance organization. *Pediatrics*. 1999;104: 1198–1203
59. Vohr BR. New approaches to assessing the risks of hyperbilirubinemia. *Clin Perinatol*. 1990;17:293–306
60. Perlman M, Fainmesser P, Sohmer H, Tamari H, Wax Y, Pevsmer B. Auditory nerve-brainstem evoked responses in hyperbilirubinemic neonates. *Pediatrics*. 1983;72:658–664
61. Nakamura H, Takada S, Shimabuku R, Matsuo M, Matsuo T, Negishi H. Auditory and brainstem responses in newborn infants with hyperbilirubinemia. *Pediatrics*. 1985;75:703–708
62. Nwaesei CG, Van Aerde J, Boyden M, Perlman M. Changes in auditory brainstem responses in hyperbilirubinemic infants before and after exchange transfusion. *Pediatrics*. 1984;74:800–803
63. Wennberg RP, Ahlfors CE, Bickers R, McMurtry CA, Shetter JL. Abnormal auditory brainstem response in a newborn infant with hyperbilirubinemia: improvement with exchange transfusion. *J Pediatr*. 1982;100:624–626
64. Soorani-Lunsing I, Woltil H, Hadders-Algra M. Are moderate degrees of hyperbilirubinemia in healthy term neonates really safe for the brain? *Pediatr Res*. 2001;50:701–705
65. Grimmer I, Berger-Jones K, Buhrer C, Brandl U, Obladen M. Late neurological sequelae of non-hemolytic hyperbilirubinemia of healthy term neonates. *Acta Paediatr*. 1999;88:661–663
66. Seidman DS, Paz I, Stevenson DK, Laor A, Danon YL, Gale R. Neonatal hyperbilirubinemia and physical and cognitive performance at 17 years of age. *Pediatrics*. 1991;88:828–833
67. Newman TB, Klebanoff MA. Neonatal hyperbilirubinemia and long-term outcome: another look at the collaborative perinatal project. *Pediatrics*. 1993;92:651–657
68. Scheidt PC, Bryla DA, Nelson KB, Hirtz DG, Hoffman HJ. Phototherapy for neonatal hyperbilirubinemia: six-year follow-up of the National Institute of Child Health and Human Development clinical trial. *Pediatrics*. 1990;85:455–463
69. Scheidt PC, Graubard BI, Nelson KB, et al. Intelligence at six years in relation to neonatal bilirubin levels: follow-up of the National Institute of Child Health and Human Development Clinical Trial of Phototherapy. *Pediatrics*. 1991;87:797–805
70. Seidman DS, Paz I, Stevenson DK, Laor A, Danon YL, Gale R. Effect of phototherapy for neonatal jaundice on cognitive performance. *J Perinatol*. 1994;14:23–28
71. Keenan WJ, Novak KK, Sutherland JM, Bryla DA, Fetterly KL. Morbidity and mortality associated with exchange transfusion. *Pediatrics*. 1985; 75:417–421
72. Hovi L, Siimes MA. Exchange transfusion with fresh heparinized blood is a safe procedure: Experiences from 1069 newborns. *Acta Paediatr Scand*. 1985;74:360–365
73. Jackson JC. Adverse events associated with exchange transfusion in healthy and ill newborns. *Pediatrics*. 1997;99(5):e7. Available at: www.pediatrics.org/cgi/content/full/99/5/e7
74. Schreiber GB, Busch MP, Kleinman SH, Korelitz JJ. The risk of transfusion-transmitted viral infections. *N Engl J Med*. 1996;334:1685–1690
75. Maisels MJ, Newman TB. Kernicterus in otherwise healthy, breast-fed term newborns. *Pediatrics*. 1995;96:730–733
76. Bratlid D. How bilirubin gets into the brain. *Clin Perinatol*. 1990;17: 449–465
77. Cashore WJ, Oh W. Unbound bilirubin and kernicterus in low-birthweight infants. *Pediatrics*. 1982;69:481–485
78. Nakamura H, Yonetani M, Uetani Y, Funato M, Lee Y. Determination of serum unbound bilirubin for prediction of kernicterus in low birthweight infants. *Acta Paediatr Jpn*. 1992;34:642–647
79. Funato M, Tamai H, Shimada S, Nakamura H. Vigintiphobia, unbound bilirubin, and auditory brainstem responses. *Pediatrics*. 1994;93:50–53
80. Amin SB, Ahlfors CE, Orlando MS, Dalzell LE, Merle KS, Guillet R. Bilirubin and serial auditory brainstem responses in premature infants. *Pediatrics*. 2001;107:664–670
81. Johnson L, Boggs TR. Bilirubin-dependent brain damage: incidence and indications for treatment. In: Odell GB, Schaffer R, Simopoulos AP, eds. *Phototherapy in the Newborn: An Overview*. Washington, DC: National Academy of Sciences; 1974:122–149
82. Odell GB, Storey GNB, Rosenberg LA. Studies in kernicterus. 3. The saturation of serum proteins with bilirubin during neonatal life and its relationship to brain damage at five years. *J Pediatr*. 1970;76:12–21
83. Ahlfors CE. Criteria for exchange transfusion in jaundiced newborns. *Pediatrics*. 1994;93:488–494
84. Cashore WJ. Free bilirubin concentrations and bilirubin-binding affinity in term and preterm infants. *J Pediatr*. 1980;96:521–527
85. Ebbesen F, Brodersen R. Risk of bilirubin acid precipitation in preterm infants with respiratory distress syndrome: considerations of blood/brain bilirubin transfer equilibrium. *Early Hum Dev*. 1982;6:341–355
86. Cashore WJ, Oh W, Brodersen R. Reserve albumin and bilirubin toxicity index in infant serum. *Acta Paediatr Scand*. 1983;72:415–419
87. Ebbesen F, Nyboe J. Postnatal changes in the ability of plasma albumin to bind bilirubin. *Acta Paediatr Scand*. 1983;72:665–670
88. Esbjorner E. Albumin binding properties in relation to bilirubin and albumin concentrations during the first week of life. *Acta Paediatr Scand*. 1991;80:400–405
89. Robertson A, Sharp C, Karp W. The relationship of gestational age to reserve albumin concentration for binding of bilirubin. *J Perinatol*. 1988; 8:17–18
90. Wennberg RP. Cellular basis of bilirubin toxicity. *N Y State J Med*. 1991;91:493–496

APPENDIX 2: Phototherapy

There is no standardized method for delivering phototherapy. Phototherapy units vary widely, as do the types of lamps used in the units. The efficacy of phototherapy depends on the dose of phototherapy administered as well as a number of clinical factors (Table 5).[1]

Measuring the Dose of Phototherapy

Table 5 shows the radiometric quantities used in measuring the phototherapy dose. The quantity most commonly reported in the literature is the spectral irradiance. In the nursery, spectral irradiance can be measured by using commercially available radiometers. These instruments take a single measurement across a band of wavelengths, typically 425 to 475 or 400 to 480 nm. Unfortunately, there is no standardized method for reporting phototherapy dosages in the clinical literature, so it is difficult to compare published studies on the efficacy of phototherapy and manufacturers' data for the irradiance produced by different systems.[2] Measurements of irradiance from the same system, using different radiometers,

TABLE 5. Factors That Affect the Dose and Efficacy of Phototherapy

Factor	Mechanism/Clinical Relevance	Implementation and Rationale	Clinical Application
Spectrum of light emitted	Blue-green spectrum is most effective. At these wavelengths, light penetrates skin well and is absorbed maximally by bilirubin.	Special blue fluorescent tubes or other light sources that have most output in the blue-green spectrum and are most effective in lowering TSB.	Use special blue tubes or LED light source with output in blue-green spectrum for intensive PT.
Spectral irradiance (irradiance in certain wavelength band) delivered to surface of infant	↑ irradiance → ↑ rate of decline in TSB	Irradiance is measured with a radiometer as $\mu W/cm^2$ per nm. Standard PT units deliver 8–10 $\mu W/cm^2$ per nm (Fig 6). Intensive PT requires >30 $\mu W/cm^2$ per nm.	If special blue fluorescent tubes are used, bring tubes as close to infant as possible to increase irradiance (Fig 6). Note: This cannot be done with halogen lamps because of the danger of burn. Special blue tubes 10–15 cm above the infant will produce an irradiance of at least 35 $\mu W/cm^2$ per nm.
Spectral power (average spectral irradiance across surface area)	↑ surface area exposed → ↑ rate of decline in TSB	For intensive PT, expose maximum surface area of infant to PT.	Place lights above and fiber-optic pad or special blue fluorescent tubes* below the infant. For maximum exposure, line sides of bassinet, warmer bed, or incubator with aluminum foil.
Cause of jaundice	PT is likely to be less effective if jaundice is due to hemolysis or if cholestasis is present. (↑ direct bilirubin)		When hemolysis is present, start PT at lower TSB levels. Use intensive PT. Failure of PT suggests that hemolysis is the cause of jaundice. If ↑ direct bilirubin, watch for bronze baby syndrome or blistering.
TSB level at start of PT	The higher the TSB, the more rapid the decline in TSB with PT.		Use intensive PT for higher TSB levels. Anticipate a more rapid decrease in TSB when TSB >20 mg/dL (342 μmol/L).

PT indicates phototherapy; LED, light-emitting diode.
* Available in the Olympic BiliBassinet (Olympic Medical, Seattle, WA).

can also produce significantly different results. The width of the phototherapy lamp's emissions spectrum (narrow versus broad) will affect the measured irradiance. Measurements under lights with a very focused emission spectrum (eg, blue light-emitting diode) will vary significantly from one radiometer to another, because the response spectra of the radiometers vary from manufacturer to manufacturer. Broader-spectrum lights (fluorescent and halogen) have fewer variations among radiometers. Manufacturers of phototherapy systems generally recommend the specific radiometer to be used in measuring the dose of phototherapy when their system is used.

It is important also to recognize that the measured irradiance will vary widely depending on where the measurement is taken. Irradiance measured below the center of the light source can be more than double that measured at the periphery, and this dropoff at the periphery will vary with different phototherapy units. Ideally, irradiance should be measured at multiple sites under the area illuminated by the unit and the measurements averaged. The International Electrotechnical Commission[3] defines the "effective surface area" as the intended treatment surface that is illuminated by the phototherapy light. The commission uses 60 × 30 cm as the standard-sized surface.

Is It Necessary to Measure Phototherapy Doses Routinely?

Although it is not necessary to measure spectral irradiance before each use of phototherapy, it is important to perform periodic checks of phototherapy units to make sure that an adequate irradiance is being delivered.

The Dose-Response Relationship of Phototherapy

Figure 5 shows that there is a direct relationship between the irradiance used and the rate at which the serum bilirubin declines under phototherapy.[4] The data in Fig 5 suggest that there is a saturation point beyond which an increase in the irradiance produces no added efficacy. We do not know, however, that a saturation point exists. Because the conversion of bilirubin to excretable photoproducts is partly irreversible and follows first-order kinetics, there may not be a saturation point, so we do not know the maximum effective dose of phototherapy.

Effect on Irradiance of the Light Spectrum and the Distance Between the Infant and the Light Source

Figure 6 shows that as the distance between the light source and the infant decreases, there is a corresponding increase in the spectral irradiance.[5] Fig 6 also demonstrates the dramatic difference in irradi-

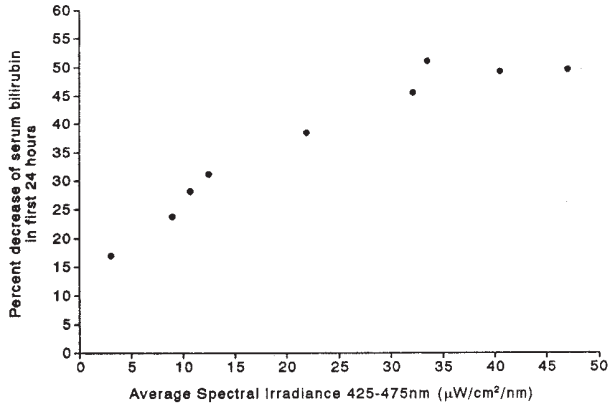


Fig 5. Relationship between average spectral irradiance and decrease in serum bilirubin concentration. Term infants with nonhemolytic hyperbilirubinemia were exposed to special blue lights (Phillips TL 52/20W) of different intensities. Spectral irradiance was measured as the average of readings at the head, trunk, and knees. Drawn from the data of Tan.[4] Source: *Pediatrics*. 1996;98: 283-287.

ance produced within the important 425- to 475-nm band by different types of fluorescent tubes.

What is Intensive Phototherapy?

Intensive phototherapy implies the use of high levels of irradiance in the 430- to 490-nm band (usually 30 $\mu W/cm^2$ per nm or higher) delivered to as much of the infant's surface area as possible. How this can be achieved is described below.

Using Phototherapy Effectively

Light Source

The spectrum of light delivered by a phototherapy unit is determined by the type of light source and any filters used. Commonly used phototherapy units contain daylight, cool white, blue, or "special blue" fluorescent tubes. Other units use tungsten-halogen lamps in different configurations, either free-standing or as part of a radiant warming device. Recently, a system using high-intensity gallium nitride light-emitting diodes has been introduced.[6] Fiber-optic systems deliver light from a high-intensity lamp to a fiber-optic blanket. Most of these devices deliver enough output in the blue-green region of the visible spectrum to be effective for standard phototherapy use. However, when bilirubin levels approach the range at which intensive phototherapy is recommended, maximal efficiency must be sought. The most effective light sources currently commercially available for phototherapy are those that use special blue fluorescent tubes[7] or a specially designed light-emitting diode light (Natus Inc, San Carlos, CA).[6] The special blue fluorescent tubes are labeled F20T12/BB (General Electric, Westinghouse, Sylvania) or TL52/20W (Phillips, Eindhoven, The Netherlands). It is important to note that special blue tubes provide much greater irradiance than regular blue tubes (labeled F20T12/B) (Fig 6). Special blue tubes are most effective because they provide light predominantly in the blue-green spectrum. At these wavelengths, light penetrates skin well and is absorbed maximally by bilirubin.[7]

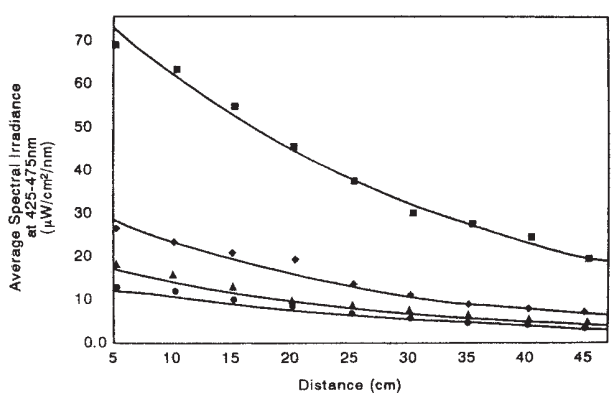


Fig 6. Effect of light source and distance from the light source to the infant on average spectral irradiance. Measurements were made across the 425- to 475-nm band by using a commercial radiometer (Olympic Bilimeter Mark II) and are the average of measurements taken at different locations at each distance (irradiance at the center of the light is much higher than at the periphery). The phototherapy unit was fitted with eight 24-in fluorescent tubes. ■ indicates special blue, General Electric 20-W F20T12/BB tube; ◆, blue, General Electric 20-W F20T12/B tube; ▲, daylight blue, 4 General Electric 20-W F20T12/B blue tubes and 4 Sylvania 20-W F20T12/D daylight tubes; •, daylight, Sylvania 20-W F20T12/D daylight tube. Curves were plotted by using linear curve fitting (True Epistat, Epistat Services, Richardson, TX). The best fit is described by the equation $y = Ae^{Bx}$. Source: *Pediatrics*. 1996;98:283-287.

There is a common misconception that ultraviolet light is used for phototherapy. The light systems used do not emit significant ultraviolet radiation, and the small amount of ultraviolet light that is emitted by fluorescent tubes and halogen bulbs is in longer wavelengths than those that cause erythema. In addition, almost all ultraviolet light is absorbed by the glass wall of the fluorescent tube and the Plexiglas cover of the phototherapy unit.

Distance From the Light

As can be seen in Fig 6, the distance of the light source from the infant has a dramatic effect on the spectral irradiance, and this effect is most significant when special blue tubes are used. To take advantage of this effect, the fluorescent tubes should be placed as close to the infant as possible. To do this, the infant should be in a bassinet, not an incubator, because the top of the incubator prevents the light from being brought sufficiently close to the infant. In a bassinet, it is possible to bring the fluorescent tubes within approximately 10 cm of the infant. Naked term infants do not become overheated under these lights. It is important to note, however, that the halogen spot phototherapy lamps cannot be positioned closer to the infant than recommended by the manufacturers without incurring the risk of a burn. When halogen lamps are used, manufacturers recommendations should be followed. The reflectors, light source, and transparent light filters (if any) should be kept clean.

Surface Area

A number of systems have been developed to provide phototherapy above and below the infant.[8,9] One commercially available system that does this is the BiliBassinet (Olympic Medical, Seattle, WA). This

unit provides special blue fluorescent tubes above and below the infant. An alternative is to place fiber-optic pads below an infant with phototherapy lamps above. One disadvantage of fiber-optic pads is that they cover a relatively small surface area so that 2 or 3 pads may be needed.[5] When bilirubin levels are extremely high and must be lowered as rapidly as possible, it is essential to expose as much of the infant's surface area to phototherapy as possible. In these situations, additional surface-area exposure can be achieved by lining the sides of the bassinet with aluminum foil or a white cloth.[10]

In most circumstances, it is not necessary to remove the infant's diaper, but when bilirubin levels approach the exchange transfusion range, the diaper should be removed until there is clear evidence of a significant decline in the bilirubin level.

What Decline in the Serum Bilirubin Can You Expect?

The rate at which the bilirubin declines depends on the factors listed in Table 5, and different responses can be expected depending on the clinical circumstances. When bilirubin levels are extremely high (more than 30 mg/dL [513 μmol/L]), and intensive phototherapy is used, a decline of as much as 10 mg/dL (171 μmol/L) can occur within a few hours,[11] and a decrease of at least 0.5 to 1 mg/dL per hour can be expected in the first 4 to 8 hours.[12] On average, for infants of more than 35 weeks' gestation readmitted for phototherapy, intensive phototherapy can produce a decrement of 30% to 40% in the initial bilirubin level by 24 hours after initiation of phototherapy.[13] The most significant decline will occur in the first 4 to 6 hours. With standard phototherapy systems, a decrease of 6% to 20% of the initial bilirubin level can be expected in the first 24 hours.[8,14]

Intermittent Versus Continuous Phototherapy

Clinical studies comparing intermittent with continuous phototherapy have produced conflicting results.[15–17] Because all light exposure increases bilirubin excretion (compared with darkness), no plausible scientific rationale exists for using intermittent phototherapy. In most circumstances, however, phototherapy does not need to be continuous. Phototherapy may be interrupted during feeding or brief parental visits. Individual judgment should be exercised. If the infant's bilirubin level is approaching the exchange transfusion zone (Fig 4), phototherapy should be administered continuously until a satisfactory decline in the serum bilirubin level occurs or exchange transfusion is initiated.

Hydration

There is no evidence that excessive fluid administration affects the serum bilirubin concentration. Some infants who are admitted with high bilirubin levels are also mildly dehydrated and may need supplemental fluid intake to correct their dehydration. Because these infants are almost always breastfed, the best fluid to use in these circumstances is a milk-based formula, because it inhibits the enterohepatic circulation of bilirubin and should help to lower the serum bilirubin level. Because the photoproducts responsible for the decline in serum bilirubin are excreted in urine and bile,[18] maintaining adequate hydration and good urine output should help to improve the efficacy of phototherapy. Unless there is evidence of dehydration, however, routine intravenous fluid or other supplementation (eg, with dextrose water) of term and near-term infants receiving phototherapy is not necessary.

When Should Phototherapy Be Stopped?

There is no standard for discontinuing phototherapy. The TSB level for discontinuing phototherapy depends on the age at which phototherapy is initiated and the cause of the hyperbilirubinemia.[13] For infants who are readmitted after their birth hospitalization (usually for TSB levels of 18 mg/dL [308 μmol/L] or higher), phototherapy may be discontinued when the serum bilirubin level falls below 13 to 14 mg/dL (239-239 μmol/L). Discharge from the hospital need not be delayed to observe the infant for rebound.[13,19,20] If phototherapy is used for infants with hemolytic diseases or is initiated early and discontinued before the infant is 3 to 4 days old, a follow-up bilirubin measurement within 24 hours after discharge is recommended.[13] For infants who are readmitted with hyperbilirubinemia and then discharged, significant rebound is rare, but a repeat TSB measurement or clinical follow-up 24 hours after discharge is a clinical option.[13]

Home Phototherapy

Because the devices available for home phototherapy may not provide the same degree of irradiance or surface-area exposure as those available in the hospital, home phototherapy should be used only in infants whose bilirubin levels are in the "optional phototherapy" range (Fig 3); it is not appropriate for infants with higher bilirubin concentrations. As with hospitalized infants, it is essential that serum bilirubin levels be monitored regularly.

Sunlight Exposure

In their original description of phototherapy, Cremer et al[21] demonstrated that exposure of newborns to sunlight would lower the serum bilirubin level. Although sunlight provides sufficient irradiance in the 425- to 475-nm band to provide phototherapy, the practical difficulties involved in safely exposing a naked newborn to the sun either inside or outside (and avoiding sunburn) preclude the use of sunlight as a reliable therapeutic tool, and it therefore is not recommended.

Complications

Phototherapy has been used in millions of infants for more than 30 years, and reports of significant toxicity are exceptionally rare. Nevertheless, phototherapy in hospital separates mother and infant, and eye patching is disturbing to parents. The most important, but uncommon, clinical complication occurs in infants with cholestatic jaundice. When these infants are exposed to phototherapy, they may develop a dark, grayish-brown discoloration of the skin, serum, and urine (the bronze infant syndrome).[22] The

pathogenesis of this syndrome is unknown, but it may be related to an accumulation of porphyrins and other metabolites in the plasma of infants who develop cholestasis.[22,23] Although it occurs exclusively in infants with cholestasis, not all infants with cholestatic jaundice develop the syndrome.

This syndrome generally has had few deleterious consequences, and if there is a need for phototherapy, the presence of direct hyperbilirubinemia should not be considered a contraindication to its use. This is particularly important in sick neonates. Because the products of phototherapy are excreted in the bile, the presence of cholestasis will decrease the efficacy of phototherapy. Nevertheless, infants with direct hyperbilirubinemia often show some response to phototherapy. In infants receiving phototherapy who develop the bronze infant syndrome, exchange transfusion should be considered if the TSB is in the intensive phototherapy range and phototherapy does not promptly lower the TSB. Because of the paucity of data, firm recommendations cannot be made. Note, however, that the direct serum bilirubin should not be subtracted from the TSB concentration in making decisions about exchange transfusions (see Fig 4).

Rarely, purpura and bullous eruptions have been described in infants with severe cholestatic jaundice receiving phototherapy,[24,25] and severe blistering and photosensitivity during phototherapy have occurred in infants with congenital erythropoietic porphyria.[26,27] Congenital porphyria or a family history of porphyria is an absolute contraindication to the use of phototherapy, as is the concomitant use of drugs or agents that are photosensitizers.[28]

REFERENCES

1. Maisels MJ. Phototherapy—traditional and nontraditional. *J Perinatol*. 2001;21(suppl 1):S93–S97
2. Fiberoptic phototherapy systems. *Health Devices*. 1995;24:132–153
3. International Electrotechnical Commission. Medical electrical equipment—part 2-50: particular requirements for the safety of infant phototherapy equipment. 2000. IEC 60601-2-50. Available at www.iec.ch. Accessed June 7, 2004
4. Tan KL. The pattern of bilirubin response to phototherapy for neonatal hyperbilirubinemia. *Pediatr Res*. 1982;16:670–674
5. Maisels MJ. Why use homeopathic doses of phototherapy? *Pediatrics*. 1996;98:283–287
6. Seidman DS, Moise J, Ergaz Z, et al. A new blue light-emitting phototherapy device: a prospective randomized controlled study. *J Pediatr*. 2000;136:771–774
7. Ennever JF. Blue light, green light, white light, more light: treatment of neonatal jaundice. *Clin Perinatol*. 1990;17:467–481
8. Garg AK, Prasad RS, Hifzi IA. A controlled trial of high-intensity double-surface phototherapy on a fluid bed versus conventional phototherapy in neonatal jaundice. *Pediatrics*. 1995;95:914–916
9. Tan KL. Phototherapy for neonatal jaundice. *Clin Perinatol*. 1991;18:423–439
10. Eggert P, Stick C, Schroder H. On the distribution of irradiation intensity in phototherapy. Measurements of effective irradiance in an incubator. *Eur J Pediatr*. 1984;142:58–61
11. Hansen TW. Acute management of extreme neonatal jaundice—the potential benefits of intensified phototherapy and interruption of enterohepatic bilirubin circulation. *Acta Paediatr*. 1997;86:843–846
12. Newman TB, Liljestrand P, Escobar GJ. Infants with bilirubin levels of 30 mg/dL or more in a large managed care organization. *Pediatrics*. 2003;111(6 Pt 1):1303–1311
13. Maisels MJ, Kring E. Bilirubin rebound following intensive phototherapy. *Arch Pediatr Adolesc Med*. 2002;156:669–672
14. Tan KL. Comparison of the efficacy of fiberoptic and conventional phototherapy for neonatal hyperbilirubinemia. *J Pediatr*. 1994;125:607–612
15. Rubaltelli FF, Zanardo V, Granati B. Effect of various phototherapy regimens on bilirubin decrement. *Pediatrics*. 1978;61:838–841
16. Maurer HM, Shumway CN, Draper DA, Hossaini AA. Controlled trial comparing agar, intermittent phototherapy, and continuous phototherapy for reducing neonatal hyperbilirubinemia. *J Pediatr*. 1973;82:73–76
17. Lau SP, Fung KP. Serum bilirubin kinetics in intermittent phototherapy of physiological jaundice. *Arch Dis Child*. 1984;59:892–894
18. McDonagh AF, Lightner DA. 'Like a shrivelled blood orange'—bilirubin, jaundice, and phototherapy. *Pediatrics*. 1985;75:443–455
19. Yetman RJ, Parks DK, Huseby V, Mistry K, Garcia J. Rebound bilirubin levels in infants receiving phototherapy. *J Pediatr*. 1998;133:705–707
20. Lazar L, Litwin A, Merlob P. Phototherapy for neonatal nonhemolytic hyperbilirubinemia. Analysis of rebound and indications for discontinuing therapy. *Clin Pediatr (Phila)*. 1993;32:264–267
21. Cremer RJ, Perryman PW, Richards DH. Influence of light on the hyperbilirubinemia of infants. *Lancet*. 1958;1(7030):1094–1097
22. Rubaltelli FF, Jori G, Reddi E. Bronze baby syndrome: a new porphyrin-related disorder. *Pediatr Res*. 1983;17:327–330
23. Meisel P, Jahrig D, Theel L, Ordt A, Jahrig K. The bronze baby syndrome: consequence of impaired excretion of photobilirubin? *Photobiochem Photobiophys*. 1982;3:345–352
24. Mallon E, Wojnarowska F, Hope P, Elder G. Neonatal bullous eruption as a result of transient porphyrinemia in a premature infant with hemolytic disease of the newborn. *J Am Acad Dermatol*. 1995;33:333–336
25. Paller AS, Eramo LR, Farrell EE, Millard DD, Honig PJ, Cunningham BB. Purpuric phototherapy-induced eruption in transfused neonates: relation to transient porphyrinemia. *Pediatrics*. 1997;100:360–364
26. Tonz O, Vogt J, Filippini L, Simmler F, Wachsmuth ED, Winterhalter KH. Severe light dermatosis following phototherapy in a newborn infant with congenital erythropoietic urophyria [in German]. *Helv Paediatr Acta*. 1975;30:47–56
27. Soylu A, Kavukcu S, Turkmen M. Phototherapy sequela in a child with congenital erythropoietic porphyria. *Eur J Pediatr*. 1999;158:526–527
28. Kearns GL, Williams BJ, Timmons OD. Fluorescein phototoxicity in a premature infant. *J Pediatr*. 1985;107:796–798

All clinical practice guidelines from the American Academy of Pediatrics automatically expire 5 years after publication unless reaffirmed, revised, or retired at or before that time.

ERRATUM

Two errors appeared in the American Academy of Pediatrics clinical practice guideline, titled "Management of Hyperbilirubinemia in the Newborn Infant 35 or More Weeks of Gestation," that was published in the July 2004 issue of *Pediatrics* (2004;114:297–316). On page 107, Background section, first paragraph, the second sentence should read: "The current guideline represents a consensus of the committee charged by the AAP with reviewing and updating the existing guideline and is based on a careful review of the evidence, including a comprehensive literature review by the Agency for Healthcare Research and Quality and the New England Medical Center Evidence-Based Practice Center.[2,,]" On page 118, Appendix 1, first paragraph, the 4 levels of evidence quality should have been labeled A, B, C, and D rather than 1, 2, 3, and 4, respectively. The American Academy of Pediatrics regrets these errors.

Hyperbilirubinemia Clinical Practice Guideline Quick Reference Tools

- Recommendation Summary
  — Management of Hyperbilirubinemia in the Newborn Infant 35 or More Weeks of Gestation
- *ICD-10-CM* Coding Quick Reference for Hyperbilirubinemia
- AAP Patient Education Handout
  — *Jaundice and Your Newborn*

Recommendation Summary

Management of Hyperbilirubinemia in the Newborn Infant 35 or More Weeks of Gestation

The following are the key elements of the recommendations provided by this guideline. Clinicians should:

1. Promote and support successful breastfeeding.
2. Establish nursery protocols for the identification and evaluation of hyperbilirubinemia.
3. Measure the total serum bilirubin (TSB) or transcutaneous bilirubin (TcB) level on infants jaundiced in the first 24 hours.
4. Recognize that visual estimation of the degree of jaundice can lead to errors, particularly in darkly pigmented infants.
5. Interpret all bilirubin levels according to the infant's age in hours.
6. Recognize that infants at less than 38 weeks' gestation, particularly those who are breastfed, are at higher risk of developing hyperbilirubinemia and require closer surveillance and monitoring.
7. Perform a systematic assessment on all infants before discharge for the risk of severe hyperbilirubinemia.
8. Provide parents with written and verbal information about newborn jaundice.
9. Provide appropriate follow-up based on the time of discharge and the risk assessment.
10. Treat newborns, when indicated, with phototherapy or exchange transfusion.

Coding Quick Reference for Hyperbilirubinemia	
ICD-10-CM	
P59.0	Neonatal jaundice associated with preterm delivery
P59.3	Neonatal jaundice from breast milk inhibitor
P59.9	Neonatal jaundice, unspecified
R17	Unspecified jaundice

Jaundice and Your Newborn

Congratulations on the birth of your new baby!

To make sure your baby's first week is safe and healthy, it is important that

1. **You find a primary care provider, such as a pediatrician you are comfortable with, for your baby's ongoing care.**
2. **Your baby is checked for jaundice in the hospital.**
3. **If you are breastfeeding, you get the help you need to make sure it is going well.**
4. **You make sure your baby is seen by a doctor or nurse at 3 to 5 days of age.**
5. **If your baby is discharged before age 72 hours, your baby should be seen by a doctor or nurse within 2 days of discharge from the hospital.**

Q: What is jaundice?

A: Jaundice is the yellow color seen in the skin of many newborns. It happens when a chemical called *bilirubin* builds up in the baby's blood. Jaundice can occur in babies of any race or color.

Q: Why is jaundice common in newborns?

A: Everyone's blood contains bilirubin, which comes from red blood cells and is removed by the liver. Before birth, the mother's liver does this for the baby. Most babies develop jaundice in the first few days after birth because it takes a few days for the baby's liver to get better at removing bilirubin.

Q: How can I tell if my baby is jaundiced?

A: The skin of a baby with jaundice usually appears yellow. The best way to see jaundice is in good light, such as daylight or under fluorescent lights. Jaundice usually appears first in the face and then moves to the chest, abdomen, arms, and legs as the bilirubin level increases. The whites of the eyes may also be yellow. Jaundice may be harder to see in babies with darker skin color.

Q: Can jaundice hurt my baby?

A: Most babies have mild jaundice that is harmless, but in unusual situations the bilirubin level can get very high and might cause brain damage. This is why newborns should be checked carefully for jaundice and treated to prevent a high bilirubin level.

Q: How should my baby be checked for jaundice?

A: If your baby looks jaundiced in the first few days after birth, your baby's doctor or nurse may use a skin or blood test to check your baby's bilirubin level. However, because estimating the bilirubin level based on the baby's appearance can be difficult, most experts recommend that a skin or blood test be done in the first 2 days even if your baby does not appear jaundiced. A bilirubin level is always needed if jaundice develops before the baby is 24 hours old. Whether a test is needed after that depends on the baby's age, the amount of jaundice, and whether the baby has other factors that make jaundice more likely or harder to see.

Q: Does breastfeeding affect jaundice?

A: Breast milk (human milk) is the ideal food for your baby. Jaundice is more common in babies who are breastfed than babies who are formula-fed. However, this occurs more often in newborns who are not getting enough breast milk because their mothers are not producing enough milk (especially if the milk comes in late) or if breastfeeding is not going well, such as babies not latching on properly.

For the first 24 hours after birth, normal breastfed newborns receive only about 1 teaspoon of milk with each feeding. The amount of breast milk provided increases with each day. If you are breastfeeding, you should breastfeed your baby at least 8 to 12 times a day for the first few days. This will help you produce enough milk and will help keep the baby's bilirubin level down. If you are having trouble breastfeeding, ask your baby's doctor or nurse or a lactation specialist for help.

Q: When should my baby get checked after leaving the hospital?

A: It is important for your baby to be seen by a nurse or doctor when the baby is between 3 and 5 days old, because this is usually when a baby's bilirubin level is highest. This is why, if your baby is discharged before age 72 hours, your baby should be seen within 2 days of discharge. The timing of this visit may vary depending on your baby's age when released from the hospital and other factors.

Q: Why do some babies need an earlier follow-up visit after leaving the hospital?

A: Some babies have a greater risk for high levels of bilirubin and may need to be seen sooner after discharge from the hospital. Ask your doctor about an early follow-up visit if your baby has any of the following symptoms:

- A high bilirubin level before leaving the hospital
- Early birth (more than 2 weeks before the due date)
- Jaundice in the first 24 hours after birth
- Breastfeeding that is not going well
- A lot of bruising or bleeding under the scalp related to labor and delivery
- A parent, brother, or sister who had a high bilirubin level and received light therapy

Q: When should I call my baby's doctor?

A: Call your baby's doctor if

- Your baby's skin turns more yellow.
- Your baby's abdomen, arms, or legs are yellow.
- The whites of your baby's eyes are yellow.
- Your baby is jaundiced and is hard to wake, fussy, or not nursing or taking formula well.

Q: How is harmful jaundice prevented?

A: Most jaundice requires no treatment. When treatment is necessary, placing your baby under special lights while he or she is undressed will lower the bilirubin level. Depending on your baby's bilirubin level, this can be done in the hospital or at home. Jaundice is treated at levels that are much lower than those at which brain damage is a concern. In some babies, supplementing breast milk with formula

can also help to lower the bilirubin level and prevent the need for phototherapy. Treatment can prevent the harmful effects of jaundice.

> **Note:** Exposing your baby to sunlight through a window might help lower the bilirubin level, but this will only work if the baby is undressed. Make sure the temperature in your home is comfortable and not too cold for your baby. Newborns should never be put in direct sunlight outside because they might get sunburned.

Q: When does jaundice go away?

A: In breastfed babies, it is common for jaundice to last 1 month or occasionally longer. In formula-fed babies, most jaundice goes away by 2 weeks. However, if your baby is jaundiced for more than 3 weeks, see your baby's doctor.

From Your Doctor

Clinical Practice Guideline for the Management of Infantile Hemangiomas

- *Clinical Practice Guideline*
  - *PPI: AAP Partnership for Policy Implementation*
    See Appendix 1 for more information.

CLINICAL PRACTICE GUIDELINE Guidance for the Clinician in Rendering Pediatric Care

American Academy of Pediatrics
DEDICATED TO THE HEALTH OF ALL CHILDREN™

Clinical Practice Guideline for the Management of Infantile Hemangiomas

Daniel P. Krowchuk, MD, FAAP,[a] Ilona J. Frieden, MD, FAAP,[b] Anthony J. Mancini, MD, FAAP,[c] David H. Darrow, MD, DDS, FAAP,[d] Francine Blei, MD, MBA, FAAP,[e] Arin K. Greene, MD, FAAP,[f] Aparna Annam, DO, FAAP,[g] Cynthia N. Baker, MD, FAAP,[h] Peter C. Frommelt, MD, FAAP,[i] Amy Hodak, CPMSM,[j] Brian M. Pate, MD, FHM, FAAP,[k] Janice L. Pelletier, MD, FAAP,[l] Deborah Sandrock, MD, FAAP,[m] Stuart T. Weinberg, MD, FAAP,[n] Mary Anne Whelan, MD, PhD, FAAP,[o] SUBCOMMITTEE ON THE MANAGEMENT OF INFANTILE HEMANGIOMAS

abstract

Infantile hemangiomas (IHs) occur in as many as 5% of infants, making them the most common benign tumor of infancy. Most IHs are small, innocuous, self-resolving, and require no treatment. However, because of their size or location, a significant minority of IHs are potentially problematic. These include IHs that may cause permanent scarring and disfigurement (eg, facial IHs), hepatic or airway IHs, and IHs with the potential for functional impairment (eg, periorbital IHs), ulceration (that may cause pain or scarring), and associated underlying abnormalities (eg, intracranial and aortic arch vascular abnormalities accompanying a large facial IH). This clinical practice guideline for the management of IHs emphasizes several key concepts. It defines those IHs that are potentially higher risk and should prompt concern, and emphasizes increased vigilance, consideration of active treatment and, when appropriate, specialty consultation. It discusses the specific growth characteristics of IHs, that is, that the most rapid and significant growth occurs between 1 and 3 months of age and that growth is completed by 5 months of age in most cases. Because many IHs leave behind permanent skin changes, there is a window of opportunity to treat higher-risk IHs and optimize outcomes. Early intervention and/or referral (ideally by 1 month of age) is recommended for infants who have potentially problematic IHs. When systemic treatment is indicated, propranolol is the drug of choice at a dose of 2 to 3 mg/kg per day. Treatment typically is continued for at least 6 months and often is maintained until 12 months of age (occasionally longer). Topical timolol may be used to treat select small, thin, superficial IHs. Surgery and/or laser treatment are most useful for the treatment of residual skin changes after involution and, less commonly, may be considered earlier to treat some IHs.

Departments of [a]Pediatrics and Dermatology, Wake Forest School of Medicine, Winston-Salem, North Carolina; Departments of [b]Dermatology and Pediatrics, School of Medicine, University of California, San Francisco, San Francisco, California; Departments of [c]Pediatrics and Dermatology, Feinberg School of Medicine, Northwestern University and Ann and Robert H. Lurie Children's Hospital of Chicago, Chicago, Illinois; Departments of [d]Otolaryngology and Pediatrics, Eastern Virginia Medical School and Children's Hospital of the King's Daughters, Norfolk, Virginia; [e]Donald and Barbara Zucker School of Medicine, Northwell Health, New York City, New York; [f]Department of Plastic and Oral Surgery, Boston Children's Hospital and Harvard Medical School, Harvard University, Boston, Massachusetts; [g]Department of Radiology, University of Colorado School of Medicine, Children's Hospital Colorado, Aurora, Colorado; [h]Department of Pediatrics, Kaiser Permanente Medical Center, Los Angeles, California; [i]Department of Pediatrics, Cardiology, Medical College of Wisconsin and Children's Hospital of Wisconsin, Milwaukee, Wisconsin; [j]American Board of Pediatrics, Chapel Hill, North Carolina; [k]Department of Pediatrics, University of Kansas School of Medicine-Wichita, Wichita, Kansas; [l]Department of Pediatrics, Northern Light Health, Bangor, Maine; [m]St Christopher's Hospital for Children and College of Medicine, Drexel University, Philadelphia, Pennsylvania; Departments of [n]Biomedical Informatics and Pediatrics, School of Medicine, Vanderbilt University, Nashville, Tennessee; and [o]College of Physicians and Surgeons, Columbia University, New York City, New York

To cite: Krowchuk DP, Frieden IJ, Mancini AJ, et al. Clinical Practice Guideline for the Management of Infantile Hemangiomas. *Pediatrics*. 2019;143(1):e20183475

INTRODUCTION

This is the first clinical practice guideline (CPG) from the American Academy of Pediatrics (AAP) regarding the management of infantile hemangiomas (IHs). Similar consensus statements have been published by European[1] and Australasian expert groups.[2] In addition, a recent AAP clinical report provided a comprehensive review of the pathogenesis, clinical features, and treatment of IH; it is available at http://pediatrics.aappublications.org/content/136/4/e1060.[3]

IHs occur in approximately 4% to 5% of infants, making them the most common benign tumor of childhood. They are more common in girls, twins, infants born preterm or with low birth weight (up to 30% of infants born weighing <1 kg are affected), and white neonates. The pathogenesis of IHs has yet to be fully defined. A leading hypothesis is that circulating endothelial progenitor cells migrate to locations in which conditions (eg, hypoxia and developmental field disturbances) are favorable for growth.[3]

Knowledge about IHs has advanced dramatically in the past decade, particularly regarding the unique timing and nature of proliferation and involution, risks of sequelae, and newer treatment options. As a result, pediatric providers have an opportunity to improve care and reduce morbidity in infants with IHs by promptly recognizing which IHs are potentially high risk and when intervention is needed.

In the broadest sense, the goal of this CPG from the AAP is to enhance primary care providers' ability to confidently evaluate, triage, and manage IHs, employing an evidence-based approach. Specifically, the CPG will:

- provide an approach to risk stratification and recognition of potentially problematic IHs;
- emphasize that early and frequent monitoring in the first few weeks and months of life is crucial in identifying those IHs that require intervention because IHs may change rapidly during this time period;
- review the role of imaging in patients who have IHs; and
- offer evidence-based guidance for the management of IHs, including indications for consultation, referral and possible intervention, pharmacologic options for therapy, the role of surgical modalities, and ongoing management and monitoring (including parent education).

This CPG is intended for pediatricians and other primary care providers who (1) manage IHs collaboratively with a hemangioma specialist (defined below), (2) care for children with IHs being managed primarily by a hemangioma specialist, or (3) manage IHs independently on the basis of their knowledge and expertise. It does not address the management of vascular malformations, congenital hemangiomas, or other vascular tumors. The CPG encourages enhanced communication between primary care clinicians and hemangioma specialists to ensure early assessment and treatment of infants in whom active intervention is indicated, to improve patient outcomes, and to enhance anticipatory guidance. It is not intended to be a sole source of guidance in the management of children with IHs, to replace clinical judgment, or to establish a protocol for all infants with IHs. Rather, it provides a framework for clinical decision-making.

METHODS

The methods of this CPG are discussed in detail in the Methods section of the Supplemental Information. Briefly, a comparative effectiveness review of potential benefits and harms of diagnostic modalities and pharmacologic and surgical treatments was conducted on behalf of the Agency for Healthcare Research and Quality (AHRQ). The literature search strategy employed Medline via the PubMed interface, the Cumulative Index to Nursing and Allied Health Literature (CINAHL), and Excerpta Medica Database (Embase). Searches were limited to the English language and to studies published from 1982 to June

TABLE 1 Highlights of This CPG

- IH growth characteristics are different than once taught.
  - Most rapid IH growth occurs between 1 and 3 months of age.
  - Although IHs involute, this process may be incomplete, leaving permanent skin changes that may be life altering. This is especially true for IHs that are thick.
  - There is a window of opportunity to treat problematic IHs. Consult early (by 1 month of age) for lesions that are potentially high risk because of the following associations (Table 3):
    - potential for disfigurement (the most common reason treatment is needed);
    - life-threatening complications;
    - functional impairment;
    - ulceration; and
    - underlying abnormalities.
- Oral propranolol is the treatment of choice for problematic IHs that require systemic therapy.
- Topical timolol may be used to treat some thin and/or superficial IHs.
- Surgery and/or laser treatment are most useful for the treatment of residual skin changes after involution. They may be used earlier to treat selected IHs.

TABLE 2 Definitions

Hemangioma specialist:	Unlike many diseases, management of IHs is not limited to 1 medical or surgical specialty. A hemangioma specialist may have expertise in dermatology, hematologyoncology, pediatrics, facial plastic and reconstructive surgery, ophthalmology, otolaryngology, pediatric surgery, and/or plastic surgery, and his or her practice is often focused primarily or exclusively on the pediatric age group.
Hemangioma specialists should:	• understand the time-sensitive nature of IHs during the growth phase and be able to accommodate requests for urgent evaluation; • have experience with accurate risk stratification and potential complications associated with IHs; • be able to provide recommendations for various management options, including observation, medical therapies, and surgical or laser procedures, and provide counseling regarding the potential risks and benefits of these interventions for specific patients; and • have a thorough knowledge of past and emerging medical literature regarding IHs. • Such specialists often have 1 or more of the following characteristics: ○ participated in a vascular anomalies program during previous medical training; ○ devotes a significant part of his or her clinical practice to IHs; ○ is a member of or collaborates with a multidisciplinary vascular anomalies center; ○ maintains membership in professional organizations or groups with a special interest in IHs; ○ participates in research studies in the field of IHs; or ○ publishes medical literature in the field of IHs.
IHs: infantile hemangiomas	Benign vascular tumors of infancy and childhood with unique clinical and histopathologic characteristics that distinguish them from other vascular tumors (eg, congenital hemangiomas) or malformations. These characteristics include development during the first weeks or months of life, a typical natural history of rapid growth followed by gradual involution, and immunohistochemical staining of biopsy specimens with erythrocyte-type glucose transporter protein and other unique markers not present on other benign vascular tumors. Many other entities are also called hemangiomas. Some are true vascular tumors, and others are vascular malformations. Therefore, it is important to use the adjective "infantile" when referring to true IHs. IHs are classified on the basis of soft-tissue depth and the pattern of anatomic involvement (see Supplemental Figs 5–10 for photographic examples).
Soft-tissue depth:	• Superficial: red with little or no evidence of a subcutaneous component (formerly called strawberry" hemangiomas); • Deep: blue and located below the skin surface (formerly called "cavernous" hemangiomas); and • Combined (mixed): both superficial and deep components are present.
Anatomic appearance:	• Localized: well-defined focal lesions (appearing to arise from a central point); • Segmental: IH involving an anatomic region that is often plaque-like and often measuring at >5 cm in diameter; • Indeterminate (undetermined): neither clearly localized or segmental (often called partial segmental); and • Multifocal: multiple discrete IHs at disparate sites.

2015. Because the therapy of IHs has been evolving rapidly, the CPG subcommittee performed an updated literature review for the period of July 2015 to January 2017 to augment the original search. This most recent search employed only Medline because previously, virtually all relevant articles had been accessed via this database. The search was concentrated on pharmacologic interventions, including topical timolol (an emerging therapeutic alternative for which limited data were available at the time of the original search). The original methodology and report, including the evidence search and review, are available in their entirety and as an executive summary at www.effectivehealthcare.ahrq.gov/reports/final.cfm.[4]

DEVELOPMENT OF THE CLINICAL PRACTICE GUIDELINE

In December 2016, the AAP convened a multidisciplinary subcommittee composed of IH experts in the fields of dermatology, cardiology, hematology-oncology, otolaryngology(head and neck surgery), plastic surgery, and radiology. The subcommittee also included general pediatricians, a parent representative, an implementation scientist, a representative from the Partnership for Policy Implementation (https://www.aap.org/en-us/professional-resources/quality-improvement/Pages/Partnership-for-Policy-Implementation.aspx), and an epidemiologist and methodologist. All panel members declared potential conflicts on the basis of the AAP policy on Conflict of Interest and Voluntary Disclosure. Subcommittee members repeated this process at the time of the publication of the guideline. All potential conflicts of interest are listed at the end of this document. The project was funded by the AAP.

The final recommendations were based on articles identified in the AHRQ and updated systematic reviews. Decisions and the strength of recommendations were based on a systematic grading of the quality of evidence by independent reviewers. Expert consensus was used when definitive data were not available. Key action statements (KASs), summarized in Table 4, were generated by subcommittee members authoring individual components of the CPG using

TABLE 3 High-Risk IHs

IH Clinical Findings	IH Risk
Life-threatening	
"Beard-area" IH	Obstructive airway hemangiomas
≥5 cutaneous IHs	Liver hemangiomas, cardiac failure, hypothyroidism
Functional impairment	
Periocular IH (>1 cm)	Astigmatism, anisometropia, proptosis, amblyopia
IH involving lip or oral cavity	Feeding impairment
Ulceration	
Segmental IH: IH of any size involving any of the following sites: lips, columella, superior helix of ear, gluteal cleft and/or perineum, perianal skin, and other intertriginous areas (eg, neck, axillae, inguinal region)	Increased risk of ulceration
Associated structural anomalies	
Segmental IH of face or scalp	PHACE syndrome
Segmental IH of lumbosacral and/or perineal area	LUMBAR syndrome
Disfigurement	
Segmental IH, especially of face and scalp	High risk of scarring and/or permanent disfigurement
Facial IH (measurements refer to size during infancy): nasal tip or lip (any size) or any facial location ≥2 cm (>1 cm if ≤3 mo of age)	Risk of disfigurement via distortion of anatomic landmarks and/or scarring and/or permanent skin changes
Scalp IH >2 cm	Permanent alopecia (especially if the hemangioma becomes thick or bulky); profuse bleeding if ulceration develops (typically more bleeding than at other anatomic sites)
Neck, trunk, or extremity IH >2 cm, especially in growth phase or if abrupt transition from normal to affected skin (ie, ledge effect); thick superficial IH (eg, ≥2 mm thickness)	Greater risk of leaving permanent scarring and/or permanent skin changes depending on anatomic location
Breast IH (female infants)	Permanent changes in breast development (eg, breast asymmetry) or nipple contour

Categorization of IH as high risk is based on published literature (including the AHRQ review and hemangioma severity scores) and consensus of CPG subcommittee members. Given the wide variation in IH location, size, and age at presentation, the subcommittee acknowledges that there may be situations in which an IH meets high-risk criteria and, therefore, merits consultation or referral, but the practitioner and parents do not believe this is necessary or practical. Clinical judgment is always involved in such decisions, and any plan of action needs to be individualized on the basis of a number of factors, including location of the lesion, age of child, family preferences, and geographic access to care.

the results of the literature review. These sections were reviewed and refined by the subcommittee chairperson and co-chairperson and ultimately by all subcommittee members.

Evidence-based guideline recommendations from the AAP may be graded as strong, moderate, weak on the basis of low-quality evidence, or weak on the basis of balance between benefits and harms. Strong and moderate recommendations usually are associated with "should" and "should not" recommendation statements, whereas some moderate and all weak recommendations may be recognized by use of "may" or "need not," signifying that moderate recommendations are based on a range of evidence strengths within the boundaries of the definition (Table 5, Fig 1).

The CPG underwent a comprehensive review by stakeholders (including AAP councils, committees, and sections), selected outside organizations, and individuals identified by the subcommittee as experts in the field before formal approval by the AAP. All comments were reviewed by the subcommittee and incorporated into the final guideline when appropriate.

RISK STRATIFICATION, TRIAGE, AND REFERRAL

Key Action Statement 1A (Table 6)

Clinicians should classify an IH as high risk if there is evidence of or potential for the following: (1) life-threatening complications, (2) functional impairment or ulceration, (3) structural anomalies (eg, in PHACE syndrome or LUMBAR syndrome), or (4) permanent disfigurement (grade X, strong recommendation).

The purpose of this statement is to ensure timely identification of IHs that may require early intervention. Clinicians in the primary care setting caring for infants with IH face 2 major challenges: disease heterogeneity and the unique growth characteristics of IHs.[24] For example, because IHs involute spontaneously, many that are small, are superficial, occur in areas covered by clothing, and/or are unlikely to cause disfigurement do not require hemangioma specialist evaluation or treatment. However, some IHs may be considered high risk, and depending on the clinician's comfort level and local access to specialty care, require a higher level of experience and expertise to determine if additional intervention is indicated. These high-risk IHs and their associated clinical findings are summarized in Table 3 and illustrated in Figs 2–4, Supplemental Table 22, and Supplemental Fig 11. Of particular note and as discussed later, segmental hemangiomas, those that cover an anatomic territory arising from 1 or more developmental units, confer a higher risk of morbidity and life-threatening complications than those that are localized, that is, seeming to arise from a central focal point.[5] At the same time, smaller IHs in particular anatomic locations, such as the cheek, tip of the

TABLE 4 Summary of Key Action Statements (KASs) for the Management of IHs

In Managing IH, Recommendations for Clinicians	Evidence Quality; Strength of Recommendation
1. Risk stratification	
1A. Classify an IH as high risk if there is evidence of or potential for the following: (1) life-threatening complications, (2) functional impairment or ulceration, (3) structural anomalies (eg, in PHACE syndrome or LUMBAR syndrome), or (4) permanent disfigurement	X; strong
1B. After identifying an IH as high risk, facilitate evaluation by a hemangioma specialist as soon possible	X; strong
2. Imaging	
2A. Do not perform imaging unless the diagnosis of IH is uncertain, there are ≥5 cutaneous IHs, or associated anatomic abnormalities are suspected	B; moderate
2B. Perform ultrasonography as the initial imaging modality when the diagnosis of IH is uncertain	C; weak
2C. Perform MRI when concerned about associated structural abnormalities (eg, PHACE syndrome or LUMBAR syndrome)	B; moderate
3. Pharmacotherapy	
3A. Use oral propranolol as the first-line agent for IHs requiring systemic treatment	A; strong
3B. Dose propranolol between 2 and 3 mg/kg per d unless there are comorbidities (eg, PHACE syndrome) or adverse effects (eg, sleep disturbance) that necessitate a lower dose	A; moderate
3C. Counsel that propranolol be administered with or after feeding and that doses be held at times of diminished oral intake or vomiting to reduce the risk of hypoglycemia	X; strong
3D. Evaluate patients for and educate caregivers about potential adverse effects of propranolol, including sleep disturbances, bronchial irritation, and clinically symptomatic bradycardia and hypotension	X; strong
3E. May prescribe oral prednisolone or prednisone to treat IHs if there are contraindications or an inadequate response to oral propranolol	B; moderate
3F. May recommend intralesional injection of triamcinolone and/or betamethasone to treat focal, bulky IHs during proliferation or in certain critical anatomic locations (eg, the lip)	B; moderate
3G. May prescribe topical timolol maleate as a therapy for thin and/or superficial IHs	B; moderate
4. Surgical management	
4. May recommend surgery and laser therapy as treatment options in managing selected IHs	C; moderate
5. Parent education	
5. Educate caregivers of infants with an IH about the condition, including the expected natural history and its potential for causing complications or disfigurement	X; strong

TABLE 5 Guideline Definitions for Key Action Statements

Statement	Definition	Implication
Strong recommendation	A particular action is favored because anticipated benefits clearly exceed harms (or vice versa), and quality of evidence is excellent or unobtainable.	Clinicians should follow a strong recommendation unless a clear and compelling rationale for an alternative approach is present.
Moderate recommendation	A particular action is favored because anticipated benefits clearly exceed harms (or vice versa), and the quality of evidence is good but not excellent (or is unobtainable).	Clinicians would be prudent to follow a moderate recommendation but should remain alert to new information and sensitive to patient preferences.
Weak recommendation (based on low-quality evidence)	A particular action is favored because anticipated benefits clearly exceed harms (or vice versa), but the quality of evidence is weak.	Clinicians would be prudent to follow a weak recommendation but should remain alert to new information and sensitive to patient preferences.
Weak recommendation (based on balance of benefits and harms)	A weak recommendation is provided when the aggregate database shows evidence of both benefit and harm that appears to be similar in magnitude for any available courses of action.	Clinicians should consider the options in their decision-making, but patient preference may have a substantial role.

PHACE indicates posterior fossa defects, hemangiomas, cerebrovascular arterial anomalies, cardiovascular anomalies including coarctation of the aorta, and eye anomalies; LUMBAR, lower body IH and other cutaneous defects, urogenital anomalies and ulceration, myelopathy, bony deformities, anorectal malformations, and arterial anomalies and renal anomalies.

nose, and perioral and periocular skin, can confer a high risk of complications as well (see discussion below).

There are 5 major indications for consideration of early treatment or need for further evaluation of IHs:

1. life-threatening complications;
2. functional impairment or risk thereof;
3. ulceration or risk thereof;
4. evaluation to identify important associated structural anomalies; and
5. risk of leaving permanent scarring or distortion of anatomic landmarks

Life-threatening Complications

Life-threatening lesions include obstructing IHs of the airway, liver IHs associated with high-output congestive heart failure and severe hypothyroidism, and, rarely, profuse bleeding from an ulcerated IH. Obstructing IHs of the airway typically involve the subglottis,

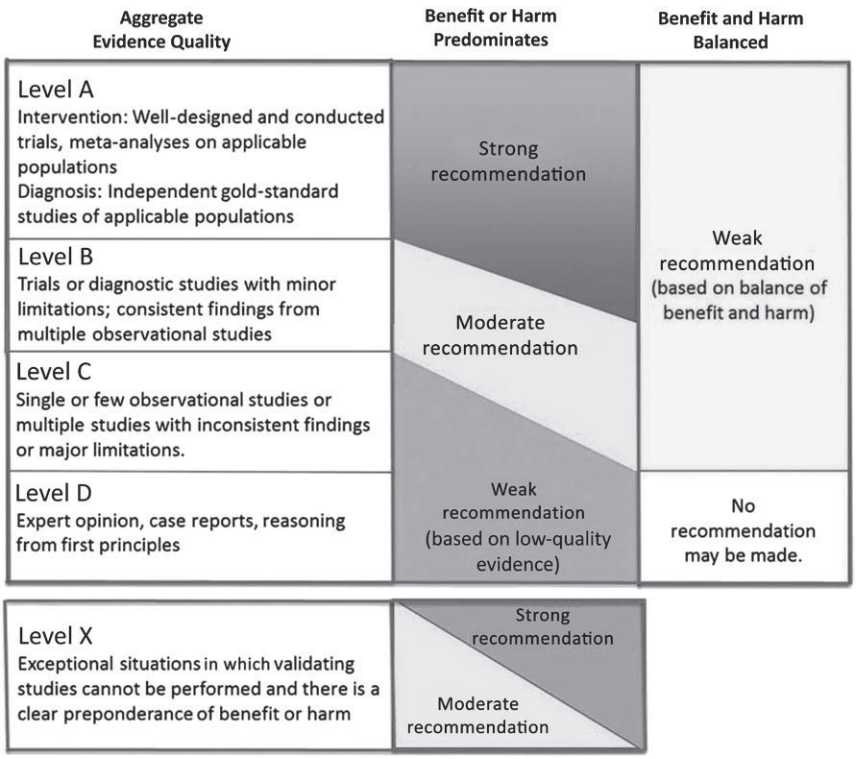


FIGURE 1
AAP rating of evidence and recommendations.

TABLE 6 Key Action Statement 1A: Clinicians should classify an IH as high risk if there is evidence of or potential for the following: (1) life-threatening complications, (2) functional impairment or ulceration, (3) structural anomalies (eg, in PHACE syndrome or LUMBAR syndrome), or (4) permanent disfigurement (grade X, strong recommendation).

Aggregate Evidence Quality	Grade X
Benefits	Early recognition of high-risk, potentially problematic IHs facilitates early specialist evaluation and management and potential avoidance of complications
Risks, harm, cost	Unnecessary parental concern regarding lesions inappropriately characterized as high-risk IHs
Benefit-harm assessment	The benefits of identifying high-risk IHs outweigh the harm
Intentional vagueness	None
Role of patient preference	None
Exclusions	Vascular lesions that are not true IHs
Strength	Strong recommendation
Key references	5–23

further compromising the narrowest portion of the pediatric airway. Although the mean age at the time of diagnosis is about 4 months, symptoms usually present much earlier but are often mistaken as infectious or inflammatory croup or reactive airway disease.[25–27] Most children who are affected develop biphasic stridor and barky cough as the IH enlarges. Approximately half of infants in whom an airway IH is diagnosed also will have a cutaneous IH. Segmental IH of the lower face ("beard distribution") or anterior neck and oral and/or pharyngeal mucosal IHs are the greatest risk factors for an airway IH.[6,27–29]

Hepatic hemangiomas have been characterized as occurring in 3 patterns: focal, multifocal, and diffuse; the latter 2 are attributable to IHs, whereas focal lesions more often represent congenital hemangiomas.[7,8] Most multifocal hepatic IHs are asymptomatic and do not require treatment. However, a minority of these lesions are associated with macrovascular shunting, causing high flow that can, in rare cases, result in high-output cardiac failure. So-called "diffuse" hepatic IHs are another rare subset that confers an even greater risk for morbidity and mortality. Infants who are affected typically present before 4 months of age with severe hepatomegaly, which can lead to potentially lethal abdominal compartment syndrome attributable to compromised ventilation, renal failure attributable to renal vein compression, or compromised inferior vena cava blood flow to the heart.[7,8] A consumptive form of hypothyroidism caused by the inactivation of thyroid hormones by type 3 iodothyronine deiodinase present in IH tissue can also be a complication of multifocal or diffuse hepatic IHs.[9] Although liver IHs can occasionally be seen in infants with 1 or no IH of the skin, the greatest risk for liver IHs is in infants who have 5 or more cutaneous IHs,[10] for whom screening ultrasonography is recommended (see KAS 2A).[11,30] Other sites of extracutaneous hemangiomas can occur, including the gastrointestinal tract, brain, and other organs. However, such involvement is rare and occurs mostly in association with large segmental IHs, and screening for these extracutaneous hemangiomas is not recommended unless signs or symptoms are present.[31,32] Severe bleeding, although often feared by parents, is an extremely rare complication of ulcerated IHs (see discussion of ulceration). Another potentially life-threatening complication is severe coarctation of the aorta not attributable to IHs but rather to structural anomalies seen in association with IHs in PHACE syndrome.

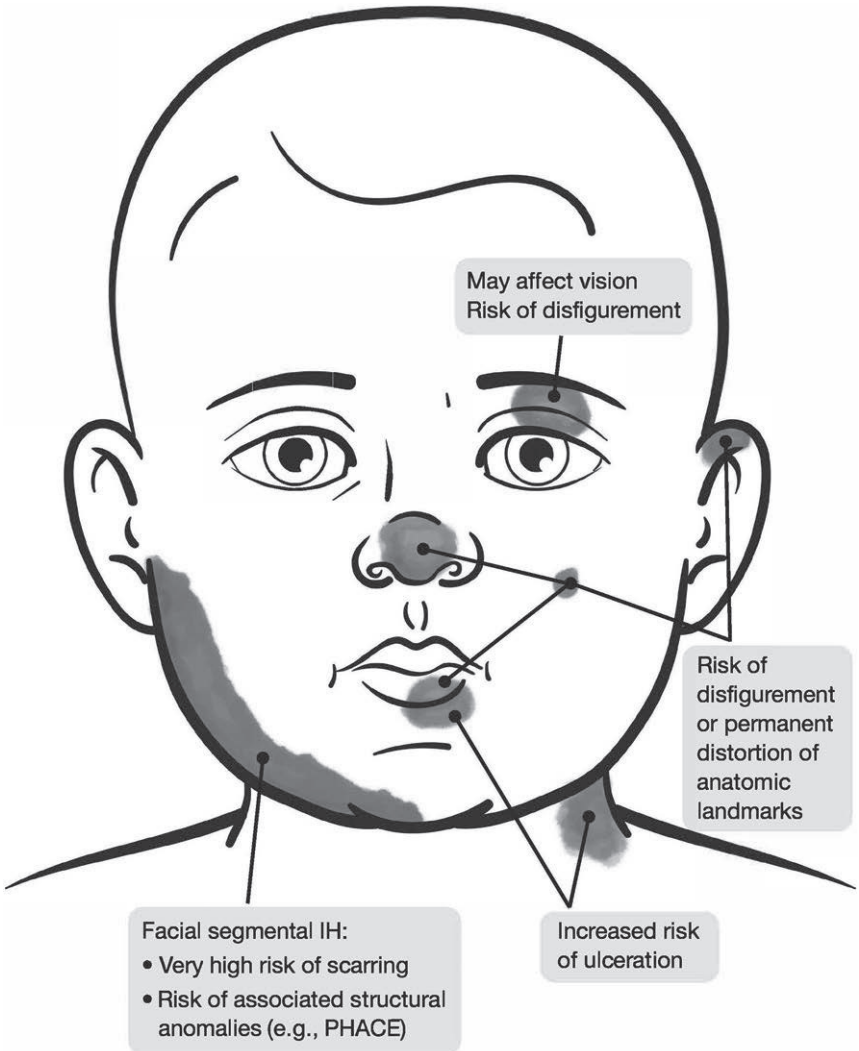


FIGURE 2
High-risk IHs involving the face and neck.

Functional Impairment

Examples of functional impairment include visual disturbance and interference with feeding because of IH involvement of the lips or mouth. IHs occurring in the periocular region have the potential to cause mechanical ptosis, strabismus, anisometropia, or astigmatism, which can quickly lead to the development of amblyopia.[12,13,33] Specific characteristics that place an infant at a higher risk for amblyopia include an IH size of >1 cm, upper eyelid involvement, associated ptosis, eyelid margin changes, medial location, and segmental morphology or displacement of the globe.[13,34,35] Feeding impairment can occur in infants with IHs involving either the perioral region or the airway. Infants with ulcerated lip IHs may have feeding difficulties secondary to severe pain.[36] Airway IHs may complicate breathing and swallowing, leading also to impaired feeding.[37]

Ulceration

Skin or mucosal ulceration of the IH surface occurs with an estimated incidence of 5% to 21% in referral populations.[14,38] Ulceration can lead to significant pain, bleeding, and secondary infection and virtually always results in scarring. Depending on the anatomic site of involvement, it can result in disfigurement. Ulceration occurs most frequently in infants younger than 4 months, during the period of active IH proliferation. Certain types of IHs are at higher risk, including superficial and mixed types, segmental IHs, and those involving the scalp, neck, and perioral, perineal, perianal, and intertriginous sites, the latter likely caused by maceration and friction. In addition, protuberant IHs can ulcerate as a result of trauma. Although concern for potential bleeding in IHs is common among caregivers and providers, most IH bleeding is minor and easily controllable with pressure. In rare cases, particularly IHs involving the scalp or with deep ulceration, bleeding can be more profuse, even life-threatening.[14,15]

Associated Structural Anomalies

A small subset of children with IHs have associated congenital anomalies. The best known phenomenon is PHACE syndrome (OMIM 606519).[39] The acronym "PHACES" is sometimes used instead to include potential ventral midline defects, specifically sternal cleft and/or supraumbilical raphe. Cerebrovascular anomalies, present in more than 90% of patients with PHACE syndrome, are the most common extracutaneous feature of the syndrome, followed by cardiac anomalies (67%) and structural brain anomalies (52%). The hallmark of PHACE syndrome is a large (often >5 cm in diameter) segmental IH that typically involves the face, scalp, and/or neck, although in rare cases, the face or scalp are spared, with a segmental IH located on the torso and upper extremity instead.[5,16] The risk of PHACE syndrome in an infant presenting with a large segmental IH of the head or neck is approximately 30%.[5] Revised consensus criteria for the diagnosis of PHACE syndrome and the care of infants who are affected have recently been published.[16]

LUMBAR syndrome may best be viewed as the "lower half of the body" equivalent of PHACE syndrome.[17] IHs in LUMBAR syndrome are almost invariably segmental, involving the

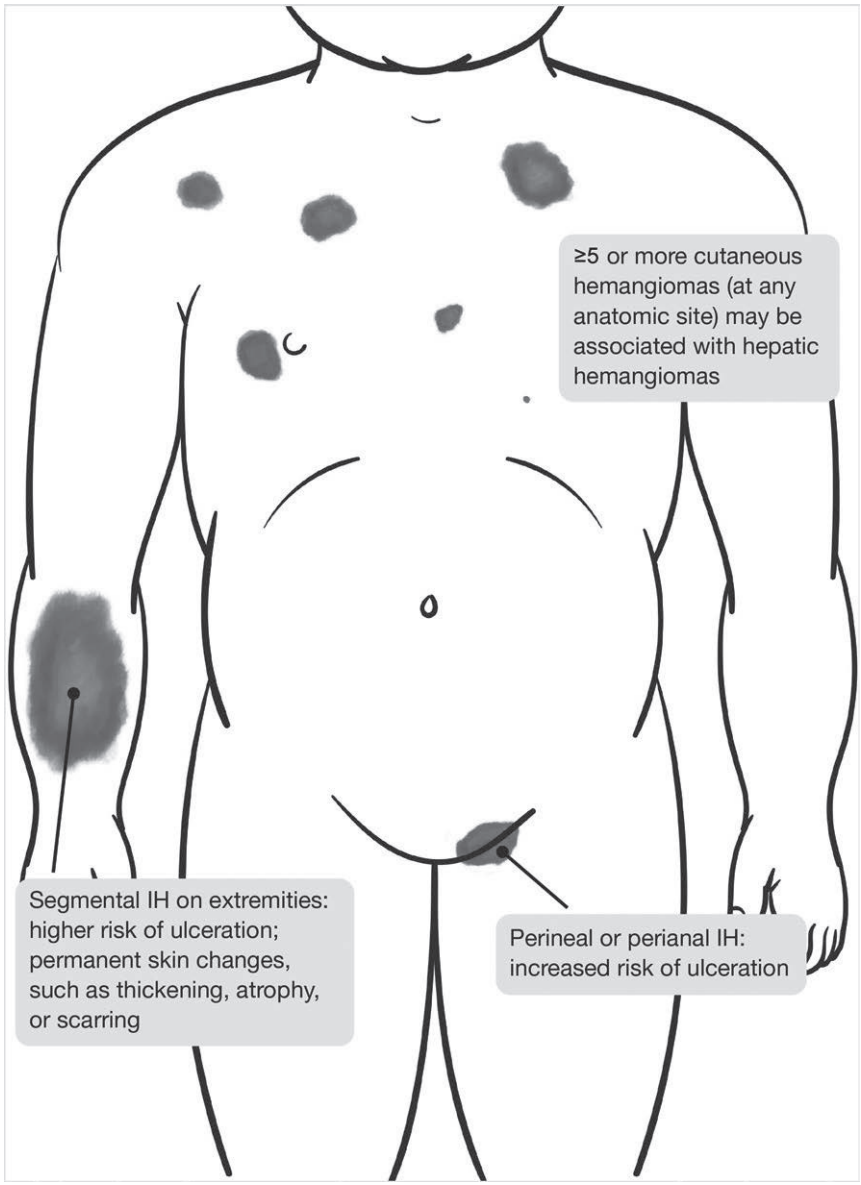


FIGURE 3
High-risk IHs involving the trunk, extremities, and perineum.

lumbosacral or perineal skin and often extending onto 1 leg. Many IHs in LUMBAR syndrome are minimally proliferative morphologically, with telangiectatic vascular stains predominating over bulkier superficial hemangiomas. In such cases, ulceration can be an early clue to the diagnosis.[17] Rarely, undergrowth or overgrowth of an affected limb may be present. Like PHACE syndrome, the cutaneous IH and underlying anomalies in LUMBAR syndrome reveal regional correlation. Myelopathy, particularly spinal dysraphism, is the most common extracutaneous anomaly.[17]

Disfigurement

IHs can lead to permanent disfigurement either via scarring of the skin or distortion of anatomic landmarks (see Table 3 for specific information). The risk of disfigurement is much higher than the risk of functional or life-threatening consequences. The majority of infants who receive treatment of IHs do so to prevent uncontrolled growth leading to permanent disfigurement.[1,18,40]

This indication for treatment represents a paradigm shift from the hands-off approach of the late 1950s through 1980s, when many experts recommended treatment only for those IHs causing functional impairment.[41] One reason for this change is an increased recognition that although IHs involute, they often leave behind permanent skin changes that, although not life or function threatening, are potentially life altering.[19,20] Moreover, with the advent of β-blocker therapies for IHs, there are now better treatment options with greater efficacy and lower potential toxicity than oral corticosteroids, the previous gold standard. There is also increased recognition that parental and patient quality of life can be adversely affected by visible birthmarks and resultant scarring, particularly in areas that cannot be easily covered with clothing, such as the face, neck, arms, and hands, as well as other emotionally sensitive areas, such as the breasts and genitalia.[42–44]

The precise risk of a patient in a primary care setting having permanent skin changes from an IH is not known, but in a referral setting, such changes are seen in 55% to 69% of those with untreated IHs.[19,20] This risk is greatest in IHs with a prominent and thick superficial (strawberry) component, especially when there is a steep step-off (ie, ledge effect) from affected to surrounding normal skin. However, the degree of superficial thickening may be difficult to predict in early infancy. Thus, even in IHs that do not initially appear to be high risk, it is prudent to serially follow lesion growth and establish a means for prompt evaluation if ongoing or rapid growth is observed because this could alter management.

Key Action Statement 1B (Table 7)

After identifying an IH as high risk, clinicians should facilitate an evaluation by a hemangioma specialist as soon as possible (grade X, strong recommendation).

The purpose of this statement is to ensure timely evaluation by a

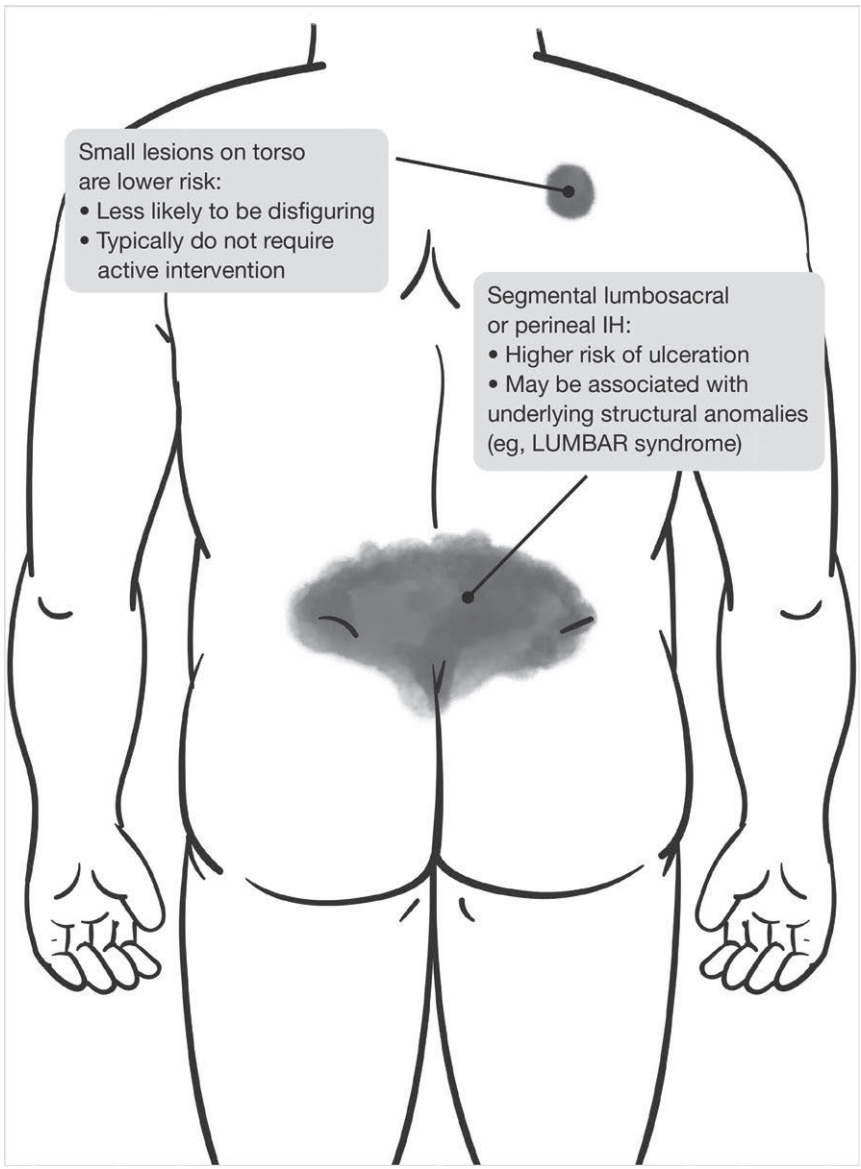


FIGURE 4
IHs involving the posterior trunk.

hemangioma specialist of an IH identified as high risk. IH is a disease with a window of opportunity in which to intervene and prevent poorer outcomes, and this critical time frame for optimizing outcomes can be missed if there are delays in referral or treatment. Recent literature suggests that the presence and growth of IHs is apparent much earlier than originally thought.[21,22] Premonitory findings appear in the skin during early infancy, including localized blanching or macular telangiectatic erythema.[21] As endothelial cell proliferation continues, the IH enlarges, becomes more elevated, and develops a rubbery consistency. IHs typically have their clinical onset before 4 weeks of age.[21,22]

Several studies have helped to better characterize the proliferative phase of IHs. Although IHs proliferate for variable periods of time and to varying degrees, the most rapid growth of superficial IHs typically occurs between 1 and 3 months' chronological age.[21] IHs reach 80% of their ultimate size by 3 months of age, and the large majority of IHs have completed growth by 5 months of age.[22] In a study in which parents' photographs were used, early IH growth was found to be nonlinear, with an accelerated period of rapid growth between 5 and 7 weeks of age, and the optimal time for referral or initiation of treatment was 1 month of age, a time far earlier than the time most infants with IHs are typically referred to (or seen by) hemangioma specialists.[21,22]

These observations regarding growth are helpful, but their impact in individual case management is limited by the tremendous degree of disease heterogeneity of IHs. Even for the most experienced clinicians, it can be difficult to predict the degree of IH growth until several weeks to months after the lesion is first noticed. By that time, damage to the dermis and subcutaneous tissues as well as permanent distortion of important anatomic landmarks, such as the nose or lips, may already have occurred.[19,20,44] Hence, decisions regarding intervention must be based on risk stratification, including the age of the child (in anticipation of possible IH growth), health considerations (like prematurity), anatomic site, the size of the IH, any actual or potential complications, and parental preferences. In high-risk IHs, a wait-and-see approach can result in a missed window of opportunity to prevent adverse outcomes.

The rate of growth and ultimate size of an IH can vary dramatically from patient to patient. Predicting the growth of a particular IH is, therefore, difficult and made even more challenging by the minority of lesions that do not exhibit the typical pattern of proliferation followed by slow involution.[23,45] Differences in growth can even be evident when comparing 1 IH to another on the same patient. For example, in patients who have 2 or more IHs, 1 lesion may become large and problematic, and others may barely grow. A subset of IHs known as infantile hemangiomas with minimal or arrested growth (IH-MAGs) typically present as a patch of fine or coarsely reticulated

TABLE 7 Key Action Statement 1B: After identifying an IH as high risk, clinicians should facilitate an evaluation by a hemangioma specialist as soon as possible (grade X, strong recommendation).

Aggregate Evidence Quality	Grade X
Benefits	Potential for early intervention for IH at a high risk of causing complications
Risks, harm, cost	Potential for delay in intervention if specialist evaluation cannot be arranged promptly or is unavailable in the geographic region; costs associated with specialist evaluation for IH incorrectly identified as high risk
Benefit-harm assessment	The benefits of specialist evaluation outweigh harms and costs
Intentional vagueness	The subcommittee recognizes the multidisciplinary nature of IH management and the diverse level of expertise among individuals in this field. As a result, the definition of a specialist with expertise in vascular birthmarks is vague. The subcommittee also recognizes that the time frame "as soon as possible" is vague.
Role of patient preference	Parental preference should be considered in the decision to see a specialist and in the choice of specialist
Exclusions	IHs not considered high risk
Strength	Strong recommendation
Key references	19–23

telangiectasias, often within a zone of vasoconstriction.[23] They may be mistaken for a port-wine stain or other vascular birthmark. Although they lack the robust proliferative phase characteristic of many IHs, IH-MAGs may be associated with complications, such as ulceration or, if segmental, structural anomalies. The growth trajectory of deeper IHs or those with deeper soft-tissue components also differs from that of localized superficial IHs, often presenting at a later age (eg, 1–2 months and, occasionally, even later).[22]

On the basis of this information, the consensus recommendation of the subcommittee is that patients with IHs identified as high risk have expedited consultation and/or referral to a hemangioma specialist (Supplemental Table 22, Supplemental Fig 11). The type of hemangioma specialist may depend on the specific concern (eg, a hemangioma specialist experienced in airway management will be needed if concern exists for a subglottic hemangioma). Because the time to appointment with a hemangioma specialist may exceed the window of opportunity during which evaluation and possible treatment would be of maximum benefit, those who care for infants with IHs should have mechanisms in place to expedite such appointments, including the education of office staff to give young infants with high-risk IHs priority appointments. In-person consultation may not always be possible or mandatory. Clinicians may also use telemedicine (either live interactive or store and forward of photographs taken in the office) to assist with triage, evaluation, and management.

Key Action Statement 2A (Table 8)

Clinicians should not perform imaging unless the diagnosis of IH is uncertain, there are 5 or more cutaneous IHs, or associated anatomic abnormalities are suspected (grade B, moderate recommendation).

The purpose of this statement is to provide guidance to clinicians regarding the indications for imaging of IHs. Most IHs can be diagnosed clinically. Therefore, imaging of IHs is not indicated for diagnostic purposes unless the lesion has an atypical appearance (ie, the diagnosis is uncertain) or it behaves in a manner that is inconsistent with the expected proliferative growth and involution phases within the expected time frame.[46,47] Noninvasive imaging may be used to monitor response to treatment but typically is not required.[47] Occasionally, differentiating an IH from a highly vascularized malignant tumor may be difficult. Clinical history, response to therapy, and imaging characteristics considered together are extremely important in this differentiation. In rare cases, a tissue biopsy may be needed to confirm the diagnosis.

Clinicians should use imaging, specifically abdominal ultrasonography, if 5 or more cutaneous IHs are present to screen for hepatic IH.[30] Ultrasonography has a sensitivity of 95% for detection of hepatic hemangiomas and avoids the need for sedation and exposure to ionizing radiation.[46] Early detection of these lesions may lead to improved monitoring and initiation of appropriate treatment, resulting in decreased morbidity and mortality.[8,46,49]

Imaging also is indicated if concern exists for structural anomalies, as would be the case in infants at risk for PHACE syndrome or LUMBAR syndrome. These infants would typically have large (eg, >5 cm in diameter) segmental facial or scalp IHs or segmental IHs of the perineum, gluteal cleft, or lumbosacral area, with or without lower extremity IHs (see KAS 2C for further discussion).[16,17,47,48]

Key Action Statement 2B (Table 9)

Clinicians should perform ultrasonography as the initial imaging modality when the diagnosis of IH is uncertain (grade C, weak recommendation).

Ultrasonography (with Doppler imaging) is the initial imaging modality of choice when the diagnosis of IH is uncertain. The study can be performed without sedation and does not necessitate exposure to ionizing radiation, which can be risky, particularly in young infants. On ultrasonography, most IHs appear as a well-defined mass with high-flow vascular characteristics and no arteriovenous shunting (an exception to the latter is that hepatic IHs may exhibit arteriovenous shunting). This may change as the IH involutes and has a more fatty appearance with decreased vascularity.[47,50] Doppler ultrasonography is also the modality of choice when screening for hepatic IHs and can be used to monitor

TABLE 8 Key Action Statement 2A: Clinicians should not perform imaging unless the diagnosis of IH is uncertain, there are 5 or more cutaneous IHs, or associated anatomic abnormalities are suspected (grade B, moderate recommendation).

Aggregate Evidence Quality	Grade B
Benefits	Avoid the cost, risk of sedation, and radiation associated with unnecessary imaging
Risks, harm, cost	Potential misdiagnosis if imaging is not performed
Benefit-harm assessment	Benefits outweigh harm
Intentional vagueness	None
Role of patient preference	Minimal; when parental anxiety is significant, ultrasonography is a low-cost and low-risk means of confirming the diagnosis
Exclusions	None
Strength	Moderate recommendation
Key references	8,46–48

TABLE 9 Key Action Statement 2B: Clinicians should perform ultrasonography as the initial imaging modality when the diagnosis of IH is uncertain (grade C, weak recommendation).

Aggregate Evidence Quality	Grade C
Benefits	Select the appropriate imaging study to aid in diagnosis and identify associated abnormalities; avoid ionizing radiation and sedation
Risks, harm, cost	Risk that ultrasonography may not be sufficiently diagnostic or may result in the misdiagnosis of a lesion believed to represent an IH
Benefit-harm assessment	Benefits outweigh harms
Intentional vagueness	None
Role of patient preference	Minimal
Exclusions	None
Strength	Weak recommendation
Key references	47,50

progression of disease and response to treatment.[47]

Key Action Statement 2C (Table 10)

Clinicians should perform MRI when concerned about associated structural abnormalities (eg, PHACE syndrome or LUMBAR syndrome) (grade B, moderate recommendation).

Imaging for associated structural anomalies is indicated in infants at risk for PHACE syndrome or LUMBAR syndrome. For example, an infant with a large (eg, >5 cm in diameter) segmental facial or scalp IH is at risk for PHACE syndrome, and further evaluation with MRI and/or magnetic resonance angiography (MRA) of the head and neck (including the aortic arch and brachiocephalic origins) and echocardiography is advisable.[16,47]

For patients with segmental IHs of the perineum, gluteal cleft, or lumbosacral area (with or without lower extremity IHs), imaging for LUMBAR syndrome should be considered.[17,48] If there is uncertainty about whether there is a risk of associated structural anomalies, consultation with a hemangioma specialist or other appropriate expert (eg, pediatric neurologist, neurosurgeon, or radiologist) can be helpful to determine if imaging is required and which studies should be performed.

MRI is the optimal imaging modality to define underlying structural abnormalities, and contrast is needed to assess vascular components.[46] MRA can illustrate the vascular anatomy. Thus, MRI and MRA, with and without contrast of the head and neck, are the best studies to detect PHACE syndrome. MRI does not use ionizing radiation but may require sedation given the duration of the examination.[51,52] The duration of imaging is important because it has been theorized that prolonged (>3 hours) or repeated exposures to general anesthetic and sedative drugs in children younger than 3 years may negatively affect brain development.[53,54] Single, brief exposures are unlikely to have similar effects. As more rapid MRI scanning protocols are developed, the need for sedation may diminish. As an alternative to sedation, young infants fed immediately before an MRI and swaddled may sleep through the procedure. Discussion between the radiologist, ordering clinician, and sedation team is critical to determine the optimal imaging and sedation protocols.[55]

In patients in whom there is a risk of LUMBAR syndrome, spinal ultrasonography (for those with a corrected age of less than 6 months) and Doppler ultrasonography of the abdomen and pelvis can be used as an initial screen for abnormalities.[56–58] Ultimately, however, MRI likely will be required to provide greater definition. For example, if a high suspicion for spinal abnormalities remains despite normal ultrasonography (ie, there are associated markers of dysraphism [eg, sacral dimple, skin appendage, tuft of hair, and lipoma]), MRI is a more sensitive diagnostic modality.[47]

Computed tomography is not the modality of choice for imaging IHs because it involves ionizing radiation, which should be avoided in children, particularly young infants, unless absolutely necessary. Advantages of computed tomography are that it can be rapidly performed and may not require sedation.

MANAGEMENT: PHARMACOTHERAPY

Key Action Statement 3A (Table 11)

Clinicians should use oral propranolol as the first-line agent for IHs requiring

TABLE 10 Key Action Statement 2C: Clinicians should perform MRI when concerned about associated structural abnormalities (eg, PHACE syndrome or LUMBAR syndrome) (grade B, moderate recommendation).

Aggregate Evidence Quality	Grade B
Benefits	Select the appropriate imaging study to aid in diagnosis and identify associated abnormalities; avoid ionizing radiation and sedation
Risks, harm, cost	Risk of sedation or general anesthesia Cost of MRI (but offers greater diagnostic sensitivity)
Benefit-harm assessment	Benefits outweigh harms
Intentional vagueness	None
Role of patient preference	Minimal
Exclusions	None
Strength	Moderate recommendation
Key references	46,51–55

TABLE 11 Key Action Statement 3A: Clinicians should use oral propranolol as the first-line agent for IHs requiring systemic treatment (grade A, strong recommendation).

Aggregate Evidence Quality	Grade A
Benefits	Improve IH treatment; avoid adverse effects associated with oral steroid therapy
Risks, harm, cost	Occurrence of adverse effects associated with propranolol use (see KAS 3D); medication cost and cost of hospitalization if drug is initiated while infant is an inpatient
Benefit-harm assessment	Benefits outweigh harms
Intentional vagueness	None
Role of patient preference	Parents should be involved in shared decision-making regarding treatment.
Exclusions	Caution (but not exclusion) in infants <5 wk of age, postconceptional age of <48 wk; potential exclusions that require appropriate subspecialty evaluation and/or clearance; evidence of cardiogenic shock or heart failure; sinus bradycardia; heart block greater than first degree; known or suspected PHACE syndrome, including presence or risk of coarctation of the aorta and cerebrovascular anomalies; known asthma and/or reactive airway disease; known hypersensitivity to propranolol
Strength	Strong recommendation
Key references	3,46,59–61

systemic treatment (grade A, strong recommendation).

The purpose of this statement is to advise clinicians that oral propranolol is the current treatment of choice for IHs requiring systemic therapy. After the serendipitous observation of its utility in treating IHs,[59] propranolol, a nonselective antagonist of both β-1 and β-2 adrenergic receptors, has evolved to become the treatment of choice for IHs.[1,3,60] The precise mechanisms of action of propranolol on IHs are unclear but have been hypothesized to be attributable to vasoconstriction, angiogenesis inhibition, induction of apoptosis, inhibition of nitric oxide production, and regulation of the renin-angiotensin system.[61–69] Oral propranolol hydrochloride (Hemangeol) was approved by the US Food and Drug Administration (FDA) in March 2014 for use in proliferating IHs requiring systemic therapy. This therapy has now replaced the previous gold standard therapy for threatening IHs, systemic or intralesional corticosteroids.[70]

In the AHRQ review, 18 studies were included in a network meta-analysis of the effectiveness and harms of corticosteroids and β-blockers. The mean estimate of expected clearance for oral propranolol was 95%, which was superior to other interventions.[46] Ten studies compared propranolol versus another modality, including steroids, pulsed-dye laser (PDL), bleomycin, or other treatments (Table 12). Propranolol was more effective in 3 studies, effectiveness did not differ significantly in 2 other studies, and studies comparing propranolol versus steroids to reduce IH size had conflicting results. Harms are discussed in subsequent KASs, but in the AHRQ analysis, propranolol's superior safety profile is confirmed.

The subcommittee's additional review yielded another 19 studies, 4 of which met inclusion criteria for benefits of interventions (and 9 of which met inclusion criteria for harms of interventions). These 4 studies evaluated propranolol versus placebo or observation. Propranolol was associated with significantly greater clearance of IH compared with the control group in all studies. The strength of evidence (SOE) was considered high for greater effectiveness of propranolol versus placebo or observation. The review also confirmed the superiority of oral propranolol over a variety of comparators. Propranolol was superior to ibuprofen and paracetamol in treating ulcerated hemangiomas[71] and to oral captopril in patients with problematic IHs.[72] In a randomized controlled trial (RCT) of oral propranolol compared with observation for IHs, the overall efficacy of propranolol (defined as excellent, good, or medium response) was 98.97%, compared with 31.25% in the observation group ($P < .05$).[73] Last, Aly et al[74] compared oral propranolol alone versus oral propranolol combined with 2 weeks of "priming" with oral prednisolone. Those in the prednisolone-primed propranolol group showed a statistically superior reduction in IH size at weeks 2, 4, and 8 compared with the propranolol group, but the 6-month response was equivocal for both groups regarding all assessed variables.[74]

TABLE 12 AHRQ Summary of Comparative Efficacy of Various Treatments for IHs

Drug	Mean Estimate of Expected Clearance, %	95% Bayesian Credible Interval, %
Propranolol	95	88–99
Topical timolol	62	39–83
Intralesional triamcinolone	58	21–93
Oral steroid	43	21–66
Control	6	1–11

Limited data exist on the utility of β-blockers other than propranolol or different delivery mechanisms for propranolol. The AHRQ review included 3 small studies comparing propranolol versus nadolol or atenolol and 1 study comparing oral, intralesional, and topical propranolol. Atenolol and nadolol each demonstrated effectiveness on lesion size, with little difference in efficacy between propranolol and atenolol and greater efficacy of nadolol in 1 small study. The review did not find differences in response with propranolol, nadolol, or atenolol, but the SOE in comparing these was low.[46] The subcommittee's additional review yielded 1 article on oral atenolol for IH, which did not meet the AHRQ inclusion criteria for comparative effectiveness but revealed an excellent treatment response in 56.5% of patients.[75]

Key Action Statement 3B (Table 13)

Clinicians should dose propranolol between 2 and 3 mg/kg per day unless there are comorbidities (eg, PHACE syndrome) or adverse effects (eg, sleep disturbance) that necessitate a lower dose (grade A, moderate recommendation).

The purpose of this statement is to provide clinicians guidance in dosing oral propranolol for IHs. To date, authors of most studies favor dosing at 2 to 3 mg/kg per day. An RCT of 456 infants compared a placebo versus 1 of 4 propranolol regimens (1 mg/kg per day or 3 mg/kg per day for 3 or 6 months duration). The regimen of 3 mg/kg per day for 6 months was superior, with complete or nearly complete resolution in 60% of patients, compared with 4% of patients in the placebo arm ($P < .0001$).[76] The FDA approval of propranolol hydrochloride oral solution (4.28 mg/mL) recommends a starting dose of 0.6 mg/kg twice daily, with a gradual increase over 2 weeks to a maintenance dose of 1.7 mg/kg twice daily (3.4 mg/kg per day based on expression as the hydrochloride salt of propranolol). As noted in the AHRQ review, other studies typically reported dosing of 2 to 2.5 mg/kg per day,[46] and a multidisciplinary, multiinstitutional expert panel and a European expert consensus group[1,61] support a starting dose of 1 mg/kg per day and a target dose of 2 to 3 mg/kg per day. Data comparing 2 and 3 mg/kg per day are lacking.

Similarly, available data do not permit evidence-based recommendations on dosing frequency (twice daily versus 3 times daily), but both the FDA and the European Medicine Evaluation Agency labeling is for twice-daily dosing. The site for initiation of propranolol (outpatient versus inpatient) is evolving as more evidence accumulates that cardiovascular and other acute toxicities occur rarely. Although in both the aforementioned consensus articles, initiation in an inpatient setting is favored for infants younger than 8 weeks, those with cardiovascular or respiratory comorbidities, and those with poor social support, FDA labeling sanctions initiation in an outpatient setting for infants >5 weeks' corrected gestational age.

A duration of 6 months of therapy was shown to be superior to 3 months in the large RCT conducted by Léauté-Labrèze et al.[76] In the AHRQ review, the duration of propranolol treatment ranged from 3 to 13 months.[46] Rebound growth during tapering or after stopping the medication may occur in 10% to 25% of patients and can occur even after 6 months of therapy.[18,76] A large multicenter retrospective cohort study found the greatest risk of rebound occurred in those in whom therapy was discontinued at <12 months of age (and especially before 9 months), and the lowest risk was in those in whom treatment was discontinued between 12 and 15 months of age.[18] Risk factors for rebound growth noted in this study were the presence of mixed or deep morphology and female sex. These observations have led many experts to recommend continuing therapy until at least 1 year of age.

Dosing may need to be modified in certain situations. Patients with PHACE syndrome may have an increased risk of stroke, and this risk may be greater if certain neurovascular anomalies are present.[16] In patients who merit systemic IH therapy, the benefits and risks must be carefully weighed. Evaluation with MRI and/or MRA of the head and neck and echocardiography should be performed before or shortly after the initiation of therapy.[61] If patients who are at high risk require treatment with propranolol, it is advisable to use the lowest effective dose, slowly titrate the dose, and administer the drug 3 times daily (to minimize abrupt changes in blood pressure); comanagement with a pediatric neurologist is recommended.[1,16,61,77] Other patients who may require lower propranolol doses include those with progressive IH ulceration while receiving therapy and those who experience adverse effects (such as sleep disturbances).

Key Action Statement 3C (Table 14)

Clinicians should counsel that propranolol be administered with or after feeding and that doses be held at times of diminished oral intake or vomiting to reduce the risk of hypoglycemia (grade X, strong recommendation).

TABLE 13 Key Action Statement 3B: Clinicians should dose propranolol between 2 and 3 mg/kg per day unless there are comorbidities (eg, PHACE syndrome) or adverse effects (eg, sleep disturbance) that necessitate a lower dose (grade A, moderate recommendation).

Aggregate Evidence Quality	Grade A
Benefits	The recommended doses have been associated with high clearance rates of IH
Risks, harm, cost	Response rates for higher or lower doses have not been well studied
Benefit-harm assessment	Benefits outweigh harms
Intentional vagueness	None
Role of patient preference	Parents will be involved in the decision about dosing in the setting of PHACE syndrome or the occurrence of adverse effects
Exclusions	See KAS 3A; dosing may be modified if comorbidities exist
Strength	Moderate recommendation
Key references	1,46,61,76

TABLE 14 Key Action Statement 3C: Clinicians should counsel that propranolol be administered with or after feeding and that doses be held at times of diminished oral intake or vomiting to reduce the risk of hypoglycemia (grade X, strong recommendation).

Aggregate Evidence Quality	Grade X
Benefits	Reduce the likelihood of adverse reactions
Risks, harm, cost	Risk that parents will decline therapy because of concerns about potential medication adverse effects
Benefit-harm assessment	Benefits outweigh harms
Intentional vagueness	None
Role of patient preference	None
Exclusions	None
Strength	Strong recommendation
Key references	46,60,61,76,78–80

The purpose of this statement is to reinforce the importance of administering oral propranolol with feeds and of holding therapy at times of restricted oral intake to prevent hypoglycemia and hypoglycemia-induced seizures. The association between hypoglycemia and propranolol in infants and children is well established and is related to effects on glycogenolysis and gluconeogenesis.[78] β-blockade by propranolol can affect these processes, and infants and children may be particularly susceptible to this effect.[78,79] Early clinical features of hypoglycemia in infants, which may be masqueraded by β-adrenergic blockade, include sweating, tachycardia, shakiness, and anxious appearance, whereas later manifestations (signs of neuroglycopenia) may include lethargy, poor feeding, apnea, seizures, stupor, and loss of consciousness.[79]

The AHRQ review identified 24 comparative studies (4 good quality) and 56 case series (4 good quality) that reported harms data of β-blockers for IHs. Rates of clinically important harms (hypoglycemia, hypotension, bradycardia, and bronchospasm) varied widely, and the authors assigned a moderate SOE for the association of propranolol with both clinically important and minor harms (with high study limitations).[46] Harms overall did not cause treatment discontinuation.

The subcommittee's additional review yielded 8 reports that met inclusion criteria for harms regarding oral propranolol for treatment of IHs. These reports provided more detailed information about the occurrence of hypoglycemia. Three of the 8 articles reported hypoglycemia; these articles included 1021 patients, 10 of whom experienced hypoglycemia (3 of these suffered hypoglycemic seizures in the setting of viral gastroenteritis and poor oral intake).[80–82]

In a large meta-analysis of oral propranolol for IHs not included in the AHRQ review, adverse events were reported for 1945 of 5862 patients who were treated.[60] The investigators identified 24 cases of hypoglycemia and 2 cases of hypoglycemic seizures among 3766 patients who were treated with propranolol from their literature review (some of whom are included in aforementioned studies). Of the 14 events with resolution details, 9 led to dose adjustment or temporary discontinuation of propranolol, and 1 led to permanent discontinuation of treatment. The authors mention that 1 case of hypoglycemic seizure was related to overdose, and the other was associated with diminished oral intake because of infection.[60]

Although the risk of hypoglycemia must be considered when prescribing oral propranolol for IHs, routine glucose screening is not indicated.[1,61] Hypoglycemia occurs infrequently and can be minimized with appropriate education of caregivers on the importance of administering propranolol during or immediately after a feeding and of temporarily withdrawing therapy during periods of fasting (including poor oral intake because of illness or before general anesthesia) or vomiting.[60] Prolonged fasting should be avoided, and parents should be advised that hypoglycemia becomes more likely after ≥8 hours of fasting in infants and young children.[83,84]

Key Action Statement 3D (Table 15)

Clinicians should evaluate patients for and educate caregivers about potential adverse effects of propranolol, including sleep disturbances, bronchial irritation, and clinically symptomatic bradycardia and hypotension (grade X, strong recommendation).

The purpose of this statement is to increase awareness of potential propranolol-associated adverse effects other than hypoglycemia for clinicians

and caregivers of patients receiving this medical therapy for IHs. Propranolol has been used in pediatric patients for decades, primarily in an off-label fashion. In young infants, is has been used primarily for cardiac disorders and for the treatment of thyrotoxicosis at doses up to 6 to 8 mg/kg per day. Despite this use, many pediatricians will be unfamiliar with the drug, and reviewing its possible adverse effects is warranted.

As noted in the discussion of KAS 3C, the AHRQ review identified a number of adverse effects during propranolol treatment. Adverse effects most frequently reported included sleep disturbances, cold extremities, gastrointestinal symptoms, bronchial irritation (classified as hyperreactivity, bronchospasm, bronchiolitis, and cold-induced wheezing), and a decrease in heart rate or blood pressure. Rates of clinically important harms (hypoglycemia, hypotension, bradycardia, and bronchospasm) varied widely across the studies, and the authors assigned a moderate SOE for the association of propranolol with both clinically important and minor harms (with high study limitations).[46] Overall, harms did not cause treatment discontinuation.

Our additional review yielded 8 reports that met inclusion criteria for harms of interventions. Sleep disturbance, sleeping disorders, agitation during the night, and nightmares or night terrors were mentioned in 6 of 8 reports and occurred in 2% to 18.5% of patients who were treated.[80,82,85,86,89,90] In 3 of these 6 reports, propranolol treatment was modified (reduction in dosage, earlier-evening dosing, and early discontinuation of therapy) in response to these effects.[80,82,85]

In 4 reports, possible respiratory adverse effects were mentioned, including labored breathing in 0.9%,[86] breathing-related problems in 11.5%,[89] respiratory disorders in 3.4%,[80] and wheezing or bronchiolitis in 12.9%.[82] In 3 of these series treatment modifications in response to the respiratory events were mentioned, including temporary discontinuation of therapy[80,82] and decreased dosage of propranolol.[89]

TABLE 15 Key Action Statement 3D: Clinicians should evaluate patients for and educate caregivers about potential adverse effects of propranolol, including sleep disturbances, bronchial irritation, and clinically symptomatic bradycardia and hypotension (grade X, strong recommendation).

Aggregate Evidence Quality	Grade X
Benefits	Recognition of adverse effects of propranolol treatment
Risks, harm, cost	Risk of caregivers declining medical therapy because of concern about potential adverse effects
Benefit-harm assessment	Benefits outweigh harms
Intentional vagueness	None
Role of patient preference	None
Exclusions	None
Strength	Strong recommendation
Key references	3,46,61,76,80,85–88

Although bradycardia and hypotension are known to accompany propranolol-associated β-receptor blockade, both tend to be mild and asymptomatic in children treated for IHs who have no preexisting cardiac comorbidities.[3,84,87,88,91–93] In the subcommittee's review, only 1 of the 8 reports mentioned hypotension or bradycardia as an adverse event, with 1 of 906 patients (0.1%) exhibiting bradycardia and 2 of 906 exhibiting asymptomatic hypotension.[80] The use of pretreatment electrocardiography (ECG) is controversial. Although this initially was advocated by some, several studies have revealed no actionable findings with continuous ECG monitoring, and researchers have questioned its value.[61,91] FDA guidelines for patient monitoring do not include routine ECG.[61] In their consensus recommendations, Drolet et al[61] suggest ECG screening only (1) in infants with a baseline heart rate below normal for age, (2) in infants with a family history of congenital heart conditions or arrhythmias or with a maternal history of connective tissue disease, or (3) when there is a history of arrhythmia or one is auscultated during examination. Currently, the FDA-approved administration guidelines mirror those used in the pivotal clinical trial, with a recommendation for in-office intermittent heart rate and blood pressure monitoring for 2 hours after the first dose of propranolol or for increasing the dose for infants 5 weeks' adjusted gestational age or older.[76] Monitoring for those who are younger or for those with other comorbidities should be individualized and may require brief hospitalization for medication initiation. These recommendations may change over time as more information becomes available now that the medication is in widespread use.

Theoretical concerns about adverse effects of propranolol on brain development have been raised. As a highly lipophilic β-blocker, propranolol has the ability to cross the blood brain barrier.[94] Adult studies have revealed impairments in short- and long-term memory, psychomotor function, and mood, and prenatal β-blockade has been associated with long-term cognitive impairment,[95,96] leading some to question the potential central nervous system effects of this agent when used to treat young children with IHs.[97,98] In the large prospective randomized propranolol trial conducted by Léauté-Labrèze et al,[76] no appreciable neurodevelopmental differences were noted between the propranolol-treated groups and the placebo group at week 96. Four other studies addressing development in infants treated with propranolol for

IHs have yielded conflicting results. In 2 case series (with a total of 272 patients), gross motor delay was reported in 4.8% to 6.9%.[99,100] In contrast, a case series of 141 patients found psychomotor delay in only 1 child, and a controlled trial of 82 children found no increase in the rate of developmental concerns as assessed by the Ages and Stages Questionnaire.[101,102] Although these latter studies are reassuring, further prospective psychometric studies of children treated with oral propranolol for IHs may be warranted.

Key Action Statement 3E (Table 16)

Clinicians may prescribe oral prednisolone or prednisone to treat IHs if there are contraindications or an inadequate response to oral propranolol (grade B, moderate recommendation).

The purpose of this statement is to highlight the utility of systemic corticosteroid therapy for IHs in certain settings, such as for patients in whom β-blocker therapy is contraindicated, poorly tolerated, or ineffective. Systemic therapy with corticosteroids was considered the standard of care for several decades before being supplanted by oral propranolol.

In the AHRQ review, oral steroids had a mean estimate of expected clearance of 43% (Table 12).[46,103] The AHRQ report identified 24 studies (3 RCTs, 1 cohort study, and 20 case series) reporting outcomes and/or harms after corticosteroid use in children with IHs. One RCT was judged as good, 1 as fair, and 1 as poor quality, and the cohort study was judged as fair quality (all case series were judged as poor quality for harms reporting). The steroids studied varied in terms of dose, type, route of administration, and patient ages. Children in steroid treatment arms typically had modest improvement in lesion size, but outcomes were difficult to compare given differences in scales. The optimal dosing of systemic corticosteroids for IHs remains unclear. Dose ranges of prednisone or prednisolone reported most frequently in the literature are between 2 and 5 mg/kg per day,[3,70,104–106] and most consider optimal dosing to be 2 to 3 mg/kg per day. Typical protocols include treating at full dose for 4 to 12 weeks followed by a gradual taper and completion of therapy by 9 to 12 months of age.[3,70,105,106] Some have advocated for shorter treatment durations (1–6 weeks), with multiple intermittent courses as needed.[107]

In the AHRQ review, steroids were consistently associated with clinically important harms, including Cushingoid appearance, infection, growth retardation, hypertension, and mood changes. The authors considered the SOE to be moderate for the association of steroids with clinically important harms.[46]

Key Action Statement 3F (Table 17)

Clinicians may recommend intralesional injection of triamcinolone and/or betamethasone to treat focal, bulky IHs during proliferation or in certain critical anatomic locations (eg, the lip) (grade B, moderate recommendation).

The purpose of this statement is to highlight the utility of intralesional corticosteroid injection for certain IH subsets. Numerous studies have reported success in the use of steroid injections for IHs, demonstrating it to be safe and effective.[108–114] This modality is most often reserved for IHs that are relatively small and well localized where proliferation is resulting in increased bulk and threatening anatomic landmarks (eg, the lip or nose). Larger or more extensive lesions are poorer candidates for this treatment modality given the larger volume of steroids necessary (and the inherent systemic risks), the difficulty of obtaining even distribution throughout the tumor, and the potential for local complications in lesions that are mostly flat or superficial.[3] Most studies have used triamcinolone either alone or in conjunction with betamethasone, with injections given on average every 4 to 6 weeks (but with wide variability). Repeat injections are often administered, with the number used ranging in most reports from 1 to 7.[109–112]

The AHRQ review found that intralesional triamcinolone had a mean estimate of expected clearance of 58% (Table 12).[46,103] Overall, the SOE was low for intralesional steroids having a modest effect relative to control, with wide confidence bounds.[46] The subcommittee's additional search yielded 1 report that met inclusion criteria for benefits of interventions as a comparative study. This was a retrospective review of patients with periocular IHs treated with oral propranolol, who were compared with a cohort treated with intralesional corticosteroid injection. Both groups showed a reduction in astigmatism over 12 months, and neither experienced significant adverse effects necessitating dose reduction or treatment cessation.[115] The authors concluded that oral propranolol (given its efficacy and safety profiles) has emerged as the treatment of choice for periocular IHs requiring therapy.[115]

Steroids (oral and intralesional forms were grouped together in the AHRQ harms analysis) were consistently associated with clinically important harms, including Cushingoid appearance, infection, growth retardation, hypertension, and mood changes. The authors considered the SOE to be moderate for the association of steroids with clinically important harms. The most commonly reported complications associated with intralesional steroid injection for IHs are transient Cushingoid features, failure to thrive, and local skin complications.[109–112] Local complications may include fat and/or dermal atrophy and pigmentary changes.[108–110] Adrenal suppression is infrequently reported in association with intralesional steroid injections but has been observed when large doses (eg, >4 mg/kg) have been administered.[116,117] There have been rare reports of central retinal artery embolization, usually after injection into IHs of the upper eyelid, likely related to high injection pressures and/or volumes.[118–121]

TABLE 16 Key Action Statement 3E: Clinicians may prescribe oral prednisolone or prednisone to treat IHs if there are contraindications or an inadequate response to oral propranolol (grade B, moderate recommendation).

Aggregate Evidence Quality	Grade B
Benefits	Modest benefit in IH clearance; medication cost is low
Risks, harm, cost	Clinically important harms; cost associated with the evaluation and treatment of adverse effects
Intentional vagueness	None
Benefit-harm assessment	Benefits outweigh harms
Role of patient preference	Shared decision-making regarding treatment
Exclusions	None
Strength	Moderate recommendation
Key references	46,70,103

TABLE 17 Key Action Statement 3F: Clinicians may recommend intralesional injection of triamcinolone and/or betamethasone to treat focal, bulky IHs during proliferation or in certain critical anatomic locations (eg, the lip) (grade B, moderate recommendation).

Aggregate Evidence Quality	Grade B
Benefits	Modest benefit in IH clearance
Risks, harm, cost	Clinically important harms; cost of medication, visits for injection; risk of anesthesia if used
Benefit-harm assessment	Benefits outweigh harms in selected clinical situations
Intentional vagueness	None
Role of patient preference	Shared decision-making regarding route of drug delivery
Exclusions	None
Strength	Moderate recommendation
Key references	3,46,103,108–112

Key Action Statement 3G (Table 18)

Clinicians may prescribe topical timolol maleate as a therapy for thin and/or superficial IHs (grade B, moderate recommendation).

The purpose of this statement is to highlight the potential utility of topical timolol in treating thin and/or superficial IHs. Topical timolol maleate, a nonselective β-adrenergic receptor inhibitor, has been used in the treatment of pediatric glaucoma as a first-line agent for several decades.[122,127,128] Treatment of IHs with ophthalmic timolol maleate was initially reported in 2010, and since that time, there have been many reports (including some with hundreds of patients), as well as an RCT, with positive findings. [40,122–125,129–134] On the basis of these reports showing efficacy with minimal adverse effects, timolol is increasingly being used for thin and superficial IHs, and many centers report that their use of timolol exceeds that of oral β-blockers.[135]

In the AHRQ review, 2 RCTs and 4 cohort studies were included. Topical timolol had a mean estimate of expected clearance of 62% (Table 12).[46,103] Timolol was significantly more effective than observation or a placebo in 3 studies; 1 study comparing topical imiquimod with timolol did not demonstrate superiority of either agent but was found to have insufficient SOE.[46] Our subsequent review found 3 further reports meeting criteria for efficacy, including 1study comparing timolol to an ultrapotent corticosteroid and 2 other studies of timolol alone.[40,133,134] In the largest of these, a multicenter retrospective cohort study of 731 patients, most infants were treated with the 0.5% gel-forming solution. The study reveal improvement in nearly 70% of patients treated for 1 to 3 months and in 92.3% of patients who received 6 to 9 months of therapy. The greatest improvement was in color; however, with a longer duration of treatment, improvement in size, extent, and volume were also observed. Best responses were observed in thinner superficial IHs (ie, <1 mm thick) versus mixed or deep IHs. The large majority of infants studied were 6 months or younger at time of initiation of treatment, and 41% were ≤3 months of age. This suggests that early topical timolol treatment may also inhibit IH growth. Only 7% of infants required subsequent treatment with a systemic β-blocker.[40]

Although pharmacokinetic data are limited, evidence suggests that timolol maleate can be detected in the blood or urine of at least some infants treated topically.[126,136] Additional pharmacokinetic studies are needed given occasional reports of systemic toxicity.[137–139] It should be noted that timolol is significantly more potent than propranolol, and topical application avoids first-pass liver metabolism, as would occur with an oral β-blocker.[127] Pending the results of ongoing studies, these factors should lead to caution when using timolol, especially if prescribing more than 1 drop twice daily or when treating preterm or young infants.

The AHRQ report emphasized that there were far more reports of harms with oral β-blockers than with timolol but did note 1 report of shortness of breath and insomnia.[46] Subsequent to that report, tolerability data have been reassuring overall, but some adverse events have been reported.[40,122,124,125,131–134,140] In the large cohort study of 731 patients conducted by Püttgen et al,[40] adverse events were noted in 3.4% of patients and included local irritation (nearly half of the adverse events) and bronchospasm (in 3 patients); no cardiovascular events were reported. No adverse events were significant enough to necessitate drug discontinuation.[40] In a retrospective case series of 30 children with ulcerated IHs treated with topical timolol maleate 0.5% gel-forming solution and evaluating for

TABLE 18 Key Action Statement 3G: Clinicians may prescribe topical timolol maleate as a therapy for thin and/or superficial IHs (grade B, moderate recommendation).

Aggregate Evidence Quality	Grade B
Benefit	Modest benefit in IH clearance
Harm	Low but possible risk of local irritation, sleep disturbance, cold extremities, bronchospasm, and bradycardia, with more caution needed in preterm infants and those without intact skin (ie, ulceration)
Cost	Cost of medication
Benefits-harm assessment	Benefits outweigh harms
Value judgments	None
Role of patient preference	Parents have a significant role in decision-making regarding the desire to treat small superficial lesions for which timolol may be effective
Intentional vagueness	None
Exclusions	Lesions that are large size, significantly elevated, or life-threatening
Strength	Moderate recommendation
Key references	40,46,85,122–126

adverse events, sleep disturbance was observed in 1 infant (who was treated simultaneously with oral propranolol and topical timolol) and a single episode of cold extremities was reported in another. The remainder had no reported adverse events.[141] Bradycardia, both symptomatic and asymptomatic, was reported in 4 of 22 young and preterm infants given timolol for IHs. Two infants had bradycardia that was mild and asymptomatic, but in 2 (both of whom were born preterm and weighed less than 2500 g at initiation of therapy) there were associated symptoms.[126] To address concerns regarding potential percutaneous absorption and toxicity, many authors have advocated using limited amounts of medication (eg, 1 drop 2–3 times per day),[40] and some have cautioned against application to ulcerated lesions.[127]

SURGICAL MANAGEMENT

Key Action Statement 4 (Table 19)

Clinicians may recommend surgery and laser therapy as treatment options in managing selected IHs (grade C, moderate recommendation).

The purpose of this statement is to support surgery and laser therapy as treatment options for selected IHs, although it is recommended that decisions regarding their use should be made in consultation with a hemangioma specialist, especially in young infants. With the advent of β-blocker therapy, surgical and laser approaches are used less frequently.

In general, surgical interventions are not performed in infancy. During this time, anesthetic risks are of greater concern, and the tumor is highly vascular, posing a higher risk of blood loss, iatrogenic injury, and an inferior outcome.[142,143,145]

In certain locations, such as the lip and nasal tip, the final cosmetic result is superior when growth of the lesion has ceased and the number of surgical interventions can be kept to a minimum. Furthermore, there is no psychosocial urgency to improve a deformity caused by IHs in this age group because long-term memory and self-esteem are not established until later in childhood.[143,146–148] There are certain clinical situations, however, in which early surgery can be an important treatment option. These include IHs that ulcerate, obstruct or deform vital structures (such as the airway or orbit), or involve aesthetically sensitive areas. In these circumstances, surgery may be indicated when (1) the lesion has failed to improve with local wound care and/or pharmacotherapy; (2) the lesion is well localized, and early surgery will simplify later reconstruction (eg, a prominent IH involving the ear or eyelid [causing ptosis]); (3) the lesion is well localized in an anatomically favorable area; or (4) resection is likely to be necessary in the future, and the resultant scar would be the same.[142,143,145] The decision to undertake surgery during infancy should take into consideration current knowledge of the risks of general anesthesia in this age group.[53–55]

Surgery also is an important treatment option for IHs that, despite involution, have left residual skin changes (eg, thinned skin, scar, fibrofatty tissue, telangiectasias, and/or anatomic deformities in areas such as the nose, ear, or lip).[19,20,143] In most cases, deferring surgery until the child is 3 to 5 years of age is reasonable because: (1) the lesion may resolve significantly without leaving a deformity that necessitates intervention; (2) the tumor is smaller than it was during infancy, and thus, the operation is often easier, and the resultant scar may be smaller; and (3) the IH primarily is adipose tissue instead of blood vessels, and thus, the operation is safer.[142,143,145] However, it is usually unnecessary to wait longer than 3 to 5 years of age because the previously accepted adage that 50% of IHs complete involution by 5 years of age, 70% by 7 years of age, and 90% by 9 years of age has proven to be incorrect.[19,143,149] In fact, most IHs do not improve significantly after 3 to 4 years of age.[20,143] Moreover, performing surgery at this earlier age can be beneficial in minimizing stigma and impact on a child's self-esteem.[143] There is less urgency to correct a residual deformity in an area that is concealed by clothing (eg, a lesion on the trunk). Some parents may elect to wait until the child is older and able to help in decision-making, especially if the reason for surgery is the management of less disfiguring skin changes.[143]

Laser Management

PDL has been used for several decades to treat IHs. The AHRQ review noted that most studies that were reviewed

TABLE 19 Key Action Statement 4: Clinicians may recommend surgery and laser therapy as treatment options in managing selected IHs (grade C, moderate recommendation).

Aggregate Evidence Quality	Grade C
Benefits	Early surgical intervention after infancy corrects residual deformities before the child's self-esteem develops
Risks, harm, cost	Risk of surgical complications and general anesthesia; costs associated with operative intervention, anesthesia, and postoperative care
Benefits-harm assessment	Preponderance of benefit
Intentional vagueness	None
Role of patient preference	Significant
Exclusions	Children with a nonproblematic IH
Strength	Moderate recommendation
Key references	20,142–144

evaluated PDL (as opposed to other lasers) and examined heterogeneous end points (the latter factor limiting the ability to draw conclusions). However, there is low SOE that PDL is more effective in reducing IH size when compared with observation.[46] There is evidence that PDL is superior to other lasers. In contrast, there is wide recognition that PDL is effective and safe in removing residual macular erythema and superficial telangiectasias in involuting or involuted IHs, but it often requires several treatments to achieve optimal results.[1,142] Other lasers, such as erbium-yttrium-aluminum-garnet, have been reportedly effective in ameliorating textural changes in small case series.[150] Harms associated with laser therapy that were identified in the AHRQ review included skin atrophy, bleeding, scarring, ulceration, purpura, and pigmentation changes.[46] The AHRQ review also noted that most studies of lasers reviewed evaluated lasers as a first-line treatment, a practice that is less common since the advent of β-blocker treatment.

There is controversy regarding whether PDL should be used to treat IHs early in infancy (ie, during the proliferative phase). Several case reports and case series have revealed an increased risk of ulceration, scarring, and hypopigmentation when PDL is used during this period.[1,144,151] Moreover, PDL penetrates only into the superficial dermis, and thus, although redness may be diminished, deeper elements of the IH (that increase the risk of residual skin changes) are not affected.[144,152,153]

Some authors advocate for using PDL as a treatment of ulceration. However, evidence supporting the use of PDL for this indication comes from case reports and small case series. Propranolol has been associated with faster healing of ulceration when compared with laser therapy and antibiotics.[46]

PARENT EDUCATION

Key Action Statement 5 (Table 20)

Clinicians should educate parents of infants with an IH about the condition, including the expected natural history, and its potential for causing complications or disfigurement (grade X, strong recommendation).

The purpose of this statement is to ensure that parents are knowledgeable about their child's IH and to provide clinicians with a framework for educating those parents about IHs. The information provided by clinicians should be as specific to the patient's IH as possible (eg, indicating whether and why an IH is low risk and, thus, likely to cause no problems or sequelae or is potentially high risk and requires urgent evaluation or treatment; Table 3, illustrated in Figs 2–4, Supplemental Table 22, and Supplemental Fig 11).

IHs That Do Not Raise Concern

In a primary care setting, the majority of IHs are not problematic and require no active intervention (ie, are low risk; Supplemental Table 22, Supplemental Fig 11). However, given their appearance, even nonproblematic (that is, low-risk) IHs may cause significant parental anxiety and concern. These emotions may be amplified by information gleaned from Internet searches that show photographs emphasizing the more severe end of the disease spectrum as well as public reactions to the child's IH if the lesion is located at a site not easily covered by clothing.[42,155,156] Formal educational efforts can reduce parental anxiety and enhance comfort with a plan to observe the IH for any unexpected or worrisome changes.[154]

Parents should be educated about the natural history of IHs. Specifically, they may be advised that, although growth characteristics vary from case to case, most superficial IHs have a maximum growth potential between 1 and 3 months of age[3,21,157] and that the majority of growth is complete by 5 months of age.[22] Deeper IHs may have a slightly later onset and a more prolonged duration of growth. During the period of growth, clinicians should encourage parents to call, schedule an office visit, or share photographs of the IH with them to reassess if concerns exist about the lesion's appearance, unexpectedly rapid growth, ulceration, bleeding, or pain, all findings that indicate that a lesion is no longer low risk.

Parents should be advised that by age 5 to 12 months, most IHs have stopped growing and are beginning to involute. For IHs with a superficial component, this appears as a gradual change in color from red to milky-white or gray. Lesions gradually flatten and shrink from the center outward. Involution proceeds more slowly than growth. Newer studies have demonstrated that 90% of IH involution is complete by 4 years of age.[20,143] This

is in contrast to traditional teaching that involution proceeds at 10% per year (ie, 50% of IHs resolve by 5 years of age and 90% by 9 years of age). Parents should be advised that even after involution, residual changes, such as telangiectasias, redundant skin, or a scar,[3,19] may be left. It is usually possible to tell whether such changes are going to persist by 4 years of age, and if concerning, consultation for management of these skin changes, particularly laser or surgical treatment, may be pursued.

A collection of serial photographs can be useful to demonstrate to parents the natural history of IHs and the process of spontaneous involution.[154] Such photos are available on the Hemangioma Investigator Group (https://hemangiomaeducation.org/) and Yale Dermatology (http://medicine.yale.edu/dermatology/patient/conditions/hemangioma.aspx) Web sites. Information sheets (ie, handouts) are available from the Society for Pediatric Dermatology Web site (http://pedsderm.net/) under the "For Patients and Families" tab, and adapted versions of their hemangioma patient information and propranolol sheets are included in the What Are Hemangiomas? Propranolol for Hemangiomas, and Medication Information sections of the Supplemental Information. A video for parents is also available on the Society for Pediatric Dermatology Web site (https://pedsderm.net/for-patients-families/patient-education-videos/#InfantileHemangiomas). Information also is available from the AHRQ (https://effectivehealthcare.ahrq.gov/topics/infantile-hemangioma/consumer/),[158] and answers to frequently asked questions are available on the Hemangioma Investigator Group and Yale Dermatology Web sites.

TABLE 20 Key Action Statement 5: Clinicians should educate parents of infants with an IH about the condition, including the expected natural history, and its potential for causing complications or disfigurement (grade X, strong recommendation).

Aggregate Evidence Quality	Grade X
Benefits	Promotes parent satisfaction and understanding, may reduce medication errors, may improve clinical outcomes
Risks, harm, cost	May increase parental anxiety because of the need to administer medication; time spent in education, may increase health care costs because of the need for follow-up visits
Benefit-harm assessment	Benefits outweigh harms
Intentional vagueness	None
Role of parental preferences	Essential; shared decision-making regarding the need for treatment is vital
Exclusions	None
Strength	Strong recommendation
Key references	21,22,154

IHs That May Be Problematic

When confronted with a potentially problematic IH (ie, high risk; Table 3; illustrated in Figs 2–4, Supplemental Table 22, and Supplemental Fig 11), primary care clinicians are encouraged to consult promptly with a hemangioma specialist unless they have the experience and knowledge to manage such patients independently. Because IH proliferation may occur early and be unpredictable and because there is a window of opportunity for optimal treatment, caregivers can be advised that consultation should take place in a timely manner. Unfortunately, this does not always occur. Although caregivers first notice lesions by 1 month of age (on average, at 2 weeks) and the ideal time for consultation may be 4 weeks of age, 1 study found that the mean age at presentation to a dermatologist was 5 months, by which time most growth is complete.[21,22]

Recognizing that it may be difficult to obtain an appointment with a hemangioma specialist in a timely manner, caregivers and clinicians may need to advocate on behalf of the infant. In settings where a hemangioma specialist is not readily available, telemedicine triage or consultation, using photographs taken by caregivers or the clinician, can be helpful. In 1 academic center in Spain, teledermatology triage reduced the age at first evaluation of an infant with an IH from 5.9 to 3.5 months.[159]

Once the hemangioma specialist has an opportunity to meet with parents and evaluate the infant, a discussion about management can take place. If medical treatment is recommended, the specialist will educate parents about the medication and its dosing, its possible adverse effects, and the expected duration of treatment. If the medication selected is propranolol, as often is the case, a patient information sheet (such as that developed by the Society for Pediatric Dermatology or that provided in the What Are Hemangiomas? and Propranolol for Hemangiomas sections of the Supplemental Information) or information from the article by Martin et al[160] may be provided. For families unable to travel to see a hemangioma specialist, collaborative care may be considered. The hemangioma specialist can evaluate serial photographs and provide the primary care clinician with guidance on treatment. In this case, the primary care clinician will assume a more active role in parent education.

CHALLENGES TO IMPLEMENTING THIS CPG

Several potential challenges exist to implementing this CPG. The first is the dynamic nature of individual IHs with a period of rapid growth, the degree of which can be difficult to predict, particularly in young infants. There are no surrogate markers or imaging studies that have been shown to reliably predict growth. Hence, frequent

in-person visits or a review of parental photos may be needed, especially in infants younger than 3 to 4 months. However, this may be complicated by the frequency and timing of well-child visits during this period. After the first-week visit, an infant who is well, has regained birth weight, and has parents who are experienced caregivers may not be seen again until 2 months of age. As noted by Tollefson and Frieden,[21] most superficial IHs have accelerated growth between 5 and 7 weeks of age, and 4 weeks of age may be the ideal time for referral if high-risk features are present. Thus, the most dramatic IH growth (and potentially permanent skin changes) may occur during a time when an infant is not scheduled to see a health care provider. Although awareness of this issue does not justify altering the interval of well-child visits for all infants, it heightens the need for more frequent monitoring in those with possible or definite IHs. Prompt evaluation, either in-person or via photographs, is warranted for any infant reported by parents to have a changing birthmark during the first 2 months of life.

A second challenge is the wide heterogeneity of IHs in terms of size, location, patterns of distribution (ie, segmental versus localized), and depth (ie, superficial, mixed, or deep). This heterogeneity, particularly when combined with the unpredictable growth of any given IH, may lead to uncertainty in management (ie, whether to treat or observe). Although this CPG provides guidance regarding risk stratification and growth characteristics, there is no one-size-fits-all approach. If uncertainty exists, consultation with a hemangioma specialist (whether by an in-person visit or photographic triage) can be helpful.

A third challenge is the long-held tenet that IHs are benign and go away. Because of this myth, parents and caregivers are often reassured that the lesion will disappear, and this is accurate in the vast majority of cases. However, there is ample evidence that false reassurance can be given even in high-risk cases; indeed, all hemangioma specialists have seen examples of lost opportunities to intervene and prevent poor outcomes because of lack of or delayed referral. The availability of highly effective treatments for IHs makes it critical that this myth is debunked and that practitioners become more comfortable with the concept of identifying high-risk IHs that require close observation or prompt intervention.

Last, some geographical locations lack access to prompt specialty care from hemangioma specialists. Lack of access can also result in delays in referrals or prompt appointments. Possible solutions could include establishing resources for the photographic triage of cases in which risk stratification is uncertain or in which triage to hasten referral can be augmented by this methodology.

EVIDENCE GAPS AND PROPOSED FUTURE DIRECTIONS

The proportion of IHs in primary care settings that are truly high risk is not known. Even in a referral setting, the proportions needing active intervention vary depending on referral patterns.[3,161] This information would be useful to pediatricians and other primary care providers and should be the subject of future research.

Scoring systems for IH severity have been proposed, and one in particular, the Hemangioma Severity Score, has gained some favor as a triage tool.[162–164] However, more research is needed to ensure that it can accurately be interpreted by primary care physicians and to find scores that capture the vast majority of high-risk IHs requiring specialty care without overreferring.

Other important evidence gaps should be highlighted, including the following:

- How safe is topical timolol as a treatment during early infancy, and which patients being treated with the drug need referral versus which can be observed without referral by the pediatrician?
- Is outpatient in-office cardiovascular monitoring for propranolol truly needed in healthy infants 5 weeks or older? Is blood pressure monitoring necessary, or is measuring heart rate sufficient?
- What is the role of the pediatrician in managing infants placed on β-blocker therapies (both topical and systemic), and are there specific time frames for specialty reevaluation?
- How accurate are primary care physicians in identifying high-risk IHs using parameters such as those outlined in this CPG?
- Are pediatric trainees receiving adequate training in risk stratification and management of IHs?

Some of these questions may be answered by research that is currently underway. Other studies will be needed to identify and remedy remaining gaps. Moreover, because there has been a tremendous accrual of information about IH management, there will need to be periodic updates as new information becomes available (and possibly sooner than the 5 years typical for CPGs). With such ongoing reassessment and revision, the subcommittee hopes this CPG will be viewed as an effective guide to IH triage and management and to minimize poor outcomes from higher-risk IHs. One barrier to a better understanding of IHs and to answering the questions posed here is the imprecision of current diagnostic codes. For example, the *International Classification of Diseases, 10th Revision* code for "hemangioma of the skin and subcutaneous tissues" is not specific to IHs and can include other entities (eg, congenital hemangioma and verrucous hemangioma) that are not IHs. In addition, current diagnostic codes do not contain sufficient detail to permit appreciation of higher-risk features, such as location or multifocality. Advocacy for the creation of a unique and exclusive *International*

Classification of Diseases, 10th Revision code (and appropriate modifiers) for IHs would be an appropriate step in addressing this issue.

Implementation tools for this guideline are available on the AAP Web site at https://www.aap.org/en-us/professional-resources/quality-improvement/Pages/default.aspx (this may leave or stay depending on the Digital Transformation Initiative). A useful resource for clinicians is the AAP Web page, "Diagnosis and Management of Infantile Hemangiomas" (https://www.aap.org/en-us/advocacy-and-policy/aap-health-initiatives/Infantile-Hemangiomas/Pages/default.aspx).

LEAD AUTHORS

Daniel P. Krowchuk, MD, FAAP
Ilona J. Frieden, MD, FAAP
Anthony J. Mancini MD, FAAP
David H. Darrow, MD, DDS, FAAP
Francine Blei, MD, MBA, FAAP
Arin K. Greene, MD, FAAP
Aparna Annam, DO, FAAP
Cynthia N. Baker, MD, FAAP
Peter C. Frommelt, MD
Amy Hodak, CPMSM
Brian M. Pate, MD, FHM, FAAP
Janice L. Pelletier, MD, FAAP
Deborah Sandrock, MD, FAAP
Stuart T. Weinberg, MD, FAAP
Mary Anne Whelan, MD, PhD, FAAP

SUBCOMMITTEE ON THE MANAGEMENT OF INFANTILE HEMANGIOMAS (OVERSIGHT BY THE COUNCIL ON QUALITY IMPROVEMENT AND PATIENT SAFETY)

Daniel P. Krowchuk, MD, FAAP, Chairperson, General Pediatrics and Adolescent Medicine
Ilona Frieden, MD, FAAP, Vice Chairperson, Pediatric Dermatology
Aparna Annam, DO, FAAP, Pediatric Radiology
Cynthia N. Baker, MD, FAAP, General Pediatrics
Francine Blei, MD, MBA, FAAP, Pediatric Hematology-Oncology
David H. Darrow, MD, DDS, FAAP, Otolaryngology Head and Neck Surgery
Peter C. Frommelt, MD, Pediatric Cardiology
Arin K. Greene, MD, FAAP, Plastic Surgery
Amy Hodak, CPMSM, Family Representative
Anthony J. Mancini, MD, FAAP, Pediatric Dermatology
Brian M. Pate, MD, FHM, FAAP, Implementation Scientist
Janice L. Pelletier, MD, FAAP, General Pediatrics
Deborah Sandrock, MD, FAAP, General Pediatrics
Stuart T. Weinberg, MD, FAAP, Partnership for Policy Implementation Representative
Mary Anne Whelan, MD, PhD, FAAP, Epidemiologist and Methodologist

STAFF

Kymika Okechukwu, MPA, Senior Manager, Evidence-Based Medicine Initiatives

ABBREVIATIONS

AAP: American Academy of Pediatrics
AHRQ: Agency for Healthcare Research and Quality
CPG: clinical practice guideline
ECG: electrocardiography
FDA: Food and Drug Administration
IH: infantile hemangioma
IH-MAG: infantile hemangioma with minimal or arrested growth
KAS: key action statement
LUMBAR: lower body infantile hemangiomas and other cutaneous defects, urogenital anomalies and ulceration, myelopathy, bony deformities, anorectal malformations, and arterial anomalies and renal anomalies
MRA: magnetic resonance angiography
PDL: pulsed-dye laser
PHACE: posterior fossa defects, hemangiomas, cerebrovascular arterial anomalies, cardiovascular anomalies (including coarctation of the aorta), and eye anomalies
RCT: randomized controlled trial
SOE: strength of evidence

DOI: https://doi.org/10.1542/peds.2018-3475

Address correspondence to Daniel P. Krowchuk, MD, FAAP. E-mail: krowchuk@wakehealth.edu

PEDIATRICS (ISSN Numbers: Print, 0031-4005; Online, 1098-4275).

FINANCIAL DISCLOSURE: Dr Frieden is a member of the Data Monitoring Safety Board for Pfizer and the Scientific Advisory Board for Venthera/Bridge Bio; Dr Mancini has indicated that he has advisory board relationships with Verrica, Valeant, and Pfizer; the other authors have indicated they have no financial relationships relevant to this article to disclose.

FUNDING: No external funding.

POTENTIAL CONFLICT OF INTEREST: The authors have indicated they have no potential conflicts of interest to disclose.

REFERENCES

1. Hoeger PH, Harper JI, Baselga E, et al. Treatment of infantile haemangiomas: recommendations of a European expert group. *Eur J Pediatr*. 2015;174(7):855–865
2. Smithson SL, Rademaker M, Adams S, et al. Consensus statement for the treatment of infantile haemangiomas with propranolol. *Australas J Dermatol*. 2017;58(2):155–159
3. Darrow DH, Greene AK, Mancini AJ, Nopper AJ; Section on Dermatology; Section on Otolaryngology–Head and Neck Surgery; Section on Plastic Surgery. Diagnosis and management of infantile hemangioma. *Pediatrics*. 2015;136(4). Available at: www.pediatrics.org/cgi/content/full/136/4/e1060
4. Agency for Healthcare Research and Quality. Effective health care program.

Available at: www.effectivehealthcare.ahrq.gov/reports/final.cfm. Accessed February 6, 2018

5. Haggstrom AN, Garzon MC, Baselga E, et al. Risk for PHACE syndrome in infants with large facial hemangiomas. *Pediatrics*. 2010;126(2). Available at: www.pediatrics.org/cgi/content/full/126/2/e418
6. Orlow SJ, Isakoff MS, Blei F. Increased risk of symptomatic hemangiomas of the airway in association with cutaneous hemangiomas in a "beard" distribution. *J Pediatr*. 1997;131(4):643–646
7. Kulungowski AM, Alomari AI, Chawla A, Christison-Lagay ER, Fishman SJ. Lessons from a liver hemangioma registry: subtype classification. *J Pediatr Surg*. 2012;47(1):165–170
8. Rialon KL, Murillo R, Fevurly RD, et al. Risk factors for mortality in patients with multifocal and diffuse hepatic hemangiomas. *J Pediatr Surg*. 2015;50(5):837–841
9. Huang SA, Tu HM, Harney JW, et al. Severe hypothyroidism caused by type 3 iodothyronine deiodinase in infantile hemangiomas. *N Engl J Med*. 2000;343(3):185–189
10. Horii KA, Drolet BA, Frieden IJ, et al; Hemangioma Investigator Group. Prospective study of the frequency of hepatic hemangiomas in infants with multiple cutaneous infantile hemangiomas. *Pediatr Dermatol*. 2011;28(3):245–253
11. Rialon KL, Murillo R, Fevurly RD, et al. Impact of screening for hepatic hemangiomas in patients with multiple cutaneous infantile hemangiomas. *Pediatr Dermatol*. 2015;32(6):808–812
12. Jockin YM, Friedlander SF. Periocular infantile hemangioma. *Int Ophthalmol Clin*. 2010;50(4):15–25
13. Schwartz SR, Blei F, Ceisler E, Steele M, Furlan L, Kodsi S. Risk factors for amblyopia in children with capillary hemangiomas of the eyelids and orbit. *J AAPOS*. 2006;10(3):262–268
14. Chamlin SL, Haggstrom AN, Drolet BA, et al. Multicenter prospective study of ulcerated hemangiomas [published correction appears in *J Pediatr*. 2008;152(4):597]. *J Pediatr*. 2007;151(6):684–689, 689.e1
15. Connelly EA, Viera M, Price C, Waner M. Segmental hemangioma of infancy complicated by life-threatening arterial bleed. *Pediatr Dermatol*. 2009;26(4):469–472
16. Garzon MC, Epstein LG, Heyer GL, et al. PHACE syndrome: consensus-derived diagnosis and care recommendations. *J Pediatr*. 2016;178:24–33.e2
17. Iacobas I, Burrows PE, Frieden IJ, et al. LUMBAR: association between cutaneous infantile hemangiomas of the lower body and regional congenital anomalies. *J Pediatr*. 2010;157(5):795–801.e1–e7
18. Shah SD, Baselga E, McCuaig C, et al. Rebound growth of infantile hemangiomas after propranolol therapy. *Pediatrics*. 2016;137(4):e20151754
19. Bauland CG, Lüning TH, Smit JM, Zeebregts CJ, Spauwen PH. Untreated hemangiomas: growth pattern and residual lesions. *Plast Reconstr Surg*. 2011;127(4):1643–1648
20. Baselga E, Roe E, Coulie J, et al. Risk factors for degree and type of sequelae after involution of untreated hemangiomas of infancy. *JAMA Dermatol*. 2016;152(11):1239–1243
21. Tollefson MM, Frieden IJ. Early growth of infantile hemangiomas: what parents' photographs tell us. *Pediatrics*. 2012;130(2). Available at: www.pediatrics.org/cgi/content/full/130/2/e314
22. Chang LC, Haggstrom AN, Drolet BA, et al; Hemangioma Investigator Group. Growth characteristics of infantile hemangiomas: implications for management. *Pediatrics*. 2008;122(2):360–367
23. Suh KY, Frieden IJ. Infantile hemangiomas with minimal or arrested growth: a retrospective case series. *Arch Dermatol*. 2010;146(9):971–976
24. Luu M, Frieden IJ. Haemangioma: clinical course, complications and management. *Br J Dermatol*. 2013;169(1):20–30
25. Shikhani AH, Jones MM, Marsh BR, Holliday MJ. Infantile subglottic hemangiomas. An update. *Ann Otol Rhinol Laryngol*. 1986;95(4, pt 1):336–347
26. Bitar MA, Moukarbel RV, Zalzal GH. Management of congenital subglottic hemangioma: trends and success over the past 17 years. *Otolaryngol Head Neck Surg*. 2005;132(2):226–231
27. Uthurriague C, Boccara O, Catteau B, et al. Skin patterns associated with upper airway infantile haemangiomas: a retrospective multicentre study. *Acta Derm Venereol*. 2016;96(7):963–966
28. Sherrington CA, Sim DK, Freezer NJ, Robertson CF. Subglottic haemangioma. *Arch Dis Child*. 1997;76(5):458–459
29. Sie KC, McGill T, Healy GB. Subglottic hemangioma: ten years' experience with the carbon dioxide laser. *Ann Otol Rhinol Laryngol*. 1994;103(3):167–172
30. Horii KA, Drolet BA, Baselga E, et al; Hemangioma Investigator Group. Risk of hepatic hemangiomas in infants with large hemangiomas. *Arch Dermatol*. 2010;146(2):201–203
31. Drolet BA, Pope E, Juern AM, et al. Gastrointestinal bleeding in infantile hemangioma: a complication of segmental, rather than multifocal, infantile hemangiomas. *J Pediatr*. 2012;160(6):1021–1026.e3
32. Viswanathan V, Smith ER, Mulliken JB, et al. Infantile hemangiomas involving the neuraxis: clinical and imaging findings. *AJNR Am J Neuroradiol*. 2009;30(5):1005–1013
33. von Noorden GK. Application of basic research data to clinical amblyopia. *Ophthalmology*. 1978;85(5):496–504
34. Dubois J, Milot J, Jaeger BI, McCuaig C, Rousseau E, Powell J. Orbit and eyelid hemangiomas: is there a relationship between location and ocular problems? *J Am Acad Dermatol*. 2006;55(4):614–619
35. Frank RC, Cowan BJ, Harrop AR, Astle WF, McPhalen DF. Visual development in infants: visual complications of periocular haemangiomas. *J Plast Reconstr Aesthet Surg*. 2010;63(1):1–8
36. Yan AC. Pain management for ulcerated hemangiomas. *Pediatr Dermatol*. 2008;25(6):586–589
37. Thomas MW, Burkhart CN, Vaghani SP, Morrell DS, Wagner AM. Failure to thrive in infants with complicated facial hemangiomas. *Pediatr Dermatol*. 2012;29(1):49–52

38. Shin HT, Orlow SJ, Chang MW. Ulcerated haemangioma of infancy: a retrospective review of 47 patients. *Br J Dermatol*. 2007;156(5):1050–1052

39. Frieden IJ, Reese V, Cohen D. PHACE syndrome. The association of posterior fossa brain malformations, hemangiomas, arterial anomalies, coarctation of the aorta and cardiac defects, and eye abnormalities. *Arch Dermatol*. 1996;132(3):307–311

40. Püttgen K, Lucky A, Adams D, et al; Hemangioma Investigator Group. Topical timolol maleate treatment of infantile hemangiomas. *Pediatrics*. 2016;138(3):e20160355

41. Jacobs AH. Strawberry hemangiomas; the natural history of the untreated lesion. *Calif Med*. 1957;86(1):8–10

42. Tanner JL, Dechert MP, Frieden IJ. Growing up with a facial hemangioma: parent and child coping and adaptation. *Pediatrics*. 1998;101 (3, pt 1):446–452

43. Fay A, Nguyen J, Waner M. Conceptual approach to the management of infantile hemangiomas. *J Pediatr*. 2010;157(6):881–888.e1–e5

44. O TM, Scheuermann-Poley C, Tan M, Waner M. Distribution, clinical characteristics, and surgical treatment of lip infantile hemangiomas. *JAMA Facial Plast Surg*. 2013;15(4):292–304

45. Ma EH, Robertson SJ, Chow CW, Bekhor PS. Infantile hemangioma with minimal or arrested growth: further observations on clinical and histopathologic findings of this unique but underrecognized entity. *Pediatr Dermatol*. 2017;34(1):64–71

46. Chinnadurai S, Snyder K, Sathe N, et al. *Diagnosis and Management of Infantile Hemangioma*. Rockville, MD: Agency for Healthcare Research and Quality; 2016

47. Menapace D, Mitkov M, Towbin R, Hogeling M. The changing face of complicated infantile hemangioma treatment. *Pediatr Radiol*. 2016;46(11):1494–1506

48. Bessis D, Bigorre M, Labrèze C. Reticular infantile hemangiomas with minimal or arrested growth associated with lipoatrophy. *J Am Acad Dermatol*. 2015;72(5):828–833

49. Dickie B, Dasgupta R, Nair R, et al. Spectrum of hepatic hemangiomas: management and outcome. *J Pediatr Surg*. 2009;44(1):125–133

50. Rotter A, Samorano LP, de Oliveira Labinas GH, et al. Ultrasonography as an objective tool for assessment of infantile hemangioma treatment with propranolol. *Int J Dermatol*. 2017;56(2):190–194

51. Mamlouk MD, Hess CP. Arterial spin-labeled perfusion for vascular anomalies in the pediatric head and neck. *Clin Imaging*. 2016;40(5):1040–1046

52. Aggarwal N, Tekes A, Bosemani T. Infantile hepatic hemangioma: role of dynamic contrast-enhanced magnetic resonance angiography. *J Pediatr*. 2015;167(4):940–940.e1

53. US Food and Drug Administration. FDA drug safety communications: FDA review results in new warnings about using general anesthetics and sedation drugs in young children and pregnant women. 2016. Available at: www.fda.gov/downloads/Drugs/DrugSafety/UCM533197.pdf. Accessed September 10, 2018

54. American Society of Anesthesiologists. ASA response to the FDA med watch warning - December 16, 2016. 2016. Available at: https://www.asahq.org/advocacy-and-asapac/fda-and-washington-alerts/washington-alerts/2016/12/asa-response-to-the-fda-med-watch. Accessed September 10, 2018

55. Practice advisory on anesthetic care for magnetic resonance imaging: an updated report by the American Society of Anesthesiologists Task Force on Anesthetic Care for Magnetic Resonance Imaging. *Anesthesiology*. 2015;122(3):495–520

56. Drolet BA, Chamlin SL, Garzon MC, et al. Prospective study of spinal anomalies in children with infantile hemangiomas of the lumbosacral skin. *J Pediatr*. 2010;157(5):789–794

57. Schumacher WE, Drolet BA, Maheshwari M, et al. Spinal dysraphism associated with the cutaneous lumbosacral infantile hemangioma: a neuroradiological review. *Pediatr Radiol*. 2012;42(3):315–320

58. Yu J, Maheshwari M, Foy AB, Calkins CM, Drolet BA. Neonatal lumbosacral ulceration masking lumbosacral and intraspinal hemangiomas associated with occult spinal dysraphism. *J Pediatr*. 2016;175:211–215

59. Léauté-Labrèze C, Dumas de la Roque E, Hubiche T, Boralevi F, Thambo JB, Taïeb A. Propranolol for severe hemangiomas of infancy. *N Engl J Med*. 2008;358(24):2649–2651

60. Léaute-Labrèze C, Boccara O, Degrugillier-Chopinet C, et al. Safety of oral propranolol for the treatment of infantile hemangioma: a systematic review. *Pediatrics*. 2016;138(4):e20160353

61. Drolet BA, Frommelt PC, Chamlin SL, et al. Initiation and use of propranolol for infantile hemangioma: report of a consensus conference. *Pediatrics*. 2013;131(1):128–140

62. Itinteang T, Withers AH, Davis PF, Tan ST. Biology of infantile hemangioma. *Front Surg*. 2014;1:38

63. Dai Y, Hou F, Buckmiller L, et al. Decreased eNOS protein expression in involuting and propranolol-treated hemangiomas. *Arch Otolaryngol Head Neck Surg*. 2012;138(2):177–182

64. Greenberger S, Bischoff J. Infantile hemangioma-mechanism(s) of drug action on a vascular tumor. *Cold Spring Harb Perspect Med*. 2011;1(1):a006460

65. Storch CH, Hoeger PH. Propranolol for infantile haemangiomas: insights into the molecular mechanisms of action. *Br J Dermatol*. 2010;163(2): 269–274

66. Sans V, de la Roque ED, Berge J, et al. Propranolol for severe infantile hemangiomas: follow-up report. *Pediatrics*. 2009;124(3). Available at: www.pediatrics.org/cgi/content/full/124/3/e423

67. Pan WK, Li P, Guo ZT, Huang Q, Gao Y. Propranolol induces regression of hemangioma cells via the down-regulation of the PI3K/Akt/eNOS/VEGF pathway. *Pediatr Blood Cancer*. 2015;62(8):1414–1420

68. Sharifpanah F, Saliu F, Bekhite MM, Wartenberg M, Sauer H. β-adrenergic receptor antagonists inhibit vasculogenesis of embryonic stem cells by downregulation of nitric oxide generation and interference

with VEGF signalling. *Cell Tissue Res*. 2014;358(2):443–452

69. Ji Y, Chen S, Xu C, Li L, Xiang B. The use of propranolol in the treatment of infantile haemangiomas: an update on potential mechanisms of action. *Br J Dermatol*. 2015;172(1):24–32
70. Greene AK, Couto RA. Oral prednisolone for infantile hemangioma: efficacy and safety using a standardized treatment protocol. *Plast Reconstr Surg*. 2011;128(3):743–752
71. Tiwari P, Pandey V, Gangopadhyay AN, Sharma SP, Gupta DK. Role of propranolol in ulcerated haemangioma of head and neck: a prospective comparative study. *Oral Maxillofac Surg*. 2016;20(1):73–77
72. Zaher H, Rasheed H, El-Komy MM, et al. Propranolol versus captopril in the treatment of infantile hemangioma (IH): a randomized controlled trial. *J Am Acad Dermatol*. 2016;74(3):499–505
73. Wu S, Wang B, Chen L, et al. Clinical efficacy of propranolol in the treatment of hemangioma and changes in serum VEGF, bFGF and MMP-9. *Exp Ther Med*. 2015;10(3):1079–1083
74. Aly MM, Hamza AF, Abdel Kader HM, Saafan HA, Ghazy MS, Ragab IA. Therapeutic superiority of combined propranolol with short steroids course over propranolol monotherapy in infantile hemangioma. *Eur J Pediatr*. 2015;174(11):1503–1509
75. Ji Y, Wang Q, Chen S, et al. Oral atenolol therapy for proliferating infantile hemangioma: a prospective study. *Medicine (Baltimore)*. 2016;95(24):e3908
76. Léauté-Labrèze C, Hoeger P, Mazereeuw-Hautier J, et al. A randomized, controlled trial of oral propranolol in infantile hemangioma. *N Engl J Med*. 2015;372(8):735–746
77. Siegel DH, Tefft KA, Kelly T, et al. Stroke in children with posterior fossa brain malformations, hemangiomas, arterial anomalies, coarctation of the aorta and cardiac defects, and eye abnormalities (PHACE) syndrome: a systematic review of the literature. *Stroke*. 2012;43(6):1672–1674
78. Breur JM, de Graaf M, Breugem CC, Pasmans SG. Hypoglycemia as a result of propranolol during treatment of infantile hemangioma: a case report. *Pediatr Dermatol*. 2011;28(2):169–171
79. Holland KE, Frieden IJ, Frommelt PC, Mancini AJ, Wyatt D, Drolet BA. Hypoglycemia in children taking propranolol for the treatment of infantile hemangioma. *Arch Dermatol*. 2010;146(7):775–778
80. Prey S, Voisard JJ, Delarue A, et al. Safety of propranolol therapy for severe infantile hemangioma. *JAMA*. 2016;315(4):413–415
81. Techasatian L, Komwilaisak P, Panombualert S, Uppala R, Jetsrisuparb C. Propranolol was effective in treating cutaneous infantile haemangiomas in Thai children. *Acta Paediatr*. 2016;105(6):e257–e262
82. Stringari G, Barbato G, Zanzucchi M, et al. Propranolol treatment for infantile hemangioma: a case series of sixty-two patients. *Pediatr Med Chir*. 2016;38(2):113
83. Sreekantam S, Preece MA, Vijay S, Raiman J, Santra S. How to use a controlled fast to investigate hypoglycaemia. *Arch Dis Child Educ Pract Ed*. 2017;102(1):28–36
84. Cushing SL, Boucek RJ, Manning SC, Sidbury R, Perkins JA. Initial experience with a multidisciplinary strategy for initiation of propranolol therapy for infantile hemangiomas. *Otolaryngol Head Neck Surg*. 2011;144(1):78–84
85. Ng M, Knuth C, Weisbrod C, Murthy A. Propranolol therapy for problematic infantile hemangioma. *Ann Plast Surg*. 2016;76(3):306–310
86. Chang L, Ye X, Qiu Y, et al. Is propranolol safe and effective for outpatient use for infantile hemangioma? A prospective study of 679 cases from one center in China. *Ann Plast Surg*. 2016;76(5):559–563
87. Liu LS, Sokoloff D, Antaya RJ. Twenty-four-hour hospitalization for patients initiating systemic propranolol therapy for infantile hemangiomas–is it indicated? *Pediatr Dermatol*. 2013;30(5):554–560
88. El Ezzi O, Hohlfeld J, de Buys Roessingh A. Propranolol in infantile haemangioma: simplifying pretreatment monitoring. *Swiss Med Wkly*. 2014;144:w13943
89. Tang LY, Hing JW, Tang JY, et al. Predicting complications with pretreatment testing in infantile haemangioma treated with oral propranolol. *Br J Ophthalmol*. 2016;100(7):902–906
90. Ge J, Zheng J, Zhang L, Yuan W, Zhao H. Oral propranolol combined with topical timolol for compound infantile hemangiomas: a retrospective study. *Sci Rep*. 2016;6:19765
91. Raphael MF, Breugem CC, Vlasveld FA, et al. Is cardiovascular evaluation necessary prior to and during beta-blocker therapy for infantile hemangiomas?: a cohort study. *J Am Acad Dermatol*. 2015;72(3):465–472
92. de Graaf M, Breur JMPJ, Raphaël MF, Vos M, Breugem CC, Pasmans SGMA. Adverse effects of propranolol when used in the treatment of hemangiomas: a case series of 28 infants. *J Am Acad Dermatol*. 2011;65(2):320–327
93. Xu DP, Cao RY, Xue L, Sun NN, Tong S, Wang XK. Treatment of severe infantile hemangiomas with propranolol: an evaluation of the efficacy and effects of cardiovascular parameters in 25 consecutive patients. *J Oral Maxillofac Surg*. 2015;73(3):430–436
94. Street JA, Hemsworth BA, Roach AG, Day MD. Tissue levels of several radiolabelled beta-adrenoceptor antagonists after intravenous administration in rats. *Arch Int Pharmacodyn Ther*. 1979;237(2):180–190
95. Feenstra MG. Functional neuroteratology of drugs acting on adrenergic receptors. *Neurotoxicology*. 1992;13(1):55–63
96. Pitzer M, Schmidt MH, Esser G, Laucht M. Child development after maternal tocolysis with beta-sympathomimetic drugs. *Child Psychiatry Hum Dev*. 2001;31(3):165–182
97. Langley A, Pope E. Propranolol and central nervous system function: potential implications for paediatric patients with infantile haemangiomas. *Br J Dermatol*. 2015;172(1):13–23

98. Bryan BA. Reconsidering the use of propranolol in the treatment of cosmetic infantile hemangiomas. *Angiology: Open Access*. 2013;1:e101

99. Phillips RJ, Penington AJ, Bekhor PS, Crock CM. Use of propranolol for treatment of infantile haemangiomas in an outpatient setting. *J Paediatr Child Health*. 2012;48(10):902–906

100. Gonski K, Wargon O. Retrospective follow up of gross motor development in children using propranolol for treatment of infantile haemangioma at Sydney Children's Hospital. *Australas J Dermatol*. 2014;55(3):209–211

101. Moyakine AV, Hermans DJ, Fuijkschot J, van der Vleuten CJ. Propranolol treatment of infantile hemangiomas does not negatively affect psychomotor development. *J Am Acad Dermatol*. 2015;73(2):341–342

102. Moyakine AV, Kerstjens JM, Spillekom-van Koulil S, van der Vleuten CJ. Propranolol treatment of infantile hemangioma (IH) is not associated with developmental risk or growth impairment at age 4 years. *J Am Acad Dermatol*. 2016;75(1):59–63.e1

103. Chinnadurai S, Fonnesbeck C, Snyder KM, et al. Pharmacologic interventions for infantile hemangioma: a meta-analysis. *Pediatrics*. 2016;137(2):e20153896

104. Frieden IJ, Eichenfield LF, Esterly NB, Geronemus R, Mallory SB; American Academy of Dermatology Guidelines Outcomes Committee. Guidelines of care for hemangiomas of infancy. *J Am Acad Dermatol*. 1997;37(4):631–637

105. Sadan N, Wolach B. Treatment of hemangiomas of infants with high doses of prednisone. *J Pediatr*. 1996;128(1):141–146

106. Bennett ML, Fleischer AB Jr, Chamlin SL, Frieden IJ. Oral corticosteroid use is effective for cutaneous hemangiomas: an evidence-based evaluation. *Arch Dermatol*. 2001;137(9):1208–1213

107. Nieuwenhuis K, de Laat PC, Janmohamed SR, Madern GC, Oranje AP. Infantile hemangioma: treatment with short course systemic corticosteroid therapy as an alternative for propranolol. *Pediatr Dermatol*. 2013;30(1):64–70

108. Sloan GM, Reinisch JF, Nichter LS, Saber WL, Lew K, Morwood DT. Intralesional corticosteroid therapy for infantile hemangiomas. *Plast Reconstr Surg*. 1989;83(3):459–467

109. Chowdri NA, Darzi MA, Fazili Z, Iqbal S. Intralesional corticosteroid therapy for childhood cutaneous hemangiomas. *Ann Plast Surg*. 1994;33(1):46–51

110. Chen MT, Yeong EK, Horng SY. Intralesional corticosteroid therapy in proliferating head and neck hemangiomas: a review of 155 cases. *J Pediatr Surg*. 2000;35(3):420–423

111. Buckmiller LM, Francis CL, Glade RS. Intralesional steroid injection for proliferative parotid hemangiomas. *Int J Pediatr Otorhinolaryngol*. 2008;72(1):81–87

112. Prasetyono TO, Djoenaedi I. Efficacy of intralesional steroid injection in head and neck hemangioma: a systematic review. *Ann Plast Surg*. 2011;66(1):98–106

113. Zarem HA, Edgerton MT. Induced resolution of cavernous hemangiomas following prednisolone therapy. *Plast Reconstr Surg*. 1967;39(1):76–83

114. Kushner BJ. The treatment of periorbital infantile hemangioma with intralesional corticosteroid. *Plast Reconstr Surg*. 1985;76(4):517–526

115. Herlihy EP, Kelly JP, Sidbury R, Perkins JA, Weiss AH. Visual acuity and astigmatism in periocular infantile hemangiomas treated with oral beta-blocker versus intralesional corticosteroid injection. *J AAPOS*. 2016;20(1):30–33

116. Goyal R, Watts P, Lane CM, Beck L, Gregory JW. Adrenal suppression and failure to thrive after steroid injections for periocular hemangioma. *Ophthalmology*. 2004;111(2):389–395

117. Weiss AH. Adrenal suppression after corticosteroid injection of periocular hemangiomas. *Am J Ophthalmol*. 1989;107(5):518–522

118. Shorr N, Seiff SR. Central retinal artery occlusion associated with periocular corticosteroid injection for juvenile hemangioma. *Ophthalmic Surg*. 1986;17(4):229–231

119. Ruttum MS, Abrams GW, Harris GJ, Ellis MK. Bilateral retinal embolization associated with intralesional corticosteroid injection for capillary hemangioma of infancy. *J Pediatr Ophthalmol Strabismus*. 1993;30(1):4–7

120. Egbert JE, Schwartz GS, Walsh AW. Diagnosis and treatment of an ophthalmic artery occlusion during an intralesional injection of corticosteroid into an eyelid capillary hemangioma. *Am J Ophthalmol*. 1996;121(6):638–642

121. Egbert JE, Paul S, Engel WK, Summers CG. High injection pressure during intralesional injection of corticosteroids into capillary hemangiomas. *Arch Ophthalmol*. 2001;119(5):677–683

122. Chan H, McKay C, Adams S, Wargon O. RCT of timolol maleate gel for superficial infantile hemangiomas in 5- to 24-week-olds. *Pediatrics*. 2013;131(6). Available at: www.pediatrics.org/cgi/content/full/131/6/e1739

123. Pope E, Chakkittakandiyil A. Topical timolol gel for infantile hemangiomas: a pilot study. *Arch Dermatol*. 2010;146(5):564–565

124. Chakkittakandiyil A, Phillips R, Frieden IJ, et al. Timolol maleate 0.5% or 0.1% gel-forming solution for infantile hemangiomas: a retrospective, multicenter, cohort study. *Pediatr Dermatol*. 2012;29(1):28–31

125. Chambers CB, Katowitz WR, Katowitz JA, Binenbaum G. A controlled study of topical 0.25% timolol maleate gel for the treatment of cutaneous infantile capillary hemangiomas. *Ophthal Plast Reconstr Surg*. 2012;28(2):103–106

126. Frommelt P, Juern A, Siegel D, et al. Adverse events in young and preterm infants receiving topical timolol for infantile hemangioma. *Pediatr Dermatol*. 2016;33(4):405–414

127. McMahon P, Oza V, Frieden IJ. Topical timolol for infantile hemangiomas: putting a note of caution in "cautiously optimistic". *Pediatr Dermatol*. 2012;29(1):127–130

128. Coppens G, Stalmans I, Zeyen T, Casteels I. The safety and efficacy of glaucoma medication in the pediatric

population. *J Pediatr Ophthalmol Strabismus*. 2009;46(1):12–18

129. Guo S, Ni N. Topical treatment for capillary hemangioma of the eyelid using beta-blocker solution. *Arch Ophthalmol*. 2010;128(2):255–256
130. Ni N, Langer P, Wagner R, Guo S. Topical timolol for periocular hemangioma: report of further study. *Arch Ophthalmol*. 2011;129(3):377–379
131. Moehrle M, Léauté-Labrèze C, Schmidt V, Röcken M, Poets CF, Goelz R. Topical timolol for small hemangiomas of infancy. *Pediatr Dermatol*. 2013;30(2):245–249
132. Yu L, Li S, Su B, et al. Treatment of superficial infantile hemangiomas with timolol: evaluation of short-term efficacy and safety in infants. *Exp Ther Med*. 2013;6(2):388–390
133. Danarti R, Ariwibowo L, Radiono S, Budiyanto A. Topical timolol maleate 0.5% for infantile hemangioma: its effectiveness compared to ultrapotent topical corticosteroids - a single-center experience of 278 cases. *Dermatology*. 2016;232(5):566–571
134. Oranje AP, Janmohamed SR, Madern GC, de Laat PC. Treatment of small superficial haemangioma with timolol 0.5% ophthalmic solution: a series of 20 cases. *Dermatology*. 2011;223(4):330–334
135. Gomulka J, Siegel DH, Drolet BA. Dramatic shift in the infantile hemangioma treatment paradigm at a single institution. *Pediatr Dermatol*. 2013;30(6):751–752
136. Weibel L, Barysch MJ, Scheer HS, et al. Topical timolol for infantile hemangiomas: evidence for efficacy and degree of systemic absorption. *Pediatr Dermatol*. 2016;33(2): 184–190
137. Olson RJ, Bromberg BB, Zimmerman TJ. Apneic spells associated with timolol therapy in a neonate. *Am J Ophthalmol*. 1979;88(1):120–122
138. Burnstine RA, Felton JL, Ginther WH. Cardiorespiratory reaction to timolol maleate in a pediatric patient: a case report. *Ann Ophthalmol*. 1982;14(10):905–906
139. Kiryazov K, Stefova M, Iotova V. Can ophthalmic drops cause central nervous system depression and cardiogenic shock in infants? *Pediatr Emerg Care*. 2013; 29(11):1207–1209
140. Semkova K, Kazandjieva J. Topical timolol maleate for treatment of infantile haemangiomas: preliminary results of a prospective study. *Clin Exp Dermatol*. 2013;38(2):143–146
141. Boos MD, Castelo-Soccio L. Experience with topical timolol maleate for the treatment of ulcerated infantile hemangiomas (IH). *J Am Acad Dermatol*. 2016;74(3):567–570
142. Greene AK. Management of hemangiomas and other vascular tumors. *Clin Plast Surg*. 2011;38(1):45–63
143. Couto RA, Maclellan RA, Zurakowski D, Greene AK. Infantile hemangioma: clinical assessment of the involuting phase and implications for management. *Plast Reconstr Surg*. 2012;130(3):619–624
144. Batta K, Goodyear HM, Moss C, Williams HC, Hiller L, Waters R. Randomised controlled study of early pulsed dye laser treatment of uncomplicated childhood haemangiomas: results of a 1-year analysis. *Lancet*. 2002;360(9332):521–527
145. Mulliken JB, Fishman SJ, Burrows PE. Vascular anomalies. *Curr Probl Surg*. 2000;37(8):517–584
146. Charlesworth R. The toddler: affective development. In: *Understanding Child Development*. 6th ed. Delmar Learning; 1994:304
147. Santrock JW. The self and identity. In: *Child Development*. 7th ed. McGraw-Hill; 1996:378–385
148. Neisser U. Memory development: new questions and old. *Dev Rev*. 2004;24(1):154–158
149. Bowers RE, Graham EA, Tomlinson KM. The natural history of the strawberry nevus. *Arch Dermatol*. 1960;82(5):667–680
150. Laubach HJ, Anderson RR, Luger T, Manstein D. Fractional photothermolysis for involuted infantile hemangioma. *Arch Dermatol*. 2009;145(7):748–750
151. Witman PM, Wagner AM, Scherer K, Waner M, Frieden IJ. Complications following pulsed dye laser treatment of superficial hemangiomas. *Lasers Surg Med*. 2006;38(2):116–123
152. Scheepers JH, Quaba AA. Does the pulsed tunable dye laser have a role in the management of infantile hemangiomas? Observations based on 3 years' experience. *Plast Reconstr Surg*. 1995;95(2):305–312
153. Kessels JP, Hamers ET, Ostertag JU. Superficial hemangioma: pulsed dye laser versus wait-and-see. *Dermatol Surg*. 2013;39(3, pt 1):414–421
154. Liu LS, Sowa A, Antaya RJ. Educating caregivers about the natural history of infantile hemangiomas. *Acta Paediatr*. 2015;104(1):9–11
155. Zweegers J, van der Vleuten CJ. The psychosocial impact of an infantile haemangioma on children and their parents. *Arch Dis Child*. 2012;97(10):922–926
156. Minzer-Conzetti K, Garzon MC, Haggstrom AN, et al. Information about infantile hemangiomas on the Internet: how accurate is it? *J Am Acad Dermatol*. 2007;57(6):998–1004
157. Takahashi K, Mulliken JB, Kozakewich HP, Rogers RA, Folkman J, Ezekowitz RA. Cellular markers that distinguish the phases of hemangioma during infancy and childhood. *J Clin Invest*. 1994;93(6):2357–2364
158. Agency for Healthcare Research and Quality. Treating infantile hemangiomas in children. Available at: https://effectivehealthcare.ahrq.gov/topics/infantile-hemangioma/consumer. Accessed November 27, 2018
159. Bernabeu-Wittel J, Pereyra J, Corb R, Ruiz-Canela J, Tarilonte A M, Conejo-Mir J. Teledermatology for infantile hemangiomas. Comment on: Chang LC, Haggstrom AN, Drolet BA, et al for the Hemangioma Investigator Group. Growth characteristics of infantile hemangiomas: implications for management. Pediatrics. 2008;122:360-367. Available at: http://pediatrics.aappublications.org/content/122/2/360.comments
160. Martin K, Blei F, Chamlin SL, et al. Propranolol treatment of infantile hemangiomas: anticipatory guidance for parents and caretakers [published correction appears in *Pediatr*

Dermatol. 2013;30(2):280]. *Pediatr Dermatol*. 2013;30(1):155–159

161. Munden A, Butschek R, Tom WL, et al. Prospective study of infantile haemangiomas: incidence, clinical characteristics and association with placental anomalies. *Br J Dermatol*. 2014;170(4):907–913
162. Moyakine AV, Herwegen B, van der Vleuten CJM. Use of the Hemangioma Severity Scale to facilitate treatment decisions for infantile hemangiomas. *J Am Acad Dermatol*. 2017;77(5): 868–873
163. Mull JL, Chamlin SL, Lai JS, et al. Utility of the Hemangioma Severity Scale as a triage tool and predictor of need for treatment. *Pediatr Dermatol*. 2017;34(1):78–83
164. Haggstrom AN, Beaumont JL, Lai JS, et al. Measuring the severity of infantile hemangiomas: instrument development and reliability. *Arch Dermatol*. 2012;148(2):197–202

Infantile Hemangiomas Clinical Practice Guideline Quick Reference Tools

- Action Statement Summary
  — Clinical Practice Guideline for the Management of Infantile Hemangiomas
- *ICD-10-CM* Coding Quick Reference for Infantile Hemangiomas

Action Statement Summary

Clinical Practice Guideline for the Management of Infantile Hemangiomas

Key Action Statement 1

Risk stratification

Key Action Statement 1A

Clinicians should classify an IH as high risk if there is evidence of or potential for the following: (1) life-threatening complications, (2) functional impairment or ulceration, (3) structural anomalies (eg, in PHACE syndrome or LUMBAR syndrome), or (4) permanent disfigurement (grade X, strong recommendation).

Key Action Statement 1B

After identifying an IH as high risk, clinicians should facilitate an evaluation by a hemangioma specialist as soon as possible (grade X, strong recommendation).

Key Action Statement 2

Imaging

Key Action Statement 2A

Clinicians should not perform imaging unless the diagnosis of IH is uncertain, there are 5 or more cutaneous IHs, or associated anatomic abnormalities are suspected (grade B, moderate recommendation).

Key Action Statement 2B

Clinicians should perform ultrasonography as the initial imaging modality when the diagnosis of IH is uncertain (grade C, weak recommendation).

Key Action Statement 2C

Clinicians should perform MRI when concerned about associated structural abnormalities (eg, PHACE syndrome or LUMBAR syndrome) (grade B, moderate recommendation).

Key Action Statement 3

Pharmacotherapy

Key Action Statement 3A

Clinicians should use oral propranolol as the first-line agent for IHs requiring systemic treatment (grade A, strong recommendation).

Key Action Statement 3B

Clinicians should dose propranolol between 2 and 3 mg/kg per day unless there are comorbidities (eg, PHACE syndrome) or adverse effects (eg, sleep disturbance) that necessitate a lower dose (grade A, moderate recommendation).

Key Action Statement 3C

Clinicians should counsel that propranolol be administered with or after feeding and that doses be held at times of diminished oral intake or vomiting to reduce the risk of hypoglycemia (grade X, strong recommendation).

Key Action Statement 3D

Clinicians should evaluate patients for and educate caregivers about potential adverse effects of propranolol, including sleep disturbances, bronchial irritation, and clinically symptomatic bradycardia and hypotension (grade X, strong recommendation).

Key Action Statement 3E

Clinicians may prescribe oral prednisolone or prednisone to treat IHs if there are contraindications or an inadequate response to oral propranolol (grade B, moderate recommendation).

Key Action Statement 3F

Clinicians may recommend intralesional injection of triamcinolone and/or betamethasone to treat focal, bulky IHs during proliferation or in certain critical anatomic locations (eg, the lip) (grade B, moderate recommendation).

Key Action Statement 3G

Clinicians may prescribe topical timolol maleate as a therapy for thin and/or superficial IHs (grade B, moderate recommendation).

Key Action Statement 4

Clinicians may recommend surgery and laser therapy as treatment options in managing selected IHs (grade C, moderate recommendation).

Key Action Statement 5

Clinicians should educate parents of infants with an IH about the condition, including the expected natural history, and its potential for causing complications or disfigurement (grade X, strong recommendation).

Coding Quick Reference for Infantile Hemangiomas
ICD-10-CM
D18.00 Hemangioma unspecified site
D18.01 Hemangioma of skin and subcutaneous tissue
D18.02 Hemangioma of intracranial structures
D18.03 Hemangioma of intra-abdominal structures
D18.09 Hemangioma of other sites

Clinical Practice Guideline: Maintenance Intravenous Fluids in Children

- *Clinical Practice Guideline*
  - *PPI: AAP Partnership for Policy Implementation*
    See Appendix 1 for more information.

CLINICAL PRACTICE GUIDELINE Guidance for the Clinician in Rendering Pediatric Care

American Academy of Pediatrics
DEDICATED TO THE HEALTH OF ALL CHILDREN™

Clinical Practice Guideline: Maintenance Intravenous Fluids in Children

Leonard G. Feld, MD, PhD, MMM, FAAP,[a] Daniel R. Neuspiel, MD, MPH, FAAP,[b] Byron A. Foster, MD, MPH, FAAP,[c] Michael G. Leu, MD, MS, MHS, FAAP,[d] Matthew D. Garber, MD, FHM, FAAP,[e] Kelly Austin, MD, MS, FAAP, FACS,[f] Rajit K. Basu, MD, MS, FCCM,[g,h] Edward E. Conway Jr, MD, MS, FAAP,[i] James J. Fehr, MD, FAAP,[j] Clare Hawkins, MD,[k] Ron L. Kaplan, MD, FAAP,[l] Echo V. Rowe, MD, FAAP,[m] Muhammad Waseem, MD, MS, FAAP, FACEP,[n] Michael L. Moritz, MD, FAAP,[o] SUBCOMMITTEE ON FLUID AND ELECTROLYTE THERAPY

abstract

Maintenance intravenous fluids (IVFs) are used to provide critical supportive care for children who are acutely ill. IVFs are required if sufficient fluids cannot be provided by using enteral administration for reasons such as gastrointestinal illness, respiratory compromise, neurologic impairment, a perioperative state, or being moribund from an acute or chronic illness. Despite the common use of maintenance IVFs, there is high variability in fluid prescribing practices and a lack of guidelines for fluid composition administration and electrolyte monitoring. The administration of hypotonic IVFs has been the standard in pediatrics. Concerns have been raised that this approach results in a high incidence of hyponatremia and that isotonic IVFs could prevent the development of hyponatremia. Our goal in this guideline is to provide an evidence-based approach for choosing the tonicity of maintenance IVFs in most patients from 28 days to 18 years of age who require maintenance IVFs. This guideline applies to children in surgical (postoperative) and medical acute-care settings, including critical care and the general inpatient ward. Patients with neurosurgical disorders, congenital or acquired cardiac disease, hepatic disease, cancer, renal dysfunction, diabetes insipidus, voluminous watery diarrhea, or severe burns; neonates who are younger than 28 days old or in the NICU; and adolescents older than 18 years old are excluded. We specifically address the tonicity of maintenance IVFs in children.

The Key Action Statement of the subcommittee is as follows:

1A: The American Academy of Pediatrics recommends that patients 28 days to 18 years of age requiring maintenance IVFs should receive isotonic solutions with appropriate potassium chloride and dextrose because they significantly decrease the risk of developing hyponatremia (evidence quality: A; recommendation strength: strong)

[a]Retired, Nicklaus Children's Health System, Miami, Florida; [b]Retired, Levine Children's Hospital, Charlotte, North Carolina; [c]Oregon Health and Science University, Portland, Oregon; [f]Department of Pediatric Emergency Medicine, [d]School of Medicine, University of Washington and Seattle Children's Hospital, Seattle, Washington; [e]Department of Pediatrics, College of Medicine – Jacksonville, University of Florida, Jacksonville, Florida; Departments of [f]Surgery and [o]Pediatrics, University of Pittsburgh School of Medicine, Children's Hospital of Pittsburgh, Pittsburgh, Pennsylvania; [g]Division of Critical Care Medicine, Children's Healthcare of Atlanta, Atlanta, Georgia; [h]Department of Pediatrics, School of Medicine, Emory University, Atlanta, Georgia; [i]Division of Pediatric Critical Care Medicine, Department of Pediatrics, Jacobi Medical Center, Bronx, New York; Departments of [j]Anesthesiology and Pediatrics, Washington University in St Louis, St Louis, Missouri; [k]Department of Family Medicine, Houston Methodist Hospital, Houston, Texas; [m]Department of Anesthesia, Stanford University School of Medicine, Stanford, California; and [n]Lincoln Medical Center, Bronx, New York

To cite: Feld LG, Neuspiel DR, Foster BA, et al. Clinical Practice Guideline: Maintenance Intravenous Fluids in Children. *Pediatrics.* 2018;142(6):e20183083

INTRODUCTION

Maintenance intravenous fluids (IVFs) are used to provide critical supportive care for children who are acutely ill. IVFs are required if sufficient fluids cannot be provided by using enteral administration for reasons such as gastrointestinal illness, respiratory compromise, neurologic impairment, a perioperative state, or being moribund from an acute or chronic illness. For the purposes of this document, specifying appropriate maintenance IVFs includes the composition of IVF needed to preserve a child's extracellular volume while simultaneously minimizing the risk of developing volume depletion, fluid overload, or electrolyte disturbances, such as hyponatremia or hypernatremia. Because maintenance IVFs may have both potential benefits and harms, they should only be administered when clinically indicated. The administration of hypotonic IVF has been the standard in pediatrics. Concerns have been raised that this approach results in a high incidence of hyponatremia and that isotonic IVF could prevent the development of hyponatremia. Guidelines for maintenance IVF therapy in children have primarily been opinion based, and evidence-based consensus guidelines are lacking.

OBJECTIVE

Despite the common use of maintenance IVFs, there is high variability in fluid prescribing practices and a lack of guidelines for fluid composition and electrolyte monitoring.[1–4] Our goal in this guideline is to provide an evidence-based approach for choosing the tonicity of maintenance IVFs in most patients from 28 days to 18 years of age who require maintenance IVFs. These recommendations do not apply to patients with neurosurgical disorders, congenital or acquired cardiac disease, hepatic disease, cancer, renal dysfunction, diabetes insipidus, voluminous watery diarrhea, or severe burns; neonates who are younger than 28 days old or in the NICU; or adolescents older than 18 years old.

BACKGROUND

Phases of Fluid Therapy

Recent literature has emerged in which researchers describe the context-dependent use of IVFs, which should be prescribed, ordered, dosed, and delivered like any other drug.[5–7] Four distinct physiology-driven time periods exist for children requiring IVFs. The resuscitative phase is the acute presentation window, when IVFs are needed to restore adequate tissue perfusion and prevent or mitigate end-organ injury. The titration phase is the time when IVFs are transitioned from boluses to maintenance; this is a critical window to determine what intravascular repletion has been achieved and the trajectory of fluid gains versus losses in children who are acutely ill. The maintenance phase accounts for fluids administered during the previous 2 stabilization phases and is a time when fluids should be supplied to achieve a precise homeostatic balance between needs and losses. Finally, the convalescent phase reflects the period when exogenous fluid administration is stopped, and the patient returns to intrinsic fluid regulation. The dose of fluid during these 4 phases of fluid therapy needs to be adjusted on the basis of the unique physiologic needs of each patient, and a specific protocoled dose is not able to be applied to all patients.[8,9]

A variety of IVFs are commercially available for use in infants and children. These solutions principally vary by their specific electrolyte composition, the addition of a buffer, and whether they contain glucose (Table 1).[10] The buffer in plasma is bicarbonate, but buffers in commercially available solutions include various concentrations of lactate, acetate, and gluconate. Multiple balanced salt solutions can be compared with normal saline (0.9% saline), which has the same sodium concentration as plasma but has a supraphysiologic chloride concentration.

Effect of Dextrose on Tonicity

Tonicity is used to describe the net vector of force on cells relative to a semipermeable membrane when in solution. Physiologic relevance occurs with tonicity studied in vivo (eg, as IVF is infused intravascularly). Infused isotonic fluids do not result in osmotic shifts; the cells stay the same size. Cellular expansion occurs during immersion in hypotonic fluids as free water, in higher relative abundance in the extracellular environment, and crosses the semipermeable membrane. The converse happens in hypertonic fluid immersion: free water shifts out of the cells, leading to cellular contraction. A distinct but related concept is the concept of osmolality. Osmolality is measured as osmoles of solute per kilogram of solvent. Serum osmolality can be estimated by the following formula:

$$2 \times \mathrm{Na(mEq/}L\mathrm{)} + \mathrm{BUN\ (mg/dL)/2.8 + glucose\ (mg/dL)/18}$$

Osmolality is distinct from tonicity (effective osmolality) in that tonicity relates to both the effect on a cell of a fluid (dependent on the selective permeability of the membrane) and the osmolality of the fluid. In the plasma, urea affects osmolality but not tonicity because urea moves freely across cell membranes with no effect on tonicity. The tonicity of IVF is primarily affected by the sodium and potassium concentration.

Dextrose (D-glucose) can be added to IVFs (Table 1). Although dextrose affects the osmolarity of IVFs, it is not a significant contributor to the plasma osmotic pressure or tonicity

TABLE 1 Composition of Commonly Used Maintenance IVFs

Fluid	Glucose, g/dL	Sodium	Chloride	Potassium, mEq/L	Calcium	Magnesium	Buffer	Osmolarity,[a] mOsm/L
Human plasma	0.07–0.11	135–145	95–105	3.5–5.3	4.4–5.2	1.6–2.4	23–30 bicarbonate	308[b]
Hypotonic solutions								
D_5 0.2% NaCl	5	34	34	0	0	0	0	78
D_5 0.45% NaCl	5	77	77	0	0	0	0	154
Isotonic and/or near-isotonic solutions								
D_5 0.9% NaCl	5	154	154	0	0	0	0	308
D_5 lactated Ringer	5	130	109	4	3	0	28 lactate	273
PlasmaLyte[c,d]	0	140	98	5	0	3	27 acetate and 23 gluconate	294

[a] The osmolarity calculation excludes the dextrose in the solution because dextrose is rapidly metabolized on infusion.
[b] The osmolality for plasma is 275–295 mOsm/kg.
[c] Multiple electrolytes injection, type 1 *United States Pharmacopeia*, is the generic name for PlasmaLyte.
[d] PlasmaLyte with 5% dextrose is not available in the United States from Baxter Healthcare Corporation in Deerfield, Illinois.

in the absence of uncontrolled diabetes because it is rapidly metabolized after entering the blood stream. Thus, although dextrose will affect the osmolarity of solutions, for patients in whom maintenance IVFs are needed, the dextrose component generally is not believed to affect the tonicity of solutions.

Historical Maintenance IVF Practice and Hyponatremia

Hyponatremia (serum sodium concentration <135 mEq/L) is the most common electrolyte abnormality in patients who are hospitalized, affecting approximately 15% to 30% of children and adults.[11,12] Patients who are acutely ill frequently have disease states associated with arginine vasopressin (AVP) excess that can impair free-water excretion and place the patient at risk for developing hyponatremia when a source of electrolyte-free water is supplied, as in hypotonic fluids.[10] Nonosmotic stimuli of AVP release include pain, nausea, stress, a postoperative state, hypovolemia, medications, and pulmonary and central nervous system (CNS) disorders, including common childhood conditions such as pneumonia and meningitis.[13–15] These conditions can lead to the syndrome of inappropriate antidiuresis (SIAD) or SIAD-like states, which lead to water retention followed by a physiologic natriuresis in which fluid balance is maintained at the expense of plasma sodium.

Children have historically been administered hypotonic maintenance IVFs.[3,4] This practice is based on theoretical calculations from the 1950s.[16] The water requirement was based on the energy expenditure of healthy children, with 1 mL of fluid provided for each kilocalorie (kcal) expended, or 1500 mL/m^2 per day. The resting energy expenditure in healthy children is vastly different in those with an acute disease and/or illness or after surgery. When using calorimetric methods, energy expenditure in these patients is closer to the basal metabolic rate proposed by Talbot,[17] which averages 50 to 60 kcal/kg per day.[18] The electrolyte concentration of IVFs was estimated to reflect the composition of human and cow milk. The final composition consisted of 3 mEq of sodium and 2 mEq of potassium per 100 kcal metabolized.[16]

Most hyponatremia in patients who are hospitalized is hospital acquired and related to the administration of hypotonic IVFs in the setting of elevated AVP concentrations.[10,11] Studies in which researchers evaluated hospital-acquired hyponatremia have revealed a relationship with the administration of hypotonic IVFs.[11,19,20] The most serious complication of hospital-acquired hyponatremia is hyponatremic encephalopathy, which is a medical emergency that can be fatal or lead to irreversible brain injury if inadequately treated.[21–24] The reports of hospital-acquired hyponatremic encephalopathy have occurred primarily in otherwise healthy children who were receiving hypotonic IVFs, in many cases after minor surgical procedures.[21,23] Patients with hospital-acquired hyponatremia are at particular risk for hyponatremic encephalopathy, which usually develops acutely in less than 48 hours, leaving little time for the brain to adapt. Children are at particularly high risk of developing symptomatic hyponatremia because of their larger brain/skull size ratio.[24] Symptoms of hyponatremia can be nonspecific, including fussiness, headache, nausea, vomiting, confusion, lethargy, and muscle cramps, making prompt diagnosis difficult.

After reports of severe hyponatremia and associated neurologic injury were reported in 1992, a significant debate emerged regarding the appropriateness of administering hypotonic maintenance IVFs to children.[21] In 2003, it was

recommended that isotonic fluids be administered to children who are acutely ill and require maintenance IVFs to prevent the development of hyponatremia.[24] Since then, the Institute for Safe Medical Practices of both the United States[25] and Canada[26] released reports on deaths from severe hyponatremia in patients who were hospitalized and received hypotonic IVFs. The United Kingdom released a national safety alert reporting 4 deaths and 1 near miss from hospital-acquired hyponatremia,[27] and 50 cases of serious injury or child death from hypotonic IVFs were reported in the international literature.[22]

After the recognition of hospital-acquired hyponatremia in patients receiving hypotonic IVFs and recommendations for avoiding them,[24] the use of 0.2% saline has declined with an increase in the use of 0.45% and 0.9% saline.[3,28] There have been concerns raised about the safety of the proposed use of isotonic maintenance IVFs in children who are acutely ill for the prevention of hospital-acquired hyponatremia.[18] Some believe that this approach could lead to complications such as hypernatremia, fluid overload with edema and hypertension, and hyperchloremic acidosis.[29] In the past 15 years, there have been a multitude of clinical trials and systematic reviews in which researchers have attempted to address this debate.[30–35] Authors of textbooks and review articles in the United States continue to recommend hypotonic fluids.[36–38] Conversely, the National Clinical Guideline Centre in the United Kingdom published evidence-based guidelines for IVF therapy in children younger than 16 years old and recommended isotonic IVFs.[34]

METHODS

In April 2016, the American Academy of Pediatrics (AAP) convened a multidisciplinary subcommittee composed of primary care clinicians and experts in the fields of general pediatrics, hospital medicine, emergency medicine, critical care medicine, nephrology, anesthesiology, surgery, and quality improvement. The subcommittee also included a guideline methodologist and/or informatician and an epidemiologist who were skilled in systematic reviews. All panel members declared potential conflicts on the basis of the AAP policy on conflicts of interest and voluntary disclosure. Subcommittee members repeated this process annually and on publication of the guideline. All potential conflicts of interest are listed at the end of this document. The project was funded by the AAP.

The subcommittee initiated its literature review by combining the search strategies in 7 recent systematic reviews of clinical trials of maintenance IVFs in children and adolescents, which consisted of 11 clinical trials involving 1139 patients.[9,33,34,39–42] The subcommittee then used this combined search strategy to discover 7 additional clinical trials of maintenance IVFs involving 1316 children and adolescents (ages 28 days to 18 years) published since 2013 (the last year included in the previous 6 systematic reviews) in the PubMed, Cumulative Index to Nursing and Allied Health Literature, and Cochrane Library databases. All articles that were initially identified were back searched for other relevant publications. Studies published as of March 15, 2016, were included. Three independent reviewers from the subcommittee then critically appraised the full text of each identified article (n = 17) using a structured data collection form that was based on published guidelines for evaluating medical literature.[43,44] These reviews were integrated into an evidence table by the subcommittee epidemiologist (Supplemental Table 3). Forest plots for all included randomized controlled trials (RCTs) in which researchers used random-effects models and Mantel-Haenzel (M-H) statistics with the outcome of hyponatremia are shown in Supplemental Figs 2–4.

To appraise the methodology of the included studies, a risk-of-bias assessment was completed by using the *Cochrane Handbook* risk of bias assessment framework.[45] Using this framework, raters placed a value of low, high, or unclear risk of bias for each article in the areas of selection bias (both random-sequence generation and allocation concealment), performance bias, detection bias, attrition bias, and reporting bias. Two authors independently reviewed each study identified in the systematic review and made an independent judgment. Differences in assessment were resolved via discussion.

The resulting systematic review was used to develop the guideline recommendations by following the Policy Statement from the AAP Steering Committee on Quality Improvement and Management, "Classifying Recommendations for Clinical Practice Guidelines."[46] Decisions and the strength of recommendations were based on a systematic grading of the quality of evidence from the updated literature review by the subcommittee with guidance by the epidemiologist. Expert consensus was used when definitive data were not available. If committee members disagreed with the consensus, they were encouraged to voice their concerns until full agreement was reached. Full agreement was reached on the clinical recommendations below.

Clinical recommendations were entered into Bridge-Wiz 2.1 for AAP software (Building Recommendations in a Developers Guideline Editor), an interactive software tool that is used to lead guideline development

TABLE 2 Key Action Statement 1A

Aggregate Evidence Quality	Grade A
Benefits	More physiologic fluid, less hyponatremia
Risks, harm, cost	Potential harms of hypernatremia, fluid overload, hypertension, hyperchloremic metabolic acidosis, and acute kidney injury have not been found to be of increased risk with isotonic maintenance fluids.
Benefit-harm assessment	Decreased risk of hyponatremia
Intentional vagueness	None
Role of patient preferences	None
Exclusions	Patients with neurosurgical disorders, congenital or acquired cardiac disease, hepatic disease, cancer, renal dysfunction, diabetes insipidus, voluminous watery diarrhea, or severe burns; neonates who are <28 d old or in the NICU; or adolescents >18 y old
Strength	Strong recommendation
Key references	9·33·39–42

teams through a series of questions that are intended to create clear, transparent, and actionable Key Action Statements.[47] The committee was actively involved while the software was used and solicited the inputs of this program, which included strength of evidence and balance of benefits versus harms, and chose which sentences recommended by the program to use as part of the guideline. Bridge-Wiz also integrates the quality of available evidence and a benefit-harm assessment into the final determination of the strength of each recommendation per the guidance in Fig 1.

Before formal approval by the AAP, this guideline underwent a comprehensive review by stakeholders, including AAP councils, committees, and sections; selected outside stakeholder organizations; and individuals who were identified by the subcommittee as experts in the field. All comments were reviewed by the subcommittee and incorporated into the final guideline when appropriate.

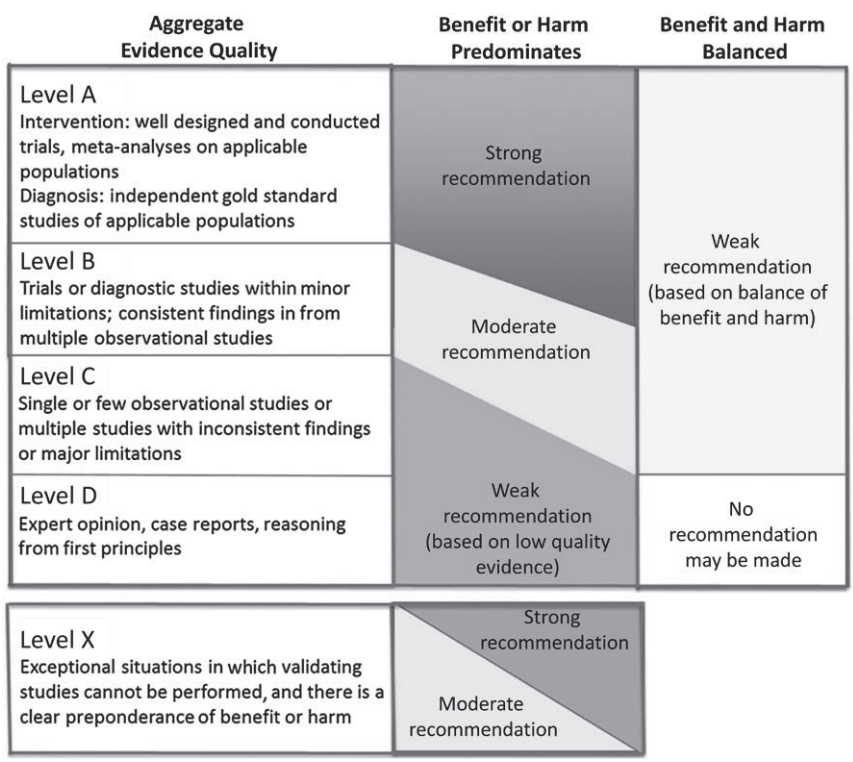


FIGURE 1
AAP rating of evidence and recommendations.

On the basis of the reviewed literature, this guideline applies to children 28 days to 18 years of age in surgical (postoperative) and medical acute-care settings, including critical care and the general inpatient ward. This guideline DOES NOT apply to children with neurosurgical disorders, congenital or acquired cardiac disease, hepatic disease, cancer, renal dysfunction, diabetes insipidus, voluminous watery diarrhea, or severe burns; neonates who are younger than 28 days old or in the NICU; or adolescents older than 18 years old because the majority of the researchers in the prospective studies reviewed in this guideline excluded these subsets of patients or did not include patients with these specific high-risk diagnoses.

RESULTS

Key Action Statement

The Key Action Statement is as follows:

1. Composition of Maintenance IVFs

1A: The AAP recommends that patients 28 days to 18 years of age requiring maintenance IVFs should receive isotonic solutions with appropriate potassium chloride (KCl) and dextrose because they significantly decrease the risk of developing hyponatremia (evidence quality: A; recommendation strength: strong; Table 2).

Isotonic Solutions Versus Hypotonic Solutions

Isotonic fluid has a sodium concentration similar to plasma (135–144 mEq/L). Plasma is approximately 93% aqueous and 7% anhydrous with a sodium concentration in the aqueous phase of plasma of 154 mEq/L and osmolarity of 308 mOsm/L, similar to that of 0.9% sodium chloride (NaCl). Conversely, hypotonic fluid has a sodium concentration lower than that of the aqueous phase of plasma. In the studies evaluated in the formulation of these guidelines, there is some heterogeneity in both the isotonic and hypotonic fluids used. The sodium concentration of isotonic fluids ranged from 131 to 154 mEq/L. Hartmann solution (sodium concentration 131 mEq/L; osmolality 279 mOsm/L) was used in only 46 patients.[48,49] PlasmaLyte (sodium concentration 140 mEq/L; osmolarity 294 mOsm/L) was used in 346 patients.[35] Researchers in the majority of the studies used either 0.9% NaCl (sodium concentration 154 mEq/L; osmolarity 308 mOsm/L) or a fluid of equivalent tonicity. Hypotonic fluids ranged from 30 to 100 mEq/L.[33] Lactated Ringer solution (sodium concentration 130 mEq/L; osmolarity 273 mOsm/L), a slightly hypotonic solution, was not involved in any of the clinical trials. For the purposes of this guideline, isotonic solutions have a sodium concentration similar to PlasmaLyte, or 0.9% NaCl. Recommendations are not made regarding the safety of lactated Ringer solution. Researchers in the majority of studies added dextrose (2.5%–5%) to the intravenous (IV) solution.

The search revealed 17 randomized clinical trials[20,31,32,35,48–60] that met the search criteria, including a total 2455 patients (2313 patients had primary outcome data for analysis in Supplemental Figs 2–4), to help evaluate the question of whether isotonic or hypotonic fluids should be used in children who are hospitalized. Sixteen of the studies revealed that isotonic fluids were superior to hypotonic fluids in preventing hyponatremia. There have also been 7 systematic reviews over the past 11 years in which researchers have synthesized various combinations of the above RCTs.[9,33,34,39–42] The number needed to treat with isotonic fluids to prevent hyponatremia (sodium <135 mEq/L) was 7.5 across all included studies and 27.8 for moderate hyponatremia (sodium <130 mEq/L).

Study appraisal for risk of bias (Supplemental Table 4) revealed the reviewed studies in total to be methodologically sound. Most types of bias were found to be of low risk in all but 2 studies. There was 1 study with 2 bias types of potentially high risk and 11 studies with 1 or more unclear bias areas.

Inclusion and Exclusion Criteria: Rationale for Specific Subgroups

Age

The specific age groups from which data are available from randomized clinical trials range from 1 day (1 trial) to 18 years. Given this broad age range, we specifically evaluated whether there was variability in the outcomes by age, particularly for the lower age range. McNab et al[33] examined this question in their systematic review and found 100 children studied at younger than 1 year of age, 243 children studied between the ages of 1 and 5 years, and 465 children studied at older than 5 years of age. They showed a significant benefit of isotonic IVFs in each age group stratum. There have been 7 additional studies in which researchers have also included children younger than 1 year old, although there are not specific outcome data reported for this age group.[31,32,35,50,51,55,58]

Surgical (Postoperative Patients)

Surgical or postoperative patients have been specifically studied in 7 studies[20,48,49,51,54,56,57] that included 529 patients. McNab[30] showed a pooled risk ratio of 0.48 (95% confidence interval [CI], 0.38–0.60) for the outcome of hyponatremia in favor of isotonic fluids.

Medical (Nonsurgical Patients)

Medical patients are defined here as children who are hospitalized in an acute-care setting with no indication for a surgical operation and no immediate history of a surgical operation. For these patients, there are 4 randomized clinical trials[32,52,55,58] in which researchers enrolled only medical patients and 6 randomized clinical trials[50,51,53,56,57,59] in which researchers enrolled both medical and surgical patients. Some of the mixed studies in which researchers looked at both medical and surgical patients include outcomes for only medical patients, whereas most include combined outcomes for both groups.

Varying Acuity (ICU Versus General Ward)

There are 6 randomized clinical trials[31,49,50,53,56,59] in which researchers enrolled only ICU patients, and all but one[50] revealed a significant difference favoring isotonic IVFs for the prevention of hyponatremia. Researchers in 8 randomized clinical trials enrolled exclusively patients in a general ward setting,[32,51,52,54,55,57,58,60] and those in all but 2[32,57] found a significant reduction in hyponatremia among those receiving isotonic IVFs. McNab et al[35] enrolled patients in both the ICU and general surgical ward, and they were at similar risk for developing hyponatremia.

Exclusion of Specific Populations Not Studied

Patients with neurosurgical disorders, congenital or acquired cardiac disease, hepatic disease,

cancer, renal dysfunction, diabetes insipidus, voluminous watery diarrhea, or severe burns; neonates who were younger than 28 days old or in the NICU (researchers in the majority of prospective studies reviewed in this guideline excluded this subset of patients); and adolescents older than 18 years old were excluded. Patients with congenital or acquired heart disease have been either explicitly excluded from every study listed previously or were not described, so no conclusions may be drawn related to this specific population. Similarly, patients with known liver or renal disease or adrenal insufficiency have also been excluded from most of the studies listed, limiting any conclusions for these patients as well. Neurosurgical patients and those with traumatic brain injury were excluded from most studies. Oncology patients have been included in some of the randomized trials, but no specific subanalysis for them has been completed, and data are not available separately to conduct one. Many patients receiving chemotherapy receive high volumes of fluids to prevent renal injury, and there are reports of clinically significant hyponatremia, which is possibly associated with the fluid type.[61] Further study is needed to evaluate the fluid type, rate, and risk of renal injury and hyponatremia for this population. The committee did not specifically review literature for those with the following care needs: patients with significant renal concentrating defects, such as nephrogenic diabetes insipidus, and patients with voluminous diarrhea or severe burns who may have significant ongoing free-water losses.

Complications

Hyponatremia

The reviewed studies revealed the relative risk of developing mild and moderate hyponatremia (defined as a serum sodium concentration <135 mEq/L and <130 mEq/L, respectively) to be >2 and >5, respectively. The risk related to hyponatremia persisted regardless of age, medical versus surgical status, and intensive care versus general pediatric ward setting. These data strongly reveal an increased risk of hyponatremia when children receive hypotonic versus isotonic IVFs. This association is reinforced by the observations that increased hyponatremia occurs in (1) children with normal sodium at baseline (hospital-acquired hyponatremia) and (2) children who have a low sodium concentration at baseline (hospital-aggravated hyponatremia). This association has been found when using both 0.2% saline (sodium 34 mEq/L) and 0.45% saline (sodium 77 mEq/L). The risk for hyponatremia with hypotonic fluids persisted in the subgroup of patients who received fluids at a restricted rate.[49,54,58,59] A sensitivity analysis in which the Shamim et al[58] study was excluded given the anomalous number of events in both arms revealed no change in the overall estimated relative risk (0.43; 95% CI, 0.35–0.53) compared with that of all the studies included (0.46; 95% CI, 0.37–0.57; Supplemental Fig 2). In the clinical trials in which researchers assessed the possible mechanism for this finding, elevated antidiuretic hormone (ADH) concentration was found to play a putative role.[54]

There is heterogeneity in the design of the above studies in the types of patients enrolled, IVF rate and type, frequency of plasma sodium monitoring, and study duration. Despite this heterogeneity, the increased risk of hyponatremia with hypotonic IVFs is consistent. Some may argue that mild hyponatremia (plasma sodium 130–134 mEq/L) and moderate hyponatremia (plasma sodium 125–129 mEq/L) may not be clinically significant or constitute harm. However, the studies in which researchers evaluated moderate hyponatremia revealed benefits of isotonic versus hypotonic IVFs (Supplemental Figs 2 and 4). Furthermore, hypotonic solutions have been associated with a larger decrease in serum sodium. Also, the true effects of hypotonic IVFs may have been underestimated because many of the studies also included rigorous monitoring of sodium, during which patients were removed from the study if mild hyponatremia developed. Numerous studies of adults have revealed that mild and asymptomatic hyponatremia is associated with deleterious consequences, is an independent risk factor for mortality,[62,63] and leads to increased length of hospitalization and increases in costs of hospitalization.[64,65] Thus, the subcommittee believes that hyponatremia is an appropriate indicator of potential harm.

Hypernatremia

One of the concerns when providing a higher level of sodium in IVFs is the development of hypernatremia (serum sodium >145 mEq/L). This was evaluated in the most recently published systematic review.[33] Those authors identified that there was no evidence of an increased risk of hypernatremia associated with the administration of isotonic fluids, although the quality of evidence was judged to be low, primarily given the low incidence of hypernatremia in the studies included. To be clear, there was not evidence of no risk; the risk is unclear from the meta-analysis results. The estimated risk ratio from that meta-analysis was 1.24 (95% CI, 0.65–2.38), drawn from 9 studies with 937 patients, although 3 studies had no events and did not contribute to the estimate. Researchers in 2 large studies published since the meta-analysis did not find evidence of an increased risk of hypernatremia with isotonic IVFs. In the study by Friedman et al,[32] there was 1 patient in each randomized group (N = 110)

who developed hypernatremia, and in the study by McNab et al,[35] the incidence of hypernatremia was 4% in the isotonic IVF group and 6% in the hypotonic IVF group, with no significant difference noted between the 2 groups (N = 641 with data for analysis). The available data among the meta-analysis discussed above and subsequent large RCTs were unable to be used to demonstrate an increased risk of hypernatremia associated with the use of isotonic IVFs.

Acidosis

A hyperchloremic metabolic acidosis has been associated with 0.9% NaCl when it is used as a resuscitation fluid. Researchers in the majority of studies reviewed in this series did not specifically evaluate the development of acidosis or report on it as a complication. Researchers in 4 studies involving 496 patients evaluated the effect of IVF composition on acid and/or base status,[31,49,54,58] and the majority were not able to demonstrate that 0.9% NaCl resulted in acidosis. Two studies in which researchers compared 0.9% NaCl to 0.45% NaCl involving 357 children found no effect on the development of acidosis based on the change in total carbon dioxide (Tco_2), a measure of plasma bicarbonate, with a low Tco_2 being a surrogate marker for acidosis rather than a low pH.[31,54] Researchers in 1 study compared Hartman solution, which has a base equivalent to 0.45% NaCl, involving 79 patients and found no effect on the development of acidosis based on a change in Tco_2.[49] Researchers in 1 study involving 60 patients compared 0.9% NaCl to 0.18% NaCl and demonstrated a decrease in pH from 7.36 to 7.32 in the 0.9% NaCl group compared with an increase in pH from 7.36 to 7.38 in the 0.18% NaCl group (P = .01), but the effect on Tco_2 was not reported.[58]

Fluid Overload

Children receiving IVFs are at risk for fluid accumulation leading to a positive fluid balance or volume overload. A combination of excessive fluid and sodium can synergistically increase retained volume, a condition that is exacerbated in children with chronic comorbidities (such as systolic cardiac dysfunction [congestive heart failure (CHF)], cirrhotic hepatic failure, chronic kidney disease, and hepatorenal syndrome) and metabolic disturbances (such as hyperaldosteronism and long-term steroid use). Researchers in recent literature, most notably in the critically ill population (adults and children), have attempted to delineate the causative and outcome associations with significant positive fluid accumulation, termed "fluid overload."[66] In the non-ICU population, researchers in only a handful of studies mention an association between fluid tonicity and volume overload (or "weight gain").[20,59,60] Choong et al[20] reported on "overhydration" as estimated by using total weight gain, finding no significant difference between isotonic and hypotonic IVF administration. In the meta-analyses that encompass 12 different RCTs and more than 750 children, neither weight nor net fluid balance is discussed. Increasing scrutiny is being given to fluid management in the critically ill population.[33] To determine any association in patients who are noncritically ill, more evidence is required.

Specific Groups That May Be at Higher Risk for Developing Hyponatremia

Researchers in the RCTs reviewed for this statement excluded many groups of patients who are at particularly high risk for hyponatremia, such as those with congenital or acquired heart disease, liver disease, renal failure or dysfunction, or adrenal insufficiency; neurosurgical patients; and patients taking medication known to impair free-water excretion, such as desmopressin. Data on the efficacy of isotonic fluids to prevent hyponatremia and the potential complications related to isotonic fluids in these patients are lacking. Further studies in which researchers evaluate optimal fluid management in these groups of patients are necessary. Patients with edematous states, such as CHF, cirrhosis, and nephrotic syndrome, have an impaired ability to excrete both free water and sodium and are at risk for both volume overload and hyponatremia. Administering isotonic saline at typical maintenance rates will likely be excessive and risk volume overload, and IVFs should be restricted with close monitoring. Renal diseases can have multiple effects on sodium and water homeostasis; patients with glomerulonephritis may avidly reabsorb sodium, whereas those with tubulopathies may have obligatory urinary sodium losses. Patients with renal failure have a relative inability to excrete free water because of the reduced glomerular filtration rate and simultaneously are unable to produce maximally concentrated urine. Patients with adrenal insufficiency can have renal salt wasting and an impaired ability to excrete free water. Patients with CNS disorders can have multiple conditions that impair water excretion, including SIAD and cerebral salt wasting. Patients receiving certain medications are at particularly high risk for developing hyponatremia, such as desmopressin administered perioperatively for Von Willebrand disease, antiepileptic medications (such as carbamazepine), and chemotherapeutic agents (such as IV cyclophosphamide and vincristine). Isotonic IVFs may be the preferred fluid composition for these disease states, but care is needed in dosing the quantity of fluids, and close

monitoring of both the volume status and electrolytes is required.

Limitations

The subcommittee's recommendation to use isotonic fluids when maintenance IVFs are required does not mean that there are no indications for administering hypotonic fluids or that isotonic fluids will be safe in all patients. Patients with significant renal concentrating defects, such as nephrogenic diabetes insipidus, could develop hypernatremia if they are administered isotonic fluids. Patients with voluminous diarrhea or severe burns may require a hypotonic fluid to keep up with ongoing free-water losses. Hypotonic fluids may also be required to correct hypernatremia. However, for the vast majority of patients, isotonic fluids are the most appropriate maintenance IVF and are the least likely to result in a disorder in serum sodium.

CONCLUSIONS

For the past 60 years, the prescription for maintenance IVFs for infants and children has been a hypotonic fluid. These recommendations were made on theoretical grounds and were not based on clinical trials. Despite this accepted dogma, over the past decade and longer, there have been increasing reports of the deleterious effect of hyponatremia in the acute care setting with the use of the prevailing hypotonic maintenance solutions. Using an evidence-based approach, recommendations for optimal sodium composition of maintenance IVFs are provided to prevent hyponatremia and acute or permanent neurologic impairment related to it. Recommendations are not made regarding the use of an isotonic buffered crystalloid solution versus saline, the optimal rate of fluid therapy, or the need for providing potassium in maintenance fluids. The use of this guideline differentiates the applicability to 2 subgroups of children: (1) The guideline applies to surgical (postoperative) medical patients in a critical care setting and the general inpatient ward. (2) The guideline does not apply to patients with neurosurgical disorders, congenital or acquired cardiac disease, hepatic disease, cancer, renal dysfunction, diabetes insipidus, voluminous watery diarrhea, or severe burns; neonates who are younger than 28 days old or in the NICU; or adolescents older than 18 years of age (Supplemental Fig 5).

This guideline is intended for use primarily by clinicians providing acute care for children and adolescents who require maintenance IVFs. It may be of interest to parents and payers, but it is not intended to be used for reimbursement or to determine insurance coverage. This guideline is not intended to be the sole source of guidance in the use of maintenance IVFs but rather is intended to assist clinicians by providing a framework for clinical decision-making.

The Key Action Statement is as follows:

1A: The AAP recommends that patients 28 days to 18 years of age requiring maintenance IVFs should receive isotonic solutions with appropriate KCl and dextrose because they significantly decrease the risk of developing hyponatremia (evidence quality: A; recommendation strength: strong).

BIOCHEMICAL LABORATORY MONITORING

Although the frequency for biochemical laboratory monitoring was not specifically addressed in the 17 RCTs included in the meta-analysis, researchers in most of the studies obtained serial plasma sodium values, with the first plasma sodium being measured between 6 hours and 12 hours. The incidence of hyponatremia in patients receiving isotonic fluids ranged from 0% to 23%, whereas that of hypotonic fluids ranged from 5% to 100%. This large variability was likely related to the different study designs. Many patients who were hospitalized and received isotonic IVFs will be at risk for hyponatremia if they are receiving IV medications containing free water or are consuming additional free water via the enteral route. For these reasons, clinicians should be aware that even patients receiving isotonic maintenance IVFs are at sufficient risk for developing hyponatremia. If an electrolyte abnormality is discovered, this could provide useful information to adjust maintenance fluid therapy. If patients receiving isotonic maintenance IVFs develop hyponatremia, they should be evaluated to determine if they are receiving other sources of free water or if they may have SIAD and/or an adrenal insufficiency. If hypernatremia develops (plasma sodium >144 mEq/L), patients should be evaluated for renal dysfunction or extrarenal free-water losses.

In patients at high risk for developing electrolyte abnormalities, such as those who have undergone major surgery, those in the ICU, or those with large gastrointestinal losses or receiving diuretics, frequent laboratory monitoring may be necessary. If neurologic symptoms that could be consistent with hyponatremic encephalopathy are present, such as unexplained nausea, vomiting, headache, confusion, or lethargy, electrolytes should be measured.

FUTURE QUALITY-IMPROVEMENT QUESTIONS

Future questions are as follows:

1. How frequently is plasma sodium concentration abnormal, and

is this abnormality clinically significant?

2. Will the widespread use of isotonic maintenance IVFs in the acute-care setting significantly reduce or eliminate hyponatremia- and hyponatremia-related neurologic events?
3. Will the widespread use of 0.9% saline for maintenance IVFs in the acute care setting increase clinically significant metabolic acidosis?
4. Are isotonic-balanced solutions superior to 0.9% saline for the maintenance IVF in the acute-care setting?
5. How frequently should clinicians monitor the serum sodium concentrations when a patient is receiving maintenance IVFs and for patients who are at high risk of sodium abnormalities?

SUBCOMMITTEE ON FLUID AND ELECTROLYTE THERAPY

Leonard G. Feld, MD, PhD, MMM, FAAP – *Chair, Pediatric Nephrology*
Daniel R. Neuspiel, MD, MPH, FAAP – *Pediatric Epidemiologist*
Byron Alexander Foster, MD, MPH, FAAP – *Pediatric Hospitalist*
Matthew D. Garber, MD, FHM, FAAP – *Pediatric Hospitalist; Implementation Scientist*
Michael G. Leu, MD, MS, MHS, FAAP – *Partnership for Policy Implementation*
Rajit K. Basu, MD, MS, FCCM – *Society of Critical Care Medicine, Pediatric Section*
Kelly Austin, MD, MS, FAAP, FACS – *American Pediatric Surgical Association*
Edward E. Conway, Jr, MD, MS, FAAP – *Pediatric Critical Care*
James J. Fehr, MD, FAAP – *Society for Pediatric Anesthesia*
Clare Hawkins, MD – *American Academy of Family Physicians*
Ron L. Kaplan, MD, FAAP – *Pediatric Emergency Medicine*
Echo V. Rowe, MD, FAAP – *Pediatric Anesthesiology and Pain Medicine*
Muhammad Waseem, MD, MS, FAAP, FACEP – *American College of Emergency Physicians*
Michael L. Moritz, MD, FAAP – *Pediatric Nephrology*

STAFF

Kymika Okechukwu, MPA – *Senior Manager, Evidence-Based Medicine Initiatives*

ABBREVIATIONS

AAP: American Academy of Pediatrics
ADH: antidiuretic hormone
AVP: arginine vasopressin
CHF: congestive heart failure
CI: confidence interval
CNS: central nervous system
IV: intravenous
IVF: intravenous fluid
kcal: kilocalorie
KCl: potassium chloride
M-H: Mantel-Haenzel
NaCl: sodium chloride
RCT: randomized controlled trial
SIAD: syndrome of inappropriate antidiuresis
Tco_2: total carbon dioxide

All clinical practice guidelines from the American Academy of Pediatrics automatically expire 5 years after publication unless reaffirmed, revised, or retired at or before that time.

DOI: https://doi.org/10.1542/peds.2018-3083

Address correspondence to Leonard G. Feld, MD, PhD, MMM, FAAP. E-mail: feldllc@gmail.com

PEDIATRICS (ISSN Numbers: Print, 0031-4005; Online, 1098-4275).

FINANCIAL DISCLOSURE: The authors have indicated they have no financial relationships relevant to this article to disclose.

FUNDING: No external funding.

POTENTIAL CONFLICT OF INTEREST: The authors have indicated they have no potential conflicts of interest to disclose.

REFERENCES

1. Chawla G, Drummond GB. Textbook coverage of a common topic: fluid management of patients after surgery. *Med Educ*. 2008;42(6):613–618
2. Davies P, Hall T, Ali T, Lakhoo K. Intravenous postoperative fluid prescriptions for children: a survey of practice. *BMC Surg*. 2008;8:10
3. Freeman MA, Ayus JC, Moritz ML. Maintenance intravenous fluid prescribing practices among paediatric residents. *Acta Paediatr*. 2012;101(10):e465–e468
4. Lee JM, Jung Y, Lee SE, et al. Intravenous fluid prescription practices among pediatric residents in Korea. *Korean J Pediatr*. 2013;56(7):282–285
5. Goldstein SL. Fluid management in acute kidney injury. *J Intensive Care Med*. 2014;29(4):183–189
6. Hoste EA, Maitland K, Brudney CS, et al; ADQI XII Investigators Group. Four phases of intravenous fluid therapy: a conceptual model. *Br J Anaesth*. 2014;113(5):740–747
7. McDermid RC, Raghunathan K, Romanovsky A, Shaw AD, Bagshaw SM. Controversies in fluid therapy: type, dose and toxicity. *World J Crit Care Med*. 2014;3(1):24–33
8. Jackson J, Bolte RG. Risks of intravenous administration of hypotonic fluids for pediatric patients in ED and prehospital settings: let's remove the handle from the pump. *Am J Emerg Med*. 2000;18(3):269–270
9. Wang J, Xu E, Xiao Y. Isotonic versus hypotonic maintenance IV fluids in hospitalized children: a meta-analysis. *Pediatrics*. 2014;133(1):105–113
10. Moritz ML, Ayus JC. Maintenance intravenous fluids in acutely ill patients. *N Engl J Med*. 2015;373(14):1350–1360
11. Carandang F, Anglemyer A, Longhurst CA, et al. Association between

maintenance fluid tonicity and hospital-acquired hyponatremia. *J Pediatr*. 2013;163(6):1646–1651

12. Upadhyay A, Jaber BL, Madias NE. Incidence and prevalence of hyponatremia. *Am J Med*. 2006;119 (7, suppl 1):S30–S35
13. Moritz ML, Ayus JC. Disorders of water metabolism in children: hyponatremia and hypernatremia. *Pediatr Rev*. 2002;23(11):371–380
14. Gerigk M, Gnehm HE, Rascher W. Arginine vasopressin and renin in acutely ill children: implication for fluid therapy. *Acta Paediatr*. 1996;85(5):550–553
15. Judd BA, Haycock GB, Dalton RN, Chantler C. Antidiuretic hormone following surgery in children. *Acta Paediatr Scand*. 1990;79(4):461–466
16. Holliday MA, Segar WE. The maintenance need for water in parenteral fluid therapy. *Pediatrics*. 1957;19(5):823–832
17. Talbot FB. Basal metabolism standards for children. *Am J Dis Child*. 1938;55(3):455–459
18. Hatherill M. Rubbing salt in the wound. *Arch Dis Child*. 2004;89(5):414–418
19. Hoorn EJ, Geary D, Robb M, Halperin ML, Bohn D. Acute hyponatremia related to intravenous fluid administration in hospitalized children: an observational study. *Pediatrics*. 2004;113(5):1279–1284
20. Choong K, Arora S, Cheng J, et al. Hypotonic versus isotonic maintenance fluids after surgery for children: a randomized controlled trial. *Pediatrics*. 2011;128(5):857–866
21. Arieff AI, Ayus JC, Fraser CL. Hyponatraemia and death or permanent brain damage in healthy children. *BMJ*. 1992;304(6836):1218–1222
22. Moritz ML, Ayus JC. Preventing neurological complications from dysnatremias in children. *Pediatr Nephrol*. 2005;20(12):1687–1700
23. Halberthal M, Halperin ML, Bohn D. Lesson of the week: acute hyponatraemia in children admitted to hospital: retrospective analysis of factors contributing to its development and resolution. *BMJ*. 2001;322(7289):780–782
24. Moritz ML, Ayus JC. Prevention of hospital-acquired hyponatremia: a case for using isotonic saline. *Pediatrics*. 2003;111(2):227–230
25. ISMP. Medication safety alert. Plain D5W or hypotonic saline solutions post-op could result in acute hyponatremia and death in healthy children. Available at: ismp.org. Accessed August 14, 2009
26. ISMP Canada. Hospital-acquired acute hyponatremia: two reports of pediatric deaths.*ISMP Canada Saf Bul*. 2009;9(7). Available at: http://www.ismp-canada.org/download/safetyBulletins/ISMPCSB2009-7-HospitalAcquiredAcuteHyponatremia.pdf. Accessed July 26, 2018
27. National Patient Safety Agency. Reducing the risk of hyponatraemia when administering intravenous infusions to children. 2007. Available at: www.npsa.nhs.uk/health/alerts. Accessed July 6, 2018
28. Drysdale SB, Coulson T, Cronin N, et al. The impact of the National Patient Safety Agency intravenous fluid alert on iatrogenic hyponatraemia in children. *Eur J Pediatr*. 2010;169(7):813–817
29. Holliday MA, Ray PE, Friedman AL. Fluid therapy for children: facts, fashions and questions. *Arch Dis Child*. 2007;92(6):546–550
30. McNab S. Isotonic vs hypotonic intravenous fluids for hospitalized children. *JAMA*. 2015;314(7):720–721
31. Almeida HI, Mascarenhas MI, Loureiro HC, et al. The effect of NaCl 0.9% and NaCl 0.45% on sodium, chloride, and acid-base balance in a PICU population. *J Pediatr (Rio J)*. 2015;91(5):499–505
32. Friedman JN, Beck CE, DeGroot J, Geary DF, Sklansky DJ, Freedman SB. Comparison of isotonic and hypotonic intravenous maintenance fluids: a randomized clinical trial. *JAMA Pediatr*. 2015;169(5):445–451
33. McNab S, Ware RS, Neville KA, et al. Isotonic versus hypotonic solutions for maintenance intravenous fluid administration in children. *Cochrane Database Syst Rev*. 2014;(12):CD009457
34. National Clinical Guideline Centre (UK). *IV Fluids in Children: Intravenous Fluid Therapy in Children and Young People in Hospital*. London, United Kingdom: National Clinical Guideline Centre; 2015. Available at: www.ncbi.nlm.nih.gov/pubmed/26741016. Accessed July 6, 2018
35. McNab S, Duke T, South M, et al. 140 mmol/L of sodium versus 77 mmol/L of sodium in maintenance intravenous fluid therapy for children in hospital (PIMS): a randomised controlled double-blind trial. *Lancet*. 2015;385(9974):1190–1197. Published online December 1, 2014
36. Siegel NJ, ed. Fluids, electrolytes and acid-base. In: *Rudolph's Pediatrics*. 21st ed. New York, NY: McGraw Hill; 2003:1653–1655
37. Greenbaum LA, ed. Pathophysiology of body fluids and fluid therapy. In: *Nelson's Textbook of Pediatrics*. 17th ed. Philadelphia, PA: WB Saunders; 2004:242–245
38. Powers KS. Dehydration: isonatremic, hyponatremic, and hypernatremic recognition and management. *Pediatr Rev*. 2015;36(7):274–283; quiz 284–285
39. Foster BA, Tom D, Hill V. Hypotonic versus isotonic fluids in hospitalized children: a systematic review and meta-analysis. *J Pediatr*. 2014;165(1):163–169.e2
40. Padua AP, Macaraya JR, Dans LF, Anacleto FE Jr. Isotonic versus hypotonic saline solution for maintenance intravenous fluid therapy in children: a systematic review. *Pediatr Nephrol*. 2015;30(7):1163–1172
41. Yang G, Jiang W, Wang X, Liu W. The efficacy of isotonic and hypotonic intravenous maintenance fluid for pediatric patients: a meta-analysis of randomized controlled trials. *Pediatr Emerg Care*. 2015;31(2):122–126
42. Choong K, Kho ME, Menon K, Bohn D. Hypotonic versus isotonic saline in hospitalised children: a systematic review. *Arch Dis Child*. 2006;91(10):828–835
43. Guyatt GH, Sackett DL, Cook DJ. Users' guides to the medical literature. II. How to use an article about therapy or prevention. A. Are the results of the study valid? Evidence-Based Medicine Working Group. *JAMA*. 1993;270(21):2598–2601
44. Guyatt GH, Sackett DL, Cook DJ. Users' guides to the medical literature. II.

How to use an article about therapy or prevention. B. What were the results and will they help me in caring for my patients? Evidence-Based Medicine Working Group. *JAMA*. 1994;271(1):59–63

45. Higgins JP, Green S, eds. *Cochrane Handbook for Systematic Reviews of Interventions. Version 5.1.0. Updated March 2011*. London, United Kingdom: The Cochrane Collaboration; 2011. Available at: http://handbook-5-1.cochrane.org/. Accessed July 6, 2018
46. American Academy of Pediatrics Steering Committee on Quality Improvement and Management. Classifying recommendations for clinical practice guidelines. *Pediatrics*. 2004;114(3):874–877
47. Bridge-Wiz. Guideline quality appraisal. Available at: http://gem.med.yale.edu/BRIDGE-Wiz/BridgeWiz_2.1_AAP.zip. Accessed April 12, 2016
48. Brazel PW, McPhee IB. Inappropriate secretion of antidiuretic hormone in postoperative scoliosis patients: the role of fluid management. *Spine*. 1996;21(6):724–727
49. Coulthard MG, Long DA, Ullman AJ, Ware RS. A randomised controlled trial of Hartmann's solution versus half normal saline in postoperative paediatric spinal instrumentation and craniotomy patients. *Arch Dis Child*. 2012;97(6):491–496
50. Jorro Barón FA, Meregalli CN, Rombola VA, et al. Hypotonic versus isotonic maintenance fluids in critically ill pediatric patients: a randomized controlled trial [in English and Spanish]. *Arch Argent Pediatr*. 2013;111(4):281–287
51. Flores Robles CM, Cuello García CA. A prospective trial comparing isotonic with hypotonic maintenance fluids for prevention of hospital-acquired hyponatraemia. *Paediatr Int Child Health*. 2016;36(3):168–174
52. Kannan L, Lodha R, Vivekanandhan S, Bagga A, Kabra SK, Kabra M. Intravenous fluid regimen and hyponatraemia among children: a randomized controlled trial. *Pediatr Nephrol*. 2010;25(11):2303–2309
53. Montañana PA, Modesto i Alapont V, Ocón AP, López PO, López Prats JL, Toledo Parreño JD. The use of isotonic fluid as maintenance therapy prevents iatrogenic hyponatremia in pediatrics: a randomized, controlled open study. *Pediatr Crit Care Med*. 2008;9(6):589–597
54. Neville KA, Sandeman DJ, Rubinstein A, et al. Prevention of hyponatremia during maintenance intravenous fluid administration: a prospective randomized study of fluid type versus fluid rate. *J Pediatr*. 2010;156(2):313–319.e1–e2
55. Ramanathan S, Kumar P, Mishra K, Dutta AK. Isotonic versus hypotonic parenteral maintenance fluids in very severe pneumonia. *Indian J Pediatr*. 2016;83(1):27–32
56. Rey C, Los-Arcos M, Hernández A, Sánchez A, Díaz JJ, López-Herce J. Hypotonic versus isotonic maintenance fluids in critically ill children: a multicenter prospective randomized study. *Acta Paediatr*. 2011;100(8):1138–1143
57. Saba TG, Fairbairn J, Houghton F, Laforte D, Foster BJ. A randomized controlled trial of isotonic versus hypotonic maintenance intravenous fluids in hospitalized children. *BMC Pediatr*. 2011;11:82
58. Shamim A, Afzal K, Ali SM. Safety and efficacy of isotonic (0.9%) vs. hypotonic (0.18%) saline as maintenance intravenous fluids in children: a randomized controlled trial. *Indian Pediatr*. 2014;51(12):969–974
59. Yung M, Keeley S. Randomised controlled trial of intravenous maintenance fluids. *J Paediatr Child Health*. 2009;45(1–2):9–14
60. Valadão MC S, Piva JP, Santana JC, Garcia PC. Comparison of two maintenance electrolyte solutions in children in the postoperative appendectomy period: a randomized, controlled trial. *J Pediatr (Rio J)*. 2015;91(5):428–434
61. Duke T, Kinney S, Waters K. Hyponatraemia and seizures in oncology patients associated with hypotonic intravenous fluids. *J Paediatr Child Health*. 2005;41(12):685–686
62. Gankam-Kengne F, Ayers C, Khera A, de Lemos J, Maalouf NM. Mild hyponatremia is associated with an increased risk of death in an ambulatory setting. *Kidney Int*. 2013;83(4):700–706
63. Holland-Bill L, Christiansen CF, Heide-Jørgensen U, et al. Hyponatremia and mortality risk: a Danish cohort study of 279508 acutely hospitalized patients. *Eur J Endocrinol*. 2015;173(1):71–81
64. Amin A, Deitelzweig S, Christian R, et al. Evaluation of incremental healthcare resource burden and readmission rates associated with hospitalized hyponatremic patients in the US. *J Hosp Med*. 2012;7(8):634–639
65. Corona G, Giuliani C, Parenti G, et al. The economic burden of hyponatremia: systematic review and meta-analysis. *Am J Med*. 2016;129(8):823–835.e4
66. Alobaidi R, Morgan C, Basu RK, et al. Associations between fluid balance and outcomes in critically ill children: a protocol for a systematic review and meta-analysis. *Can J Kidney Health Dis*. 2017;4:2054358117692560
67. Pemde HK, Dutta AK, Sodani R, Mishra K. Isotonic intravenous maintenance fluid reduces hospital acquired hyponatremia in young children with central nervous system infections. *Indian J Pediatr*. 2015;82(1):13–18

Intravenous Fluids Clinical Practice Guideline Quick Reference Tools

- Action Statement Summary
  — Clinical Practice Guideline: Maintenance Intravenous Fluids in Children
- *ICD-10-CM* Coding Quick Reference for Maintenance Intravenous Fluids

Action Statement Summary

Clinical Practice Guideline: Maintenance Intravenous Fluids in Children

Key Action Statement 1

Composition of Maintenance IVFs

Key Action Statement 1A

The AAP recommends that patients 28 days to 18 years of age requiring maintenance IVFs should receive isotonic solutions with appropriate potassium chloride (KCl) and dextrose because they significantly decrease the risk of developing hyponatremia (evidence quality: A; recommendation strength: strong).

Coding Quick Reference for Maintenance Intravenous Fluids
ICD-10-CM
E86.0 Dehydration

The Diagnosis and Management of Acute Otitis Media

- *Clinical Practice Guideline*
  - *PPI: AAP Partnership for Policy Implementation*
    See Appendix 1 for more information.

CLINICAL PRACTICE GUIDELINE

The Diagnosis and Management of Acute Otitis Media

abstract

FREE

This evidence-based clinical practice guideline is a revision of the 2004 acute otitis media (AOM) guideline from the American Academy of Pediatrics (AAP) and American Academy of Family Physicians. It provides recommendations to primary care clinicians for the management of children from 6 months through 12 years of age with uncomplicated AOM.

In 2009, the AAP convened a committee composed of primary care physicians and experts in the fields of pediatrics, family practice, otolaryngology, epidemiology, infectious disease, emergency medicine, and guideline methodology. The subcommittee partnered with the Agency for Healthcare Research and Quality and the Southern California Evidence-Based Practice Center to develop a comprehensive review of the new literature related to AOM since the initial evidence report of 2000. The resulting evidence report and other sources of data were used to formulate the practice guideline recommendations.

The focus of this practice guideline is the appropriate diagnosis and initial treatment of a child presenting with AOM. The guideline provides a specific, stringent definition of AOM. It addresses pain management, initial observation versus antibiotic treatment, appropriate choices of antibiotic agents, and preventive measures. It also addresses recurrent AOM, which was not included in the 2004 guideline. Decisions were made on the basis of a systematic grading of the quality of evidence and benefit-harm relationships.

The practice guideline underwent comprehensive peer review before formal approval by the AAP.

This clinical practice guideline is not intended as a sole source of guidance in the management of children with AOM. Rather, it is intended to assist primary care clinicians by providing a framework for clinical decision-making. It is not intended to replace clinical judgment or establish a protocol for all children with this condition. These recommendations may not provide the only appropriate approach to the management of this problem. *Pediatrics* 2013;131:e964–e999

Allan S. Lieberthal, MD, FAAP, Aaron E. Carroll, MD, MS, FAAP, Tasnee Chonmaitree, MD, FAAP, Theodore G. Ganiats, MD, Alejandro Hoberman, MD, FAAP, Mary Anne Jackson, MD, FAAP, Mark D. Joffe, MD, FAAP, Donald T. Miller, MD, MPH, FAAP, Richard M. Rosenfeld, MD, MPH, FAAP, Xavier D. Sevilla, MD, FAAP, Richard H. Schwartz, MD, FAAP, Pauline A. Thomas, MD, FAAP, and David E. Tunkel, MD, FAAP, FACS

KEY WORDS

acute otitis media, otitis media, otoscopy, otitis media with effusion, watchful waiting, antibiotics, antibiotic prophylaxis, tympanostomy tube insertion, immunization, breastfeeding

ABBREVIATIONS

AAFP—American Academy of Family Physicians
AAP—American Academy of Pediatrics
AHRQ—Agency for Healthcare Research and Quality
AOM—acute otitis media
CI—confidence interval
FDA—US Food and Drug Administration
LAIV—live-attenuated intranasal influenza vaccine
MEE—middle ear effusion
MIC—minimum inhibitory concentration
NNT—number needed to treat
OM—otitis media
OME—otitis media with effusion
OR—odds ratio
PCV7—heptavalent pneumococcal conjugate vaccine
PCV13—13-valent pneumococcal conjugate vaccine
RD—rate difference
SNAP—safety-net antibiotic prescription
TIV—trivalent inactivated influenza vaccine
TM—tympanic membrane
WASP—wait-and-see prescription

(Continued on last page)

Key Action Statement 1A: Clinicians should diagnose acute otitis media (AOM) in children who present with moderate to severe bulging of the tympanic membrane (TM) *or* new onset of otorrhea not due to acute otitis externa. Evidence Quality: Grade B. Strength: Recommendation.

Key Action Statement 1B: Clinicians should diagnose AOM in children who present with mild bulging of the TM *and* recent (less than 48 hours) onset of ear pain (holding, tugging, rubbing of the ear in a nonverbal child) or intense erythema of the TM. Evidence Quality: Grade C. Strength: Recommendation.

Key Action Statement 1C: Clinicians should not diagnose AOM in children who do not have middle ear effusion (MEE) (based on pneumatic otoscopy and/or tympanometry). Evidence Quality: Grade B. Strength: Recommendation.

Key Action Statement 2: The management of AOM should include an assessment of pain. If pain is present, the clinician should recommend treatment to reduce pain. Evidence Quality: Grade B. Strength: Strong Recommendation.

Key Action Statement 3A: Severe AOM: The clinician should prescribe antibiotic therapy for AOM (bilateral or unilateral) in children 6 months and older with severe signs or symptoms (ie, moderate or severe otalgia or otalgia for at least 48 hours or temperature 39°C [102.2°F] or higher). Evidence Quality: Grade B. Strength: Strong Recommendation.

Key Action Statement 3B: Nonsevere bilateral AOM in young children: The clinician should prescribe antibiotic therapy for bilateral AOM in children 6 months through 23 months of age without severe signs or symptoms (ie, mild otalgia for less than 48 hours and temperature less than 39°C [102.2°F]). Evidence Quality: Grade B. Strength: Recommendation.

Key Action Statement 3C: Nonsevere unilateral AOM in young children: The clinician should either prescribe antibiotic therapy *or* offer observation with close follow-up based on joint decision-making with the parent(s)/caregiver for unilateral AOM in children 6 months to 23 months of age without severe signs or symptoms (ie, mild otalgia for less than 48 hours and temperature less than 39°C [102.2°F]). When observation is used, a mechanism must be in place to ensure follow-up and begin antibiotic therapy if the child worsens or fails to improve within 48 to 72 hours of onset of symptoms. Evidence Quality: Grade B. Strength: Recommendation.

Key Action Statement 3D: Nonsevere AOM in older children: The clinician should either prescribe antibiotic therapy *or* offer observation with close follow-up based on joint decision-making with the parent(s)/caregiver for AOM (bilateral or unilateral) in children 24 months or older without severe signs or symptoms (ie, mild otalgia for less than 48 hours and temperature less than 39°C [102.2°F]). When observation is used, a mechanism must be in place to ensure follow-up and begin antibiotic therapy if the child worsens or fails to improve within 48 to 72 hours of onset of symptoms. Evidence Quality: Grade B. Strength: Recommendation.

Key Action Statement 4A: Clinicians should prescribe amoxicillin for AOM when a decision to treat with antibiotics has been made *and* the child has not received amoxicillin in the past 30 days *or* the child does not have concurrent purulent conjunctivitis *or* the child is not allergic to penicillin. Evidence Quality: Grade B. Strength: Recommendation.

Key Action Statement 4B: Clinicians should prescribe an antibiotic with additional β-lactamase coverage for AOM when a decision to treat with antibiotics has been made, *and* the child has received amoxicillin in the last 30 days *or* has concurrent purulent conjunctivitis, *or* has a history of recurrent AOM unresponsive to amoxicillin. Evidence Quality: Grade C. Strength: Recommendation.

Key Action Statement 4C: Clinicians should reassess the patient if the caregiver reports that the child's symptoms have worsened or failed to respond to the initial antibiotic treatment within 48 to 72 hours and determine whether a change in therapy is needed. Evidence Quality: Grade B. Strength: Recommendation.

Key Action Statement 5A: Clinicians should not prescribe prophylactic antibiotics to reduce the frequency of episodes of AOM in children with recurrent AOM. Evidence Quality: Grade B. Strength: Recommendation.

Key Action Statement 5B: Clinicians may offer tympanostomy tubes for recurrent AOM (3 episodes in 6 months or 4 episodes in 1 year with 1 episode in the preceding 6 months). Evidence Quality: Grade B. Strength: Option.

Key Action Statement 6A: Clinicians should recommend pneumococcal conjugate vaccine to all children according to the schedule of the Advisory Committee on Immunization Practices of the Centers for Disease Control and Prevention, American Academy of Pediatrics (AAP), and American Academy of Family Physicians (AAFP). Evidence Quality: Grade B. Strength: Strong Recommendation.

Key Action Statement 6B: Clinicians should recommend annual influenza vaccine to all children according to the schedule of the Advisory Committee on Immunization Practices, AAP, and AAFP. Evidence Quality: Grade B. Strength: Recommendation.

2Key Action Statement 6C: Clinicians should encourage exclusive breastfeeding for at least 6 months. Evidence Quality: Grade B. Strength: Recommendation.

Key Action Statement 6D: Clinicians should encourage avoidance of tobacco smoke exposure. Evidence Quality: Grade C. Strength: Recommendation.

INTRODUCTION

In May 2004, the AAP and AAFP published the "Clinical Practice Guideline: Diagnosis and Management of Acute Otitis Media".[1] The guideline offered 8 recommendations ranked according to level of evidence and benefit-harm relationship. Three of the recommendations—diagnostic criteria, observation, and choice of antibiotics—led to significant discussion, especially among experts in the field of otitis media (OM). Also, at the time the guideline was written, information regarding the heptavalent pneumococcal conjugate vaccine (PCV7) was not yet published. Since completion of the guideline in November 2003 and its publication in May 2004, there has been a significant body of additional literature on AOM.

Although OM remains the most common condition for which antibacterial agents are prescribed for children in the United States[2,3] clinician visits for OM decreased from 950 per 1000 children in 1995–1996 to 634 per 1000 children in 2005–2006. There has been a proportional decrease in antibiotic prescriptions for OM from 760 per 1000 in 1995–1996 to 484 per 1000 in 2005–2006. The percentage of OM visits resulting in antibiotic prescriptions remained relatively stable (80% in 1995–1996; 76% in 2005–2006).[2] Many factors may have contributed to the decrease in visits for OM, including financial issues relating to insurance, such as copayments, that may limit doctor visits, public education campaigns regarding the viral nature of most infectious diseases, use of the PCV7 pneumococcal vaccine, and increased use of the influenza vaccine. Clinicians may also be more attentive to differentiating AOM from OM with effusion (OME), resulting in fewer visits coded for AOM and fewer antibiotic prescriptions written.

Despite significant publicity and awareness of the 2004 AOM guideline, evidence shows that clinicians are hesitant to follow the guideline recommendations. Vernacchio et al[4] surveyed 489 primary care physicians as to their management of 4 AOM scenarios addressed in the 2004 guideline. No significant changes in practice were noted on this survey, compared with a survey administered before the 2004 AOM guideline. Coco[5] used the National Ambulatory Medical Care Survey from 2002 through 2006 to determine the frequency of AOM visits without antibiotics before and after publication of the 2004 guideline. There was no difference in prescribing rates. A similar response to otitis guidelines was found in Italy as in the United States.[6,7] These findings parallel results of other investigations regarding clinician awareness and adherence to guideline recommendations in all specialties, including pediatrics.[8] Clearly, for clinical practice guidelines to be effective, more must be done to improve their dissemination and implementation.

This revision and update of the AAP/AAFP 2004 AOM guideline[1] will evaluate published evidence on the diagnosis and management of uncomplicated AOM and make recommendations based on that evidence. The guideline is intended for primary care clinicians including pediatricians and family physicians, emergency department physicians, otolaryngologists, physician assistants, and nurse practitioners. The scope of the guideline is the diagnosis and management of AOM, including recurrent AOM, in children 6 months through 12 years of age. It applies only to an otherwise healthy child without underlying conditions that may alter the natural course of AOM, including but not limited to the presence of tympanostomy tubes; anatomic abnormalities, including cleft palate; genetic conditions with craniofacial abnormalities, such as Down syndrome; immune deficiencies; and the presence of cochlear implants. Children with OME without AOM are also excluded.

Glossary of Terms

AOM—the rapid onset of signs and symptoms of inflammation in the middle ear[9,10]

Uncomplicated AOM—AOM without otorrhea[1]

Severe AOM—AOM with the presence of moderate to severe otalgia *or* fever equal to or higher than 39°C[9,10]

Nonsevere AOM—AOM with the presence of mild otalgia and a temperature below 39°C[9,10]

Recurrent AOM—3 or more well-documented and separate AOM episodes in the preceding 6 months *or* 4 or more episodes in the preceding 12 months with at least 1 episode in the past 6 months[11,12]

OME—inflammation of the middle ear with liquid collected in the middle ear; the signs and symptoms of acute infection are absent[9]

MEE—liquid in the middle ear without reference to etiology, pathogenesis, pathology, or duration[9]

Otorrhea—discharge from the ear, originating at 1 or more of the following sites: the external auditory canal,

middle ear, mastoid, inner ear, or intracranial cavity

Otitis externa—an infection of the external auditory canal

Tympanometry—measuring acoustic immittance (transfer of acoustic energy) of the ear as a function of ear canal air pressure[13,14]

Number needed to treat (NNT)—the number of patients who need to be treated to prevent 1 additional bad outcome[15]

Initial antibiotic therapy—treatment of AOM with antibiotics that are prescribed at the time of diagnosis with the intent of starting antibiotic therapy as soon as possible after the encounter

Initial observation—initial management of AOM limited to symptomatic relief, with commencement of antibiotic therapy only if the child's condition worsens at any time or does not show clinical improvement within 48 to 72 hours of diagnosis; a mechanism must be in place to ensure follow-up and initiation of antibiotics if the child fails observation

METHODS

Guideline development using an evidence-based approach requires that all evidence related to the guideline is gathered in a systematic fashion, objectively assessed, and then described so readers can easily see the links between the evidence and recommendations made. An evidence-based approach leads to recommendations that are guided by both the quality of the available evidence and the benefit-to-harm ratio that results from following the recommendation. Figure 1 shows the relationship of evidence quality and benefit-harm balance in determining the level of recommendation. Table 1 presents the AAP definitions and implications of different levels of evidence-based recommendations.[16]

In preparing for the 2004 AAP guidelines, the Agency for Healthcare Research and Quality (AHRQ) funded and conducted an exhaustive review of the literature on diagnosis and management of AOM.[17–19] In 2008, the AHRQ and the Southern California Evidence-Based Practice Center began a similar process of reviewing the literature published since the 2001 AHRQ report. The AAP again partnered with AHRQ and the Southern California Evidence-Based Practice Center to develop the evidence report, which served as a major source of data for these practice guideline recommendations.[20,21] New key questions were determined by a technical expert panel. The scope of the new report went beyond the 2001 AHRQ report to include recurrent AOM.

The key questions addressed by AHRQ in the 2010 report were as follows:

1. Diagnosis of AOM: What are the operating characteristics (sensitivity, specificity, and likelihood ratios) of clinical symptoms and otoscopic findings (such as bulging TM) to diagnose uncomplicated AOM and to distinguish it from OME?
2. What has been the effect of the use of heptavalent PCV7 on AOM microbial epidemiology, what organisms (bacterial and viral) are associated with AOM since the introduction of PCV7, and what are the patterns of antimicrobial resistance in AOM since the introduction of PCV7?
3. What is the comparative effectiveness of various treatment options for treating uncomplicated AOM in average risk children?
4. What is the comparative effectiveness of different management options for recurrent OM (uncomplicated) and persistent OM or relapse of AOM?
5. Do treatment outcomes in Questions 3 and 4 differ by characteristics of the condition (AOM), patient, environment, and/or health care delivery system?
6. What adverse effects have been observed for treatments for which outcomes are addressed in Questions 3 and 4?

For the 2010 review, searches of PubMed and the Cochrane Database of Systematic Reviews, Cochrane Central Register of Controlled Trials, and Education Resources Information Center were conducted by using the same search strategies used for the 2001 report for publications from 1998 through June 2010. Additional terms or conditions not considered in the 2001 review (recurrent OM, new drugs, and heptavalent pneumococcal vaccine) were also included. The Web of Science was also used to search for citations of the 2001 report and its peer-reviewed publications. Titles were screened independently by 2

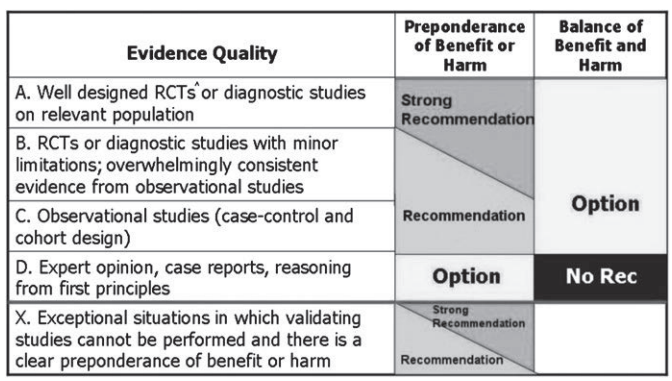


FIGURE 1
Relationship of evidence quality and benefit-harm balance in determining the level of recommendation. RCT, randomized controlled trial.

TABLE 1 Guideline Definitions for Evidence-Based Statements

Statement	Definition	Implication
Strong Recommendation	A strong recommendation in favor of a particular action is made when the anticipated benefits of the recommended intervention clearly exceed the harms (as a strong recommendation against an action is made when the anticipated harms clearly exceed the benefits) and the quality of the supporting evidence is excellent. In some clearly identified circumstances, strong recommendations may be made when high-quality evidence is impossible to obtain and the anticipated benefits strongly outweigh the harms.	Clinicians should follow a strong recommendation unless a clear and compelling rationale for an alternative approach is present.
Recommendation	A recommendation in favor of a particular action is made when the anticipated benefits exceed the harms, but the quality of evidence is not as strong. Again, in some clearly identified circumstances, recommendations may be made when high-quality evidence is impossible to obtain but the anticipated benefits outweigh the harms.	Clinicians would be prudent to follow a recommendation but should remain alert to new information and sensitive to patient preferences.
Option	Options define courses that may be taken when either the quality of evidence is suspect or carefully performed studies have shown little clear advantage to 1 approach over another.	Clinicians should consider the option in their decision-making, and patient preference may have a substantial role.
No Recommendation	No recommendation indicates that there is a lack of pertinent published evidence and that the anticipated balance of benefits and harms is presently unclear.	Clinicians should be alert to new published evidence that clarifies the balance of benefit versus harm.

pediatricians with experience in conducting systematic reviews.

For the question pertaining to diagnosis, efficacy, and safety, the search was primarily for clinical trials. For the question pertaining to the effect of PCV7 on epidemiology and microbiology, the group searched for trials that compared microbiology in the same populations before and after introduction of the vaccine or observational studies that compared microbiology across vaccinated and unvaccinated populations.

In total, the reviewers examined 7646 titles, of which 686 titles were identified for further review. Of those, 72 articles that met the predetermined inclusion and exclusion criteria were reviewed in detail. Investigators abstracted data into standard evidence tables, with accuracy checked by a second investigator. Studies were quality-rated by 2 investigators by using established criteria. For randomized controlled trials, the Jadad criteria were used.[22] QUADAS criteria[23] were used to evaluate the studies that pertained to diagnosis. GRADE criteria were applied to pooled analyses.[24] Data abstracted included parameters necessary to define study groups, inclusion/exclusion criteria, influencing factors, and outcome measures. Some of the data for analysis were abstracted by a biostatistician and checked by a physician reviewer. A sequential resolution strategy was used to match and resolve the screening and review results of the 2 pediatrician reviewers.

For the assessment of treatment efficacy, pooled analyses were performed for comparisons for which 3 or more trials could be identified. Studies eligible for analyses of questions pertaining to treatment efficacy were grouped for comparisons by treatment options. Each comparison consisted of studies that were considered homogeneous across clinical practice. Because some of the key questions were addressed in the 2001 evidence report,[17] studies identified in that report were included with newly identified articles in the 2010 evidence report.[20]

Decisions were made on the basis of a systematic grading of the quality of evidence and strength of recommendations as well as expert consensus when definitive data were not available. Results of the literature review were presented in evidence tables and published in the final evidence report.[20]

In June 2009, the AAP convened a new subcommittee to review and revise the May 2004 AOM guideline.[1] The subcommittee comprised primary care physicians and experts in the fields of pediatrics, family practice, otolaryngology, epidemiology, infectious disease, emergency medicine, and guideline methodology. All panel members reviewed the AAP policy on conflict of interest and voluntary disclosure and were given an opportunity to present any potential conflicts with the subcommittee's work. All potential conflicts of interest are listed at the end of this document. The project was funded by the AAP. New literature on OM is continually being published. Although the systematic review performed by AHRQ could not be replicated with new literature, members of the Subcommittee on Diagnosis and Management of Acute Otitis Media reviewed additional articles. PubMed was searched by using the single search term "acute otitis media,"

approximately every 6 months from June 2009 through October 2011 to obtain new articles. Subcommittee members evaluated pertinent articles for quality of methodology and importance of results. Selected articles used in the AHRQ review were also reevaluated for their quality. Conclusions were based on the consensus of the subcommittee after the review of newer literature and reevaluation of the AHRQ evidence. Key action statements were generated using BRIDGE-Wiz (Building Recommendations in a Developers Guideline Editor), an interactive software tool that leads guideline development through a series of questions that are intended to create a more actionable set of key action statements.[25] BRIDGE-Wiz also incorporates the quality of available evidence into the final determination of the strength of each recommendation.

After thorough review by the subcommittee for this guideline, a draft was reviewed by other AAP committees and sections, selected outside organizations, and individuals identified by the subcommittee as experts in the field. Additionally, members of the subcommittee were encouraged to distribute the draft to interested parties in their respective specialties. All comments were reviewed by the writing group and incorporated into the final guideline when appropriate.

This clinical practice guideline is not intended as a sole source of guidance in the management of children with AOM. Rather, it is intended to assist clinicians in decision-making. It is not intended to replace clinical judgment or establish a protocol for the care of all children with this condition. These recommendations may not provide the only appropriate approach to the management of children with AOM.

It is AAP policy to review and update evidence-based guidelines every 5 years.

KEY ACTION STATEMENTS

Key Action Statement 1A

Clinicians should diagnose AOM in children who present with moderate to severe bulging of the TM *or* new onset of otorrhea not due to acute otitis externa. (Evidence Quality: Grade B, Rec. Strength: Recommendation)

Key Action Statement Profile: KAS 1A

Aggregate evidence quality	Grade B
Benefits	• Identify a population of children most likely to benefit from intervention. • Avoid unnecessary treatment of those without highly certain AOM. • Promote consistency in diagnosis.
Risks, harms, cost	May miss AOM that presents with a combination of mild bulging, intense erythema, or otalgia that may not necessarily represent less severe disease and may also benefit from intervention.
Benefits-harms assessment	Preponderance of benefit.
Value judgments	Identification of a population of children with highly certain AOM is beneficial. Accurate, specific diagnosis is helpful to the individual patient. Modification of current behavior of overdiagnosis is a goal. Increased specificity is preferred even as sensitivity is lowered.
Intentional vagueness	By using stringent diagnostic criteria, the TM appearance of less severe illness that might be early AOM has not been addressed.
Role of patient preferences	None
Exclusions	None
Strength	**Recommendation**
Notes	Tympanocentesis studies confirm that using these diagnostic findings leads to high levels of isolation of pathogenic bacteria. Evidence is extrapolated from treatment studies that included tympanocentesis.

Key Action Statement 1B

Clinicians should diagnose AOM in children who present with mild bulging of the TM *and* recent (less than 48 hours) onset of ear pain (holding, tugging, rubbing of the ear in a nonverbal child) or intense erythema of the TM. (Evidence Quality: Grade C, Rec. Strength: Recommendation)

Key Action Statement Profile: KAS 1B

Aggregate evidence quality	Grade C
Benefits	Identify AOM in children when the diagnosis is not highly certain.
Risks, harms, cost	Overdiagnosis of AOM. Reduced precision in diagnosis.
Benefits-harms assessment	Benefits greater than harms.
Value judgments	None.
Intentional vagueness	Criteria may be more subjective.
Role of patient preferences	None
Exclusions	None
Strength	**Recommendation**
Notes	Recent onset of ear pain means within the past 48 hours.

Key Action Statement 1C

Clinicians should not diagnose AOM in children who do not have MEE (based on pneumatic otoscopy and/or tympanometry). (Evidence Quality: Grade B, Rec. Strength: Recommendation)

Key Action Statement Profile: KAS 1C

Aggregate evidence quality	Grade B
Benefits	Reduces overdiagnosis and unnecessary treatment. Increases correct diagnosis of other conditions with symptoms that otherwise might be attributed to AOM. Promotes the use of pneumatic otoscopy and tympanometry to improve diagnostic accuracy.
Risks, harms, cost	Cost of tympanometry. Need to acquire or reacquire skills in pneumatic otoscopy and tympanometry for some clinicians.
Benefits-harms assessment	Preponderance of benefit.
Value judgments	AOM is overdiagnosed, often without adequate visualization of the TM. Early AOM without effusion occurs, but the risk of overdiagnosis supersedes that concern.
Intentional vagueness	None
Role of patient preferences	None
Exclusions	Early AOM evidenced by intense erythema of the TM.
Strength	**Recommendation**

Purpose of This Section

There is no gold standard for the diagnosis of AOM. In fact, AOM has a spectrum of signs as the disease develops.[26] Therefore, the purpose of this section is to provide clinicians and researchers with a working clinical definition of AOM and to differentiate AOM from OME. The criteria were chosen to achieve high specificity recognizing that the resulting decreased sensitivity may exclude less severe presentations of AOM.

Changes From AAP/AAFP 2004 AOM Guideline

Accurate diagnosis of AOM is critical to sound clinical decision-making and high-quality research. The 2004 "Clinical Practice Guideline: Diagnosis and Management of AOM"[1] used a 3-part definition for AOM: (1) acute onset of symptoms, (2) presence of MEE, and (3) signs of acute middle ear inflammation. This definition generated extensive discussion and reanalysis of the AOM diagnostic evidence. The 2004 definition lacked precision to exclude cases of OME, and diagnoses of AOM could be made in children with acute onset of symptoms, including severe otalgia and MEE, without other otoscopic findings of inflammation.[27] Furthermore, the use of "uncertain diagnosis" in the 2004 AOM guideline may have permitted diagnoses of AOM without clear visualization of the TM. Earlier studies may have enrolled children who had OME rather than AOM, resulting in the possible classification of such children as improved because their nonspecific symptoms would have abated regardless of therapy.[28–30] Two studies, published in 2011, used stringent diagnostic criteria for diagnosing AOM with much less risk of conclusions based on data from mixed patients.[31,32]

Since publication of the 2004 AOM guideline, a number of studies have been conducted evaluating scales for the presence of symptoms. These studies did not show a consistent correlation of symptoms with the initial diagnosis of AOM, especially in preverbal children.[33–35]

Recent research has used precisely stated stringent criteria of AOM for purposes of the studies.[31,32] The current guideline endorses stringent otoscopic diagnostic criteria as a basis for management decisions (described later). As clinicians use the proposed stringent criteria to diagnose AOM, they should be aware that children with AOM may also present with recent onset of ear pain and intense erythema of the TM as the only otoscopic finding.

Symptoms

Older children with AOM usually present with a history of rapid onset of ear pain. However, in young preverbal children, otalgia as suggested by tugging/rubbing/holding of the ear, excessive crying, fever, or changes in the child's sleep or behavior pattern as noted by the parent are often relatively nonspecific symptoms. A number of studies have attempted to correlate symptom scores with diagnoses of AOM.

A systematic review[36] identified 4 articles that evaluated the accuracy of symptoms.[37–40] Ear pain appeared useful in diagnosing AOM (combined positive likelihood ratio 3.0–7.3, negative likelihood ratio 0.4–0.6); however, it was only present in 50% to 60% of children with AOM. Conclusions from these studies may be limited, because they (1) enrolled children seen by specialists, not likely to represent the whole spectrum of severity of illness; (2) used a clinical diagnosis of AOM based more on symptomatology rather than on tympanocentesis; and (3) included relatively older children.[37,40]

Laine et al[34] used a questionnaire administered to 469 parents who suspected their children, aged 6 to 35 months, had AOM. Of the children, 237 had AOM using strict otoscopic criteria, and 232 had upper respiratory tract infection without AOM. Restless sleep, ear rubbing, fever, and nonspecific respiratory or gastrointestinal

tract symptoms did not differentiate children with or without AOM.

McCormick et al[30] used 2 symptom scores—a 3-item score (OM-3), consisting of symptoms of physical suffering such as ear pain or fever, emotional distress (irritability, poor appetite), and limitation in activity; and a 5-item score (Ear Treatment Group Symptom Questionnaire, 5 Items [ETG-5]), including fever, earache, irritability, decreased appetite, and sleep disturbance—to assess AOM symptoms at the time of diagnosis and daily during the 10-day treatment or observation period. They found both to be a responsive measure of changes in clinical symptoms. The same group[35] also tested a visual scale, Acute Otitis Media-Faces Scale (AOM-FS), with faces similar to the Wong-Baker pain scale.[41] None of the scales were adequately sensitive for making the diagnosis of AOM based on symptoms. The AOM-FS combined with an otoscopy score, OS-8,[30] were presented as a double-sided pocket card. The combination of AOM-FS and OS-8 was more responsive to change than either instrument alone.

Shaikh et al[33,42] validated a 7-item parent-reported symptom score (Acute Otitis Media Severity of Symptom Scale [AOM-SOS]) for children with AOM, following stringent guidance of the US Food and Drug Administration (FDA) on the development of patient-reported outcome scales. Symptoms included ear tugging/rubbing/holding, excessive crying, irritability, difficulty sleeping, decreased activity or appetite, and fever. AOM-SOS was correlated with otoscopic diagnoses (AOM, OME, and normal middle ear status). AOM-SOS changed appropriately in response to clinical change. Its day-to-day responsiveness supports its usefulness in following AOM symptoms over time.

Signs of AOM

Few studies have evaluated the relationship of otoscopic findings in AOM and tympanocentesis. A study by Karma et al[43] is often cited as the best single study of otoscopic findings in AOM. However, the study uses only a symptom-based diagnosis of AOM plus the presence of MEE. Thus, children with acute upper respiratory tract infection symptoms and OME would have been considered to have AOM. There also were significant differences in findings at the 2 centers that participated in the study.

The investigators correlated TM color, mobility, and position with the presence of middle ear fluid obtained by tympanocentesis. At 2 sites in Finland (Tampere and Oulu), 2911 children were followed from 6 months to 2.5 years of age. A single otolaryngologist at Tampere and a single pediatrician at Oulu examined subjects. Color, position, and mobility were recorded. Myringotomy and aspiration were performed if MEE was suspected. AOM was diagnosed if MEE was found and the child had fever, earache, irritability, ear rubbing or tugging, simultaneous other acute respiratory tract symptoms, vomiting, or diarrhea. The presence or absence of MEE was noted, but no analyses of the fluid, including culture, were performed. Pneumatic otoscopic findings were classified as follows: color—hemorrhagic, strongly red, moderately red, cloudy or dull, slightly red, or normal; position—bulging, retracted, or normal; and mobility—distinctly impaired, slightly impaired, or normal.

For this analysis, 11 804 visits were available. For visits with acute symptoms, MEE was found in 84.9% and 81.8% at the 2 sites at which the study was performed. There were significant differences among the results at the 2 centers involved in the study. Table 2 shows specific data for each finding.

The combination of a "cloudy," bulging TM with impaired mobility was the best predictor of AOM using the symptom-based diagnosis in this study. Impaired mobility had the highest sensitivity and specificity (approximately 95% and 85%, respectively). Cloudiness had the next best combination of high sensitivity (~74%) and high specificity (~93%) in this study. Bulging had high specificity (~97%) but lower sensitivity (~51%). A TM that was hemorrhagic, strongly red, or moderately red also correlated with the presence of AOM, and a TM that was only "slightly red" was not helpful diagnostically.

McCormick et al reported that a bulging TM was highly associated with the presence of a bacterial pathogen, with or without a concomitant viral pathogen.[44] In a small study, 31 children (40 ears) underwent myringotomy.[45] Bulging TMs had positive bacterial cultures 75% of the time. The percentage of positive cultures for a pathogen increased to 80% if the color of the TM was yellow. The conclusion is that moderate to severe bulging of the TM represents the most important characteristic in the diagnosis of AOM—a finding that has

TABLE 2 Otoscopic Findings in Children With Acute Symptoms and MEE[a]

TM Finding in Acute Visits With MEE	Group I (Tampere, Finland), %	Group II (Oulo, Finland), %
Color		
Distinctly red	69.8	65.6
Hemorrhagic	81.3	62.9
Strongly red	87.7	68.1
Moderately red	59.8	66.0
Slightly red	39.4	16.7
Cloudy	95.7	80.0
Normal	1.7	4.9
Position		
Bulging	96.0	89
Retracted	46.8	48.6
Normal	32.1	22.2
Mobility		
Distinctly impaired	94.0	78.5
Slightly impaired	59.7	32.8
Normal	2.7	4.8

[a] Totals are greater than 100%, because each ear may have had different findings.[43]

implications for clinical care, research, and education.

The committee recognized that there is a progression from the presence of MEE to the bulging of the TM, and it is often difficult to differentiate this equivocal appearance from the highly certain AOM criteria advocated in this guideline.[26] As such, there is a role for individualized diagnosis and management decisions. Examples of normal, mild bulging, moderate bulging, and severe bulging can be seen in Fig 2.

Distinguishing AOM From OME

OME may occur either as the aftermath of an episode of AOM or as a consequence of eustachian tube dysfunction attributable to an upper respiratory tract infection.[46] However, OME may also precede and predispose to the development of AOM. These 2 forms of OM may be considered segments of a disease continuum.[47] However, because OME does not represent an acute infectious process that benefits from antibiotics, it is of utmost importance for clinicians to become proficient in distinguishing normal middle ear status from OME or AOM. Doing so will avoid unnecessary use of antibiotics, which leads to increased adverse effects of medication and facilitates the development of antimicrobial resistance.

Examination of the TM

Accurate diagnosis of AOM in infants and young children may be difficult. Symptoms may be mild or overlap with those of an upper respiratory tract illness. The TM may be obscured by cerumen, and subtle changes in the TM may be difficult to discern. Additional factors complicating diagnosis may include lack of cooperation from the child; less than optimal diagnostic equipment, including lack of a pneumatic bulb; inadequate instruments for clearing cerumen from the external auditory canal; inadequate assistance for restraining the child; and lack of experience in removing cerumen and performing pneumatic otoscopy.

The pneumatic otoscope is the standard tool used in diagnosing OM. Valuable also is a surgical head, which greatly facilitates cleaning cerumen from an infant's external auditory canal. Cerumen may be removed by using a curette, gentle suction, or irrigation.[48] The pneumatic otoscope should have a light source of sufficient brightness and an air-tight seal that permits application of positive and negative pressure. In general, nondisposable specula achieve a better seal with less pain because of a thicker, smoother edge and better light transmission properties. The speculum size should be chosen to gently seal at the outer portion of the external auditory canal.

Pneumatic otoscopy permits assessment of the contour of the TM (normal, retracted, full, bulging), its color (gray, yellow, pink, amber, white, red, blue), its translucency (translucent, semiopaque, opaque), and its mobility (normal, increased, decreased, absent). The normal TM is translucent, pearly gray, and has a ground-glass appearance (Fig 2A). Specific landmarks can be visualized. They include the short process and the manubrium of the malleus and the pars flaccida, located superiorly. These are easily observed and help to identify the position of the TM. Inward movement of the TM on positive pressure in the external canal and outward movement on negative pressure should occur, especially in the superior posterior quadrant. When the TM is retracted, the short process of the malleus becomes more prominent, and the manubrium appears shortened because of its change in position within the middle ear. Inward motion occurring with positive pressure is restricted or absent, because the TM is frequently as far inward as its range of motion allows. However, outward mobility can be visualized when negative pressure is applied. If the TM does not move perceptibly with applications of gentle positive or negative pressure, MEE is likely. Sometimes, the application of pressure will make an air-fluid interface behind the TM (which is diagnostic of MEE) more evident.[49]

Instruction in the proper evaluation of the child's middle ear status should begin with the first pediatric rotation in medical school and continue throughout postgraduate training.[50]

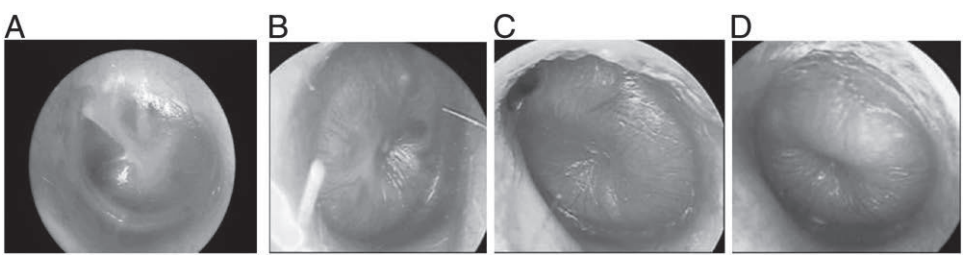


FIGURE 2

A, Normal TM. B, TM with mild bulging. C, TM with moderate bulging. D, TM with severe bulging. Courtesy of Alejandro Hoberman, MD.

Continuing medical education should reinforce the importance of, and retrain the clinician in, the use of pneumatic otoscopy.[51] Training tools include the use of a video-otoscope in residency programs, the use of Web-based educational resources,[49,52] as well as simultaneous or sequential examination of TMs with an expert otoscopist to validate findings by using a double headed or video otoscope. Tools for learning the ear examination can be found in a CD distributed by the Johns Hopkins University School of Medicine and the Institute for Johns Hopkins Nursing,[53] also available at http://www2.aap.org/sections/infectdis/video.cfm,[54] and through a Web-based program, ePROM: Enhancing Proficiency in Otitis Media.[52]

Key Action Statement 2

The management of AOM should include an assessment of pain. If pain is present, the clinician should recommend treatment to reduce pain. (Evidence Quality: Grade B, Rec. Strength: Strong Recommendation)

Key Action Statement Profile: KAS 2

Aggregate evidence quality	Grade B
Benefits	Relieves the major symptom of AOM.
Risks, harms, cost	Potential medication adverse effects. Variable efficacy of some modes of treatment.
Benefits-harms assessment	Preponderance of benefit.
Value judgments	Treating pain is essential whether or not antibiotics are prescribed.
Intentional vagueness	Choice of analgesic is not specified.
Role of patient preferences	Parents may assist in the decision as to what means of pain relief they prefer.
Exclusions	Topical analgesics in the presence of a perforated TM.
Strength	**Strong Recommendation**

Purpose of This Section

Pain is the major symptom of AOM. This section addresses and updates the literature on treating otalgia.

Changes From AAP/AAFP 2004 AOM Guideline

Only 2 new articles directly address the treatment of otalgia. Both address topical treatment. The 2 new articles are consistent with the 2004 guideline statement. The text of the 2004 guideline is, therefore, reproduced here, with the addition of discussion of the 2 new articles. Table 3 has been updated to include the new references.

Treatment of Otalgia

Many episodes of AOM are associated with pain.[55] Some children with OME also have ear pain. Although pain is a common symptom in these illnesses, clinicians often see otalgia as a peripheral concern not requiring direct attention.[56] Pain associated with AOM can be substantial in the first few days of illness and often persists longer in young children.[57] Antibiotic therapy of AOM does not provide symptomatic relief in the first 24 hours[58–61] and even after 3 to 7 days, there may be persistent pain, fever, or both in 30% of children younger than 2 years.[62] In contrast, analgesics do relieve pain associated with AOM within 24 hours[63] and should be used whether antibiotic therapy is or is not prescribed; they should be continued as long as needed. The AAP published the policy statement "The Assessment and Management of Acute Pain in Infants, Children, and Adolescents"[64] to assist the clinician in addressing pain in the context of illness. The management of pain, especially during the first 24 hours of an episode of AOM, should be addressed regardless of the use of antibiotics.

Various treatments of otalgia have been used, but none has been well studied. The clinician should select a treatment on the basis of a consideration of benefits and risks and, wherever possible, incorporate parent/caregiver and patient preference (Table 3).

TABLE 3 Treatments for Otalgia in AOM

Treatment Modality	Comments
Acetaminophen, ibuprofen[63]	Effective analgesia for mild to moderate pain. Readily available. Mainstay of pain management for AOM.
Home remedies (no controlled studies that directly address effectiveness)	May have limited effectiveness.
Distraction	
External application of heat or cold	
Oil drops in external auditory canal	
Topical agents	
Benzocaine, procaine, lidocaine[65,67,70]	Additional, but brief, benefit over acetaminophen in patients older than 5 y.
Naturopathic agents[68]	Comparable to amethocaine/phenazone drops in patients older than 6 y.
Homeopathic agents[71,72]	No controlled studies that directly address pain.
Narcotic analgesia with codeine or analogs	Effective for moderate or severe pain. Requires prescription; risk of respiratory depression, altered mental status, gastrointestinal tract upset, and constipation.
Tympanostomy/myringotomy[73]	Requires skill and entails potential risk.

Since the 2004 guideline was published, there have been only 2 significant new articles.

Bolt et al reported in 2008 on a double-blind placebo-controlled trial at the Australia Children's Hospital emergency department conducted in 2003–2004.[65] They used a convenience sample of children 3 to 17 years of age diagnosed with AOM in the ED. They excluded children with perforation of the TM, pressure-equalizing tube, allergy to local anesthetic or paracetamol, epilepsy, or liver, renal, or cardiac disease. Sixty-three eligible children were randomized to receive aqueous lidocaine or normal saline ear drops up to 3 times in 24 hours. They demonstrated a statistically significant 50% reduction in reported pain at 10 and 30 minutes but not at 20 minutes after application of topical lidocaine, compared with normal saline. Complications were minimal: 3 children reported some dizziness the next day, and none reported tinnitus. A limitation was that some children had received oral acetaminophen before administration of ear drops.

A Cochrane review of topical analgesia for AOM[66] searched the Cochrane register of controlled trials, randomized controlled trials, or quasi-randomized controlled trials that compared otic preparations to placebo or that compared 2 otic preparations. It included studies of adults and children, without TM perforation. It identified 5 trials in children 3 to 18 years of age. Two (including Bolt et al,[65] discussed above) compared anesthetic drops and placebo at diagnosis of AOM. In both studies, some children also received oral analgesics. Three studies compared anesthetic ear drops with naturopathic herbal drops. Naturopathic drops were favored 15 to 30 minutes after installation, and 1 to 3 days after diagnosis, but the difference was not statistically significant. The Cochrane group concluded that there is limited evidence that ear drops are effective at 30 minutes and unclear if results from these studies are a result of the natural course of illness, placebo effect of receiving treatment, soothing effect of any liquid in the ear, or the drops themselves. Three of the studies included in this review were cited in the 2004 AAP guideline[67–69] and the 1 new paper by Bolt et al.[65]

Key Action Statement 3A

Severe AOM

The clinician should prescribe antibiotic therapy for AOM (bilateral or unilateral) in children 6 months and older with severe signs or symptoms (ie, moderate or severe otalgia or otalgia for at least 48 hours, or temperature 39°C [102.2°F] or higher). (Evidence Quality: Grade B, Rec. Strength: Strong Recommendation)

Key Action Statement Profile: KAS 3A

Aggregate evidence quality	Grade B
Benefits	Increased likelihood of more rapid resolution of symptoms. Increased likelihood of resolution of AOM.
Risks, harms, cost	Adverse events attributable to antibiotics, such as diarrhea, diaper dermatitis, and allergic reactions. Overuse of antibiotics leads to increased bacterial resistance. Cost of antibiotics.
Benefits-harms assessment	Preponderance of benefit over harm.
Value judgments	None
Role of patient preference	None
Intentional vagueness	None
Exclusions	None
Strength	**Strong Recommendation**

Key Action Statement 3B

Nonsevere Bilateral AOM in Young Children

The clinician should prescribe antibiotic therapy for bilateral AOM in children younger than 24 months without severe signs or symptoms (ie, mild otalgia for less than 48 hours, temperature less than 39°C [102.2°F]). (Evidence Quality: Grade B, Rec. Strength: Recommendation)

Key Action Statement Profile: KAS 3B

Aggregate evidence quality	Grade B
Benefits	Increased likelihood of more rapid resolution of symptoms. Increased likelihood of resolution of AOM.
Risks, harms, cost	Adverse events attributable to antibiotics, such as diarrhea, diaper dermatitis, and allergic reactions. Overuse of antibiotics leads to increased bacterial resistance. Cost of antibiotics.
Benefits-harms assessment	Preponderance of benefit over harm.
Value judgments	None
Role of patient preference	None
Intentional vagueness	None
Exclusions	None
Strength	**Recommendation**

Key Action Statement 3C

Nonsevere Unilateral AOM in Young Children

The clinician should either prescribe antibiotic therapy *or* offer observation with close follow-up based on joint decision-making with the parent(s)/caregiver for unilateral AOM in children 6 months to 23 months of age without severe signs or symptoms (ie, mild otalgia for less than 48 hours, temperature less than 39°C [102.2°F]). When observation is used, a mechanism must be in place to ensure

follow-up and begin antibiotic therapy if the child worsens or fails to improve within 48 to 72 hours of onset of symptoms. (Evidence Quality: Grade B, Rec. Strength: Recommendation)

Key Action Statement Profile: KAS 3C

Aggregate evidence quality	Grade B
Benefits	Moderately increased likelihood of more rapid resolution of symptoms with initial antibiotics. Moderately increased likelihood of resolution of AOM with initial antibiotics.
Risks, harms, cost	Adverse events attributable to antibiotics, such as diarrhea, diaper dermatitis, and allergic reactions. Overuse of antibiotics leads to increased bacterial resistance. Cost of antibiotics.
Benefits-harms assessment	Moderate degree of benefit over harm.
Value judgments	Observation becomes an alternative as the benefits and harms approach balance.
Role of patient preference	Joint decision-making with the family is essential before choosing observation.
Intentional vagueness	Joint decision-making is highly variable from family to family
Exclusions	None
Strength	**Recommendation**
Note	In the judgment of 1 Subcommittee member (AH), antimicrobial treatment of these children is preferred because of a preponderance of benefit over harm. AH did not endorse Key Action Statement 3C

Key Action Statement 3D

Nonsevere AOM in Older Children

The clinician should either prescribe antibiotic therapy *or* offer observation with close follow-up based on joint decision-making with the parent(s)/caregiver for AOM (bilateral or unilateral) in children 24 months or older without severe signs or symptoms (ie, mild otalgia for less than 48 hours, temperature less than 39°C [102.2°F]). When observation is used, a mechanism must be in place to ensure follow-up and begin antibiotic therapy if the child worsens or fails to improve within 48 to 72 hours of onset of symptoms. (Evidence Quality: Grade B, Rec Strength: Recommendation)

Key Action Statement Profile: KAS 3D

Aggregate evidence quality	Grade B
Benefits	*Initial antibiotic treatment*: Slightly increased likelihood of more rapid resolution of symptoms; slightly increased likelihood of resolution of AOM. *Initial observation*: Decreased use of antibiotics; decreased adverse effects of antibiotics; decreased potential for development of bacterial resistance.
Risks, harms, cost	*Initial antibiotic treatment*: Adverse events attributable to antibiotics such as diarrhea, rashes, and allergic reactions. Overuse of antibiotics leads to increased bacterial resistance. *Initial observation*: Possibility of needing to start antibiotics in 48 to 72 h if the patient continues to have symptoms. Minimal risk of adverse consequences of delayed antibiotic treatment. Potential increased phone calls and doctor visits.
Benefits-harms assessment	Slight degree of benefit of initial antibiotics over harm.
Value judgments	Observation is an option as the benefits and harms approach balance.
Role of patient preference	Joint decision-making with the family is essential before choosing observation.
Intentional vagueness	Joint decision-making is highly variable from family to family.
Exclusions	None
Strength	**Recommendation.**

Purpose of This Section

The purpose of this section is to offer guidance on the initial management of AOM by helping clinicians choose between the following 2 strategies:

1. *Initial antibiotic therapy*, defined as treatment of AOM with antibiotics that are prescribed at the time of diagnosis with the intent of starting antibiotic therapy as soon as possible after the encounter.
2. *Initial observation*, defined as initial management of AOM limited to symptomatic relief, with commencement of antibiotic therapy only if the child's condition worsens at any time or does not show clinical improvement within 48 to 72 hours of diagnosis. A mechanism must be in place to ensure follow-up and initiation of antibiotics if the child fails observation.

This section assumes that the clinician has made an accurate diagnosis of AOM by using the criteria and strategies outlined earlier in this guideline. Another assumption is that a clear distinction is made between the role of analgesics and antibiotics in providing symptomatic relief for children with AOM.

Changes From Previous AOM Guideline

The AOM guideline published by the AAP and AAFP in 2004 proposed, for the first time in North America, an "observation option" for selected children with AOM, building on successful implementation of a similar policy in the state of New York[74] and the use of a similar paradigm in many countries in Europe. A common feature of both approaches was to prioritize initial antibiotic therapy according to diagnostic certainty, with greater reliance on observation when the diagnosis was uncertain. In response to criticism that allowing an "uncertain

diagnosis" might condone incomplete visualization of the TM or allow inappropriate antibiotic use, this category has been eliminated with greater emphasis now placed on maximizing diagnostic accuracy for AOM.

Since the earlier AOM guideline was published, there has been substantial new research on initial management of AOM, including randomized controlled trials of antibiotic therapy versus placebo or no therapy,[31,32,75] immediate versus delayed antibiotic therapy,[30,76,77] or delayed antibiotic with or without a concurrent prescription.[78] The Hoberman and Tähtinen articles are especially important as they used stringent criteria for diagnosing AOM.[31,32] Systematic reviews have been published on delayed antibiotic therapy,[79] the natural history of AOM in untreated children,[57] predictive factors for antibiotic benefits,[62] and the effect of antibiotics on asymptomatic MEE after therapy.[80] Observational studies provide additional data on outcomes of initial observation with delayed antibiotic therapy, if needed,[81] and on the relationship of previous antibiotic therapy for AOM to subsequent acute mastoiditis.[82,83]

In contrast to the earlier AOM guideline,[1] which recommended antibiotic therapy for all children 6 months to 2 years of age with a certain diagnosis, the current guideline indicates a choice between initial antibiotic therapy or initial observation in this age group for children with unilateral AOM and mild symptoms but only after joint decision-making with the parent(s)/caregiver (Table 4). This change is supported by evidence on the safety of observation or delayed prescribing in young children.[30,31,32,75,76,81] A mechanism must be in place to ensure follow-up and begin antibiotics if the child fails observation.

Importance of Accurate Diagnosis

The recommendations for management of AOM assume an accurate diagnosis on the basis of criteria outlined in the diagnosis section of this guideline. Many of the studies since the 2004 AAP/AAFP AOM guideline[1] used more stringent and well-defined AOM diagnostic definitions than were previously used. Bulging of the TM was required for diagnosis of AOM for most of the children enrolled in the most recent studies.[31,32] By using the criteria in this guideline, clinicians will more accurately distinguish AOM from OME. The management of OME can be found in guidelines written by the AAP, AAFP, and American Academy of Otolaryngology-Head and Neck Surgery.[84,85]

TABLE 4 Recommendations for Initial Management for Uncomplicated AOM[a]

Age	Otorrhea With AOM[a]	Unilateral or Bilateral AOM[a] With Severe Symptoms[b]	Bilateral AOM[a] Without Otorrhea	Unilateral AOM[a] Without Otorrhea
6 mo to 2 y	Antibiotic therapy	Antibiotic therapy	Antibiotic therapy	Antibiotic therapy or additional observation
≥2 y	Antibiotic therapy	Antibiotic therapy	Antibiotic therapy or additional observation	Antibiotic therapy or additional observation[c]

[a] Applies only to children with well-documented AOM with high certainty of diagnosis (see Diagnosis section).
[b] A toxic-appearing child, persistent otalgia more than 48 h, temperature ≥39°C (102.2°F) in the past 48 h, or if there is uncertain access to follow-up after the visit.
[c] This plan of initial management provides an opportunity for shared decision-making with the child's family for those categories appropriate for additional observation. If observation is offered, a mechanism must be in place to ensure follow-up and begin antibiotics if the child worsens or fails to improve within 48 to 72 h of AOM onset.

Age, Severity of Symptoms, Otorrhea, and Laterality

Rovers et al[62] performed a systematic search for AOM trials that (1) used random allocation of children, (2) included children 0 to 12 years of age with AOM, (3) compared antibiotics with placebo or no treatment, and (4) had pain or fever as an outcome. The original investigators were asked for their original data.

Primary outcome was pain and/or fever (>38°C) at 3 to 7 days. The adverse effects of antibiotics were also analyzed. Baseline predictors were age <2 years versus ≥2 years, bilateral AOM versus unilateral AOM, and the presence versus absence of otorrhea. Statistical methods were used to assess heterogeneity and to analyze the data.

Of the 10 eligible studies, the investigators of 6 studies[30,75,86–89] provided the original data requested, and 4 did not. A total of 1642 patients were included in the 6 studies from which data were obtained. Of the cases submitted, the average age was 3 to 4 years, with 35% of children younger than 2 years. Bilateral AOM was present in 34% of children, and 42% of children had a bulging TM. Otorrhea was present in 21% of children. The antibiotic and control groups were comparable for all characteristics.

The rate difference (RD) for pain, fever, or both between antibiotic and control groups was 13% (NNT = 8). For children younger than 2 years, the RD was 15% (NNT = 7); for those ≥2 years, RD was 11% (NNT = 10). For unilateral AOM, the RD was 6% (NNT = 17); for bilateral AOM, the RD was 20% (NNT = 5). When unilateral AOM was broken into age groups, among those younger than 2 years, the RD was 5% (NNT = 20), and among those ≥2 years, the RD was 7% (NNT = 15). For bilateral AOM in children younger than 2 years, the RD was 25% (NNT = 4); for

bilateral AOM in children ≥2 years, the RD was 12% (NNT = 9). For otorrhea, the RD was 36% (NNT = 3). One child in the control group who developed meningitis had received antibiotics beginning on day 2 because of worsening status. There were no cases of mastoiditis.

In a Cochrane Review, Sanders et al[59] identified 10 studies that met the following criteria: (1) randomized controlled trial, (2) compared antibiotic versus placebo or antibiotic versus observation, (3) age 1 month to 15 years, (4) reported severity and duration of pain, (5) reported adverse events, and (6) reported serious complications of AOM, recurrent attacks, and hearing problems. Studies were analyzed for risk of bias and assessment of heterogeneity. The studies were the same as analyzed by Rovers et al[62] but included the 4 studies for which primary data were not available to Rovers.[60,61,90,91]

The authors' conclusions were that antibiotics produced a small reduction in the number of children with pain 2 to 7 days after diagnosis. They also concluded that most cases spontaneously remitted with no complications (NNT = 16). Antibiotics were most beneficial in children younger than 2 years with bilateral AOM and in children with otorrhea.

Two recent studies only included children younger than 3 years[32] or younger than 2 years.[31] Both included only subjects in whom the diagnosis of AOM was certain. Both studies used improvement of symptoms and improvement in the appearance of the TM in their definitions of clinical success or failure.

Hoberman et al[31] conducted a randomized, double-blind, placebo-controlled study of the efficacy of antimicrobial treatment on AOM. The criteria for AOM were acute symptoms with a score of at least 3 on the AOM-SOS, a validated symptom scale[33,92]; MEE; and moderate or marked bulging of the TM or slight bulging accompanied by either otalgia or marked erythema of the TM. They chose to use high-dose amoxicillin-clavulanate (90 mg/kg/day) as active treatment, because it has the best oral antibiotic coverage for organisms causing AOM. Included in the study were 291 patients 6 to 23 months of age: 144 in the antibiotic group and 147 in the placebo group. The primary outcome measures were the time to resolution of symptoms and the symptom burden over time. The initial resolution of symptoms (ie, the first recording of an AOM-SOS score of 0 or 1) was recorded among the children who received amoxicillin-clavulanate in 35% by day 2, 61% by day 4, and 80% by day 7. Among children who received placebo, an AOM-SOS score of 0 or 1 was recorded in 28% by day 2, 54% by day 4, and 74% by day 7 ($P = .14$ for the overall comparison). For sustained resolution of symptoms (ie, the time to the second of 2 successive recordings of an AOM-SOS score of 0 or 1), the corresponding values were 20% at day 2, 41% at day 4, and 67% at day 7 with amoxicillin-clavulanate, compared with 14%, 36%, and 53% with placebo ($P = .04$ for the overall comparison). The symptom burden (ie, mean AOM-SOS scores) over the first 7 days were lower for the children treated with amoxicillin-clavulanate than for those who received placebo ($P = .02$). Clinical failure at or before the 4- to 5-day visit was defined as "either a lack of substantial improvement in symptoms, a worsening of signs on otoscopic examination, or both," and clinical failure at the 10- to 12-day visit was defined as "the failure to achieve complete or nearly complete resolution of symptoms and of otoscopic signs, without regard to the persistence or resolution of middle ear effusion." Treatment failure occurred by day 4 to 5 in 4% of the antimicrobial treatment group versus 23% in the placebo group ($P < .001$) and at day 10 to 12 in 16% of the antimicrobial treatment group versus 51% in the placebo group (NNT = 2.9, $P < .001$). In a comparison of outcome in unilateral versus bilateral AOM, clinical failure rates by day 10 to 12 in children with unilateral AOM were 9% in those treated with amoxicillin-clavulanate versus 41% in those treated with placebo (RD, 32%; NNT = 3) and 23% vs 60% (RD, 37%; NNT = 3) in those with bilateral AOM. Most common adverse events were diarrhea (25% vs 15% in the treatment versus placebo groups, respectively; $P = .05$) and diaper dermatitis (51% vs 35% in the treatment versus placebo groups, respectively; $P = .008$). One placebo recipient developed mastoiditis. According to these results, antimicrobial treatment of AOM was more beneficial than in previous studies that used less stringent diagnostic criteria.

Tähtinen et al[32] conducted a randomized, double-blind, placebo-controlled, intention-to-treat study of amoxicillin-clavulanate (40 mg/kg/day) versus placebo. Three hundred nineteen patients from 6 to 35 months of age were studied: 161 in the antibiotic group and 158 in the placebo group. AOM definition was the presence of MEE, distinct erythema over a bulging or yellow TM, and acute symptoms such as ear pain, fever, or respiratory symptoms. Compliance was measured by using daily patient diaries and number of capsules remaining at the end of the study. Primary outcome was time to treatment failure defined as a composite of 6 independent components: no improvement in overall condition by day 3, worsening of the child's condition at any time, no improvement in otoscopic signs by day 8, perforation of the TM,

development of severe infection (eg, pneumonia, mastoiditis), and any other reason for stopping the study drug/placebo.

Groups were comparable on multiple parameters. In the treatment group, 135 of 161 patients (84%) were younger than 24 months, and in the placebo group, 124 of 158 patients (78%) were younger than 24 months. Treatment failure occurred in 18.6% of the treatment group and 44.9% in the placebo group (NNT = 3.8, $P < .001$). Rescue treatment was needed in 6.8% of the treatment group and 33.5% of placebo patients ($P < .001$). Contralateral AOM developed in 8.2% and 18.6% of treatment and placebo groups, respectively ($P = .007$). There was no significant difference in use of analgesic or antipyretic medicine, which was used in 84.2% of the amoxicillin-clavulanate group and 85.9% of the placebo group.

Parents of child care attendees on placebo missed more days of work ($P = .005$). Clinical failure rates in children with unilateral AOM were 17.2% in those treated with amoxicillin-clavulanate versus 42.7% in those treated with placebo; for bilateral AOM, clinical failure rates were 21.7% for those treated with amoxicillin-clavulanate versus 46.3% in the placebo group. Reported rates of treatment failure by day 8 were 17.2% in the amoxicillin-clavulanate group versus 42.7% in the placebo group in children with unilateral AOM and 21.7% vs 46.3% among those with bilateral disease.

Adverse events, primarily diarrhea and/or rash, occurred in 52.8% of the treatment group and 36.1% of the placebo group ($P = .003$). Overall condition as evaluated by the parents and otoscopic appearance of the TM showed a benefit of antibiotics over placebo at the end of treatment visit ($P < .001$). Two placebo recipients developed a severe infection; 1 developed pneumococcal bacteremia, and 1 developed radiographically confirmed pneumonia.

Most studies have excluded children with severe illness and all exclude those with bacterial disease other than AOM (pneumonia, mastoiditis, meningitis, streptococcal pharyngitis). Kaleida et al[91] compared myringotomy alone with myringotomy plus antibiotics. Severe AOM was defined as temperature >39°C (102.2°F) or the presence of severe otalgia. Patients with severe AOM in the group that received only myringotomy (without initial antibiotics) had much worse outcomes.

Initial Antibiotic Therapy

The rationale for antibiotic therapy in children with AOM is based on a high prevalence of bacteria in the accompanying MEE.[93] Bacterial and viral cultures of middle ear fluid collected by tympanocentesis from children with AOM showed 55% with bacteria only and 15% with bacteria and viruses. A beneficial effect of antibiotics on AOM was first demonstrated in 1968,[94] followed by additional randomized trials and a meta-analysis[95] showing a 14% increase in absolute rates of clinical improvement. Systematic reviews of the literature published before 2011[21,59,62] revealed increases of clinical improvement with initial antibiotics of 6% to 12%.

Randomized clinical trials using stringent diagnostic criteria for AOM in young children[31,32] show differences in clinical improvement of 26% to 35% favoring initial antibiotic treatment as compared with placebo. Greater benefit of immediate antibiotic therapy was observed for bilateral AOM[62,96] or AOM associated with otorrhea.[62] In most randomized trials,[30,75,77,88,89] antibiotic therapy also decreased the duration of pain, analgesic use, or school absence and parent days missed from work.

Children younger than 2 years with AOM may take longer to improve clinically than older children,[57] and although they are more likely to benefit from antibiotics,[31,32] AOM in many children will resolve without antibiotics.[62] A clinically significant benefit of immediate antibiotic therapy is observed for bilateral AOM,[62,96] *Streptococcus pneumoniae* infection, or AOM associated with otorrhea.[62]

Initial Observation for AOM

In systematic reviews of studies that compare antibiotic therapy for AOM with placebo, a consistent finding has been the overall favorable natural history in control groups (NNT = 8–16).[12,59,62,95] However, randomized trials in these reviews had varying diagnostic criteria that would have permitted inclusion of some children with OME, viral upper respiratory infections, or myringitis, thereby limiting the ability to apply these findings to children with a highly certain AOM diagnosis. In more recent AOM studies[31,32] using stringent diagnostic criteria, approximately half of young children (younger than 2–3 years) experienced clinical success when given placebo, but the effect of antibiotic therapy was substantially greater than suggested by studies without precise diagnosis (NNT = 3–4).

Observation as initial management for AOM in properly selected children does not increase suppurative complications, provided that follow-up is ensured and a rescue antibiotic is given for persistent or worsening symptoms.[17] In contrast, withholding of antibiotics in all children with AOM, regardless of clinical course, would risk a return to the suppurative complications observed in the

preantibiotic era. At the population level, antibiotics halve the risk of mastoiditis after AOM, but the high NNT of approximately 4800 patients to prevent 1 case of mastoiditis precludes a strategy of universal antibiotic therapy as a means to prevent mastoiditis.[83]

The favorable natural history of AOM makes it difficult to demonstrate significant differences in efficacy between antibiotic and placebo when a successful outcome is defined by relief or improvement of presenting signs and symptoms. In contrast, when otoscopic improvement (resolution of TM bulging, intense erythema, or both) is also required for a positive outcome,[31,32] the NNT is 3 to 4, compared with 8 to 16 for symptom improvement alone in older studies that used less precise diagnostic criteria. MEE, however, may persist for weeks or months after an AOM episode and is not a criterion for otoscopic failure.

National guidelines for initial observation of AOM in select children were first implemented in the Netherlands[97] and subsequently in Sweden,[98] Scotland,[99] the United States,[1] the United Kingdom,[100] and Italy.[101] All included observation as an initial treatment option under specified circumstances.

In numerous studies, only approximately one-third of children initially observed received a rescue antibiotic for persistent or worsening AOM,[30,32,76,81,89,102] suggesting that antibiotic use could potentially be reduced by 65% in eligible children. Given the high incidence of AOM, this reduction could help substantially in curtailing antibiotic-related adverse events.

McCormick et al[30] reported on 233 patients randomly assigned to receive immediate antibiotics (amoxicillin, 90 mg/kg/day) or to undergo watchful waiting. Criteria for inclusion were symptoms of ear infection, otoscopic evidence of AOM, and nonsevere AOM based on a 3-item symptom score (OM-3) and TM appearance based on an 8-item scale (OS-8). Primary outcomes were parent satisfaction with AOM care, resolution of AOM symptoms after initial treatment, AOM failure and recurrence, and nasopharyngeal carriage of *S pneumoniae* strains resistant to antibiotics after treatment. The study was confounded by including patients who had received antibiotics in the previous 30 days.

In the watchful waiting group, 66% of children completed the study without antibiotics. There was no difference in parent satisfaction scores at day 12. A 5-item symptom score (ETG-5) was assessed at days 0 to 10 by using patient diaries. Subjects receiving immediate antibiotics resolved their symptoms faster than did subjects who underwent watchful waiting (P = .004). For children younger than 2 years, the difference was greater (P = .008). Otoscopic and tympanogram scores were also lower in the antibiotic group as opposed to the watchful waiting group (P = .02 for otoscopic score, P = .004 for tympanogram). Combining all ages, failure and recurrence rates were lower for the antibiotic group (5%) than for the watchful waiting group (21%) at 12 days. By day 30, there was no difference in failure or recurrence for the antibiotic and watchful waiting groups (23% and 24%, respectively). The association between clinical outcome and intervention group was not significantly different between age groups. Immediate antibiotics resulted in eradication of *S pneumoniae* carriage in the majority of children, but *S pneumoniae* strains cultured from children in the antibiotic group at day 12 were more likely to be multidrug resistant than were strains cultured from children in the watchful waiting group.

The decision not to give initial antibiotic treatment and observe should be a joint decision of the clinician and the parents. In such cases, a system for close follow-up and a means of beginning antibiotics must be in place if symptoms worsen or no improvement is seen in 48 to 72 hours.

Initial observation of AOM should be part of a larger management strategy that includes analgesics, parent information, and provisions for a rescue antibiotic. Education of parents should include an explanation about the self-limited nature of most episodes of AOM, especially in children 2 years and older; the importance of pain management early in the course; and the potential adverse effects of antibiotics. Such an approach can substantially reduce prescription fill rates for rescue antibiotics.[103]

A critical component of any strategy involving initial observation for AOM is the ability to provide a rescue antibiotic if needed. This is often done by using a "safety net" or a "wait-and-see prescription,"[76,102] in which the parent/caregiver is given an antibiotic prescription during the clinical encounter but is instructed to fill the prescription only if the child fails to improve within 2 to 3 days or if symptoms worsen at any time. An alternative approach is not to provide a written prescription but to instruct the parent/caregiver to call or return if the child fails to improve within 2 to 3 days or if symptoms worsen.

In one of the first major studies of observation with a safety-net antibiotic prescription (SNAP), Siegel et al[102] enrolled 194 patients with protocol defined AOM, of whom 175 completed the study. Eligible patients were given a SNAP with instructions to fill the prescription only if symptoms worsened or did not improve in 48 hours. The SNAP was valid for 5 days. Pain medicine was recommended to be taken as needed. A phone interview was conducted 5 to 10 days after diagnosis.

One hundred twenty of 175 families did not fill the prescription. Reasons for filling the prescription (more than 1 reason per patient was acceptable) were as follows: continued pain, 23%; continued fever, 11%; sleep disruption, 6%; missed days of work, 3%; missed days of child care, 3%; and no reason given, 5%. One 16-month-old boy completed observation successfully but 6 weeks later developed AOM in the opposite ear, was treated with antibiotics, and developed postauricular cellulitis.

In a similar study of a "wait-and-see prescription" (WASP) in the emergency department, Spiro et al[76] randomly assigned 283 patients to either a WASP or standard prescription. Clinicians were educated on the 2004 AAP diagnostic criteria and initial treatment options for AOM; however, diagnosis was made at the discretion of the clinician. Patients were excluded if they did not qualify for observation per the 2004 guidelines. The primary outcome was whether the prescription was filled within 3 days of diagnosis. Prescriptions were not filled for 62% and 13% of the WASP and standard prescription patients, respectively ($P < .001$). Reasons for filling the prescription in the WASP group were fever (60%), ear pain (34%), or fussy behavior (6%). No serious adverse events were reported.

Strategies to observe children with AOM who are likely to improve on their own without initial antibiotic therapy reduces common adverse effects of antibiotics, such as diarrhea and diaper dermatitis. In 2 trials, antibiotic therapy significantly increased the absolute rates of diarrhea by 10% to 20% and of diaper rash or dermatitis by 6% to 16%.[31,32] Reduced antibiotic use may also reduce the prevalence of resistant bacterial pathogens. Multidrug-resistant *S pneumoniae* continues to be a significant concern for AOM, despite universal immunization of children in the United States with heptavalent pneumococcal conjugate vaccine.[104,105] In contrast, countries with low antibiotic use for AOM have a low prevalence of resistant nasopharyngeal pathogens in children.[106]

Key Action Statement 4A

Clinicians should prescribe amoxicillin for AOM when a decision to treat with antibiotics has been made *and* the child has not received amoxicillin in the past 30 days *or* the child does not have concurrent purulent conjunctivitis *or* the child is not allergic to penicillin. (Evidence Quality: Grade B, Rec. Strength: Recommendation)

Key Action Statement Profile: KAS 4A

Aggregate evidence quality	Grade B
Benefits	Effective antibiotic for most children with AOM. Inexpensive, safe, acceptable taste, narrow antimicrobial spectrum.
Risks, harms, cost	Ineffective against β-lactamase–producing organisms. Adverse effects of amoxicillin.
Benefits-harms assessment	Preponderance of benefit.
Value judgments	Better to use a drug that has reasonable cost, has an acceptable taste, and has a narrow antibacterial spectrum.
Intentional vagueness	The clinician must determine whether the patient is truly penicillin allergic.
Role of patient preferences	Should be considered if previous bad experience with amoxicillin.
Exclusions	Patients with known penicillin allergy.
Strength	**Recommendation.**

Key Action Statement 4B

Clinicians should prescribe an antibiotic with additional β-lactamase coverage for AOM when a decision to treat with antibiotics has been made *and* the child has received amoxicillin in the past 30 days *or* has concurrent purulent conjunctivitis *or* has a history of recurrent AOM unresponsive to amoxicillin. (Evidence Quality: Grade C, Rec. Strength: Recommendation)

Key Action Statement Profile: KAS 4B

Aggregate evidence quality	Grade C
Benefits	Successful treatment of β-lactamase–producing organisms.
Risks, harms, cost	Cost of antibiotic. Increased adverse effects.
Benefits-harms assessment	Preponderance of benefit.
Value judgments	Efficacy is more important than taste.
Intentional vagueness	None.
Role of patient preferences	Concern regarding side effects and taste.
Exclusions	Patients with known penicillin allergy.
Strength	**Recommendation**

Key Action Statement 4C

Clinicians should reassess the patient if the caregiver reports that the child's symptoms have worsened or failed to respond to the initial antibiotic treatment within 48 to 72 hours and determine whether a change in therapy is needed. (Evidence Quality: Grade B, Rec. Strength: Recommendation)

Key Action Statement Profile: KAS 4C

Aggregate evidence quality	Grade B
Benefits	Identify children who may have AOM caused by pathogens resistant to previous antibiotics.
Risks, harms, cost	Cost. Time for patient and clinician to make change. Potential need for parenteral medication.
Benefit-harm assessment	Preponderance of benefit.
Value judgments	None.
Intentional vagueness	"Reassess" is not defined. The clinician may determine the method of assessment.
Role of patient preferences	Limited.
Exclusions	Appearance of TM improved.
Strength	**Recommendation**

Purpose of This Section

If an antibiotic will be used for treatment of a child with AOM, whether as initial management or after a period of observation, the clinician must choose an antibiotic that will have a high likelihood of being effective against the most likely etiologic bacterial pathogens with considerations of cost, taste, convenience, and adverse effects. This section proposes first- and second-line antibiotics that best meet these criteria while balancing potential benefits and harms.

Changes From AAP/AAFP 2004 AOM Guideline

Despite new data on the effect of PCV7 and updated data on the in vitro susceptibility of bacterial pathogens most likely to cause AOM, the recommendations for the first-line antibiotic remains unchanged from 2004. The current guideline contains revised recommendations regarding penicillin allergy based on new data. The increase of multidrug-resistant strains of pneumococci is noted.

Microbiology

Microorganisms detected in the middle ear during AOM include pathogenic bacteria, as well as respiratory viruses.[107–110] AOM occurs most frequently as a consequence of viral upper respiratory tract infection,[111–113] which leads to eustachian tube inflammation/dysfunction, negative middle ear pressure, and movement of secretions containing the upper respiratory tract infection causative virus and pathogenic bacteria in the nasopharynx into the middle ear cleft. By using comprehensive and sensitive microbiologic testing, bacteria and/or viruses can be detected in the middle ear fluid in up to 96% of AOM cases (eg, 66% bacteria and viruses together, 27% bacteria alone, and 4% virus alone).[114] Studies using less sensitive or less comprehensive microbiologic assays have yielded less positive results for bacteria and much less positive results for viruses.[115–117] The 3 most common bacterial pathogens in AOM are *S pneumoniae*, nontypeable *Haemophilus influenzae*, and *Moraxella catarrhalis*.[111] *Streptococcus pyogenes* (group A β-hemolytic streptococci) accounts for less than 5% of AOM cases. The proportion of AOM cases with pathogenic bacteria isolated from the middle ear fluids varies depending on bacteriologic techniques, transport issues, and stringency of AOM definition. In series of reports from the United States and Europe from 1952–1981 and 1985–1992, the mean percentage of cases with bacterial pathogens isolated from the middle ear fluids was 69% and 72%, respectively.[118] A large series from the University of Pittsburgh Otitis Media Study Group reported bacterial pathogens in 84% of the middle ear fluids from 2807 cases of AOM.[118] Studies that applied more stringent otoscopic criteria and/or use of bedside specimen plating on solid agar in addition to liquid transport media have a reported rate of recovery of pathogenic bacteria from middle ear exudates ranging from 85% to 90%.[119–121] When using appropriate stringent diagnostic criteria, careful specimen handling, and sensitive microbiologic techniques, the vast majority of cases of AOM will involve pathogenic bacteria either alone or in concert with viral pathogens.

Among AOM bacterial pathogens, *S pneumoniae* was the most frequently cultured in earlier reports. Since the debut and routine use of PCV7 in 2000, the ordinal frequency of these 3 major middle ear pathogens has evolved.[105] In the first few years after PCV7 introduction, *H influenzae* became the most frequently isolated middle ear pathogen, replacing *S pneumoniae*.[122,123] Shortly thereafter, a shift to non-PCV7 serotypes of *S pneumoniae* was described.[124] Pichichero et al[104] later reported that 44% of 212 AOM cases seen in 2003–2006 were caused by *H influenzae*, and 28% were caused by *S pneumoniae*, with a high proportion of highly resistant *S pneumoniae*. In that study, a majority (77%) of cases involved recurrent disease or initial treatment failure. A later report[125] with data from 2007 to 2009, 6 to 8 years after the introduction of PCV7 in the United States, showed that PCV7 strains of *S pneumoniae* virtually disappeared from the middle ear fluid of children with AOM who had been vaccinated. However, the frequency of isolation of non-PCV7 serotypes of *S pneumoniae* from the middle ear fluid overall was increased; this has made isolation of *S pneumoniae* and *H influenzae* of children with AOM nearly equal.

In a study of tympanocentesis over 4 respiratory tract illness seasons in a private practice, the percentage of

S pneumoniae initially decreased relative to *H influenzae*. In 2005–2006 (*N* = 33), 48% of bacteria were *S pneumoniae*, and 42% were *H influenzae*. For 2006–2007 (*N* = 37), the percentages were equal at 41%. In 2007–2008 (*N* = 34), 35% were *S pneumoniae*, and 59% were *H influenzae*. In 2008–2009 (*N* = 24), the percentages were 54% and 38%, respectively, with an increase in intermediate and nonsusceptible *S pneumoniae*.[126] Data on nasopharyngeal colonization from PCV7-immunized children with AOM have shown continued presence of *S pneumoniae* colonization. Revai et al[127] showed no difference in *S pneumoniae* colonization rate among children with AOM who have been unimmunized, underimmunized, or fully immunized with PCV7. In a study during a viral upper respiratory tract infection, including mostly PCV7-immunized children (6 months to 3 years of age), *S pneumoniae* was detected in 45.5% of 968 nasopharyngeal swabs, *H influenzae* was detected in 32.4%, and *M catarrhalis* was detected in 63.1%.[128] Data show that nasopharyngeal colonization of children vaccinated with PCV7 increasingly is caused by *S pneumoniae* serotypes not contained in the vaccine.[129–132] With the use of the recently licensed 13-valent pneumococcal conjugate vaccine (PCV13),[133] the patterns of nasopharyngeal colonization and infection with these common AOM bacterial pathogens will continue to evolve.

Investigators have attempted to predict the type of AOM pathogenic bacteria on the basis of clinical severity, but results have not been promising. *S pyogenes* has been shown to occur more commonly in older children[134] and to cause a greater degree of inflammation of the middle ear and TM, a greater frequency of spontaneous rupture of the TM, and more frequent progression to acute mastoiditis compared with other bacterial pathogens.[134–136] As for clinical findings in cases with *S pneumoniae* and nontypeable *H influenzae*, some studies suggest that signs and symptoms of AOM caused by *S pneumoniae* may be more severe (fever, severe earache, bulging TM) than those caused by other pathogens.[44,121,137] These findings were refuted by results of the studies that found AOM caused by nontypeable *H influenzae* to be associated with bilateral AOM and more severe inflammation of the TM.[96,138] Leibovitz et al[139] concluded, in a study of 372 children with AOM caused by *H influenzae* (*N* = 138), *S pneumoniae* (*N* = 64), and mixed *H influenzae* and *S pneumoniae* (*N* = 64), that clinical/otologic scores could not discriminate among various bacterial etiologies of AOM. However, there were significantly different clinical/otologic scores between bacterial culture negative and culture positive cases. A study of middle ear exudates of 82 cases of bullous myringitis has shown a 97% bacteria positive rate, primarily *S pneumoniae*. In contrast to the previous belief, mycoplasma is rarely the causative agent in this condition.[140] Accurate prediction of the bacterial cause of AOM on the basis of clinical presentation, without bacterial culture of the middle ear exudates, is not possible, but specific etiologies may be predicted in some situations. Published evidence has suggested that AOM associated with conjunctivitis (otitis-conjunctivitis syndrome) is more likely caused by nontypeable *H influenzae* than by other bacteria.[141–143]

Bacterial Susceptibility to Antibiotics

Selection of antibiotic to treat AOM is based on the suspected type of bacteria and antibiotic susceptibility pattern, although clinical pharmacology and clinical and microbiologic results and predicted compliance with the drug are also taken into account. Early studies of AOM patients show that 19% of children with *S pneumoniae* and 48% with *H influenzae* cultured on initial tympanocentesis who were not treated with antibiotic cleared the bacteria at the time of a second tympanocentesis 2 to 7 days later.[144] Approximately 75% of children infected with *M catarrhalis* experienced bacteriologic cure even after treatment with amoxicillin, an antibiotic to which it is not susceptible.[145,146]

Antibiotic susceptibility of major AOM bacterial pathogens continues to change, but data on middle ear pathogens have become scanty because tympanocentesis is not generally performed in studies of children with uncomplicated AOM. Most available data come from cases of persistent or recurrent AOM. Current US data from a number of centers indicates that approximately 83% and 87% of isolates of *S pneumoniae* from all age groups are susceptible to regular (40 mg/kg/day) and high-dose amoxicillin (80–90 mg/kg/day divided twice daily), respectively.[130,147–150] Pediatric isolates are smaller in number and include mostly ear isolates collected from recurrent and persistent AOM cases with a high percentage of multidrug-resistant *S pneumoniae*, most frequently nonvaccine serotypes that have recently increased in frequency and importance.[104]

High-dose amoxicillin will yield middle ear fluid levels that exceed the minimum inhibitory concentration (MIC) of all *S pneumoniae* serotypes that are intermediately resistant to penicillin (penicillin MICs, 0.12–1.0 μg/mL), and many but not all highly resistant serotypes (penicillin MICs, ≥2 μg/mL) for a longer period of the dosing interval and has been shown to improve bacteriologic and clinical efficacy

compared with the regular dose.[151–153] Hoberman et al[154] reported superior efficacy of high-dose amoxicillin-clavulanate in eradication of *S pneumoniae* (96%) from the middle ear at days 4 to 6 of therapy compared with azithromycin.

The antibiotic susceptibility pattern for *S pneumoniae* is expected to continue to evolve with the use of PCV13, a conjugate vaccine containing 13 serotypes of *S pneumoniae*.[133,155,156] Widespread use of PCV13 could potentially reduce diseases caused by multidrug-resistant pneumococcal serotypes and diminish the need for the use of higher dose of amoxicillin or amoxicillin-clavulanate for AOM.

Some *H influenzae* isolates produce β-lactamase enzyme, causing the isolate to become resistant to penicillins. Current data from different studies with non-AOM sources and geographic locations that may not be comparable show that 58% to 82% of *H influenzae* isolates are susceptible to regular- and high-dose amoxicillin.[130,147,148,157,158] These data represented a significant decrease in β-lactamase–producing *H influenzae*, compared with data reported in the 2004 AOM guideline.

Nationwide data suggest that 100% of *M catarrhalis* derived from the upper respiratory tract are β-lactamase–positive but remain susceptible to amoxicillin-clavulanate.[159] However, the high rate of spontaneous clinical resolution occurring in children with AOM attributable to *M catarrhalis* treated with amoxicillin reduces the concern for the first-line coverage for this microorganism.[145,146] AOM attributable to *M catarrhalis* rarely progresses to acute mastoiditis or intracranial infections.[102,160,161]

Antibiotic Therapy

High-dose amoxicillin is recommended as the first-line treatment in most patients, although there are a number of medications that are clinically effective (Table 5). The justification for the use of amoxicillin relates to its effectiveness against common AOM bacterial pathogens as well as its safety, low cost, acceptable taste, and narrow microbiologic spectrum.[145,151] In children who have taken amoxicillin in the previous 30 days, those with concurrent conjunctivitis, or those for whom coverage for β-lactamase–positive *H influenzae* and *M catarrhalis* is desired, therapy should be initiated with high-dose amoxicillin-clavulanate (90 mg/kg/day of amoxicillin, with 6.4 mg/kg/day of clavulanate, a ratio of amoxicillin to clavulanate of 14:1, given in 2 divided doses, which is less likely to cause diarrhea than other amoxicillin-clavulanate preparations).[162]

Alternative initial antibiotics include cefdinir (14 mg/kg per day in 1 or 2 doses), cefuroxime (30 mg/kg per day in 2 divided doses), cefpodoxime (10 mg/kg per day in 2 divided doses), or ceftriaxone (50 mg/kg, administered intramuscularly). It is important to note that alternative antibiotics vary in their efficacy against AOM pathogens. For example, recent US data on in vitro susceptibility of *S pneumoniae* to cefdinir and cefuroxime are 70% to 80%, compared with 84% to 92% amoxicillin efficacy.[130,147–149] In vitro efficacy of cefdinir and cefuroxime against *H influenzae* is approximately 98%, compared with 58% efficacy of amoxicillin and nearly 100% efficacy of amoxicillin-clavulanate.[158] A multicenter double tympanocentesis open-label study of

TABLE 5 Recommended Antibiotics for (Initial or Delayed) Treatment and for Patients Who Have Failed Initial Antibiotic Treatment

Initial Immediate or Delayed Antibiotic Treatment		Antibiotic Treatment After 48–72 h of Failure of Initial Antibiotic Treatment	
Recommended First-line Treatment	Alternative Treatment (if Penicillin Allergy)	Recommended First-line Treatment	Alternative Treatment
Amoxicillin (80–90 mg/ kg per day in 2 divided doses)	Cefdinir (14 mg/kg per day in 1 or 2 doses)	Amoxicillin-clavulanate[a] (90 mg/kg per day of amoxicillin, with 6.4 mg/kg per day of clavulanate in 2 divided doses)	Ceftriaxone, 3 d Clindamycin (30–40 mg/kg per day in 3 divided doses), with or without third-generation cephalosporin
or	Cefuroxime (30 mg/kg per day in 2 divided doses)	or	Failure of second antibiotic
Amoxicillin-clavulanate[a] (90 mg/kg per day of amoxicillin, with 6.4 mg/kg per day of clavulanate [amoxicillin to clavulanate ratio, 14:1] in 2 divided doses)	Cefpodoxime (10 mg/kg per day in 2 divided doses)	Ceftriaxone (50 mg IM or IV for 3 d)	Clindamycin (30–40 mg/kg per day in 3 divided doses) plus third-generation cephalosporin
	Ceftriaxone (50 mg IM or IV per day for 1 or 3 d)		Tympanocentesis[b] Consult specialist[b]

IM, intramuscular; IV, intravenous.

[a] May be considered in patients who have received amoxicillin in the previous 30 d or who have the otitis-conjunctivitis syndrome.

[b] Perform tympanocentesis/drainage if skilled in the procedure, or seek a consultation from an otolaryngologist for tympanocentesis/drainage. If the tympanocentesis reveals multidrug-resistant bacteria, seek an infectious disease specialist consultation.

[c] Cefdinir, cefuroxime, cefpodoxime, and ceftriaxone are highly unlikely to be associated with cross-reactivity with penicillin allergy on the basis of their distinct chemical structures. See text for more information.

cefdinir in recurrent AOM attributable to *H influenzae* showed eradication of the organism in 72% of patients.[163]

For penicillin-allergic children, recent data suggest that cross-reactivity among penicillins and cephalosporins is lower than historically reported.[164–167] The previously cited rate of cross-sensitivity to cephalosporins among penicillin-allergic patients (approximately 10%) is likely an overestimate. The rate was based on data collected and reviewed during the 1960s and 1970s. A study analyzing pooled data of 23 studies, including 2400 patients with reported history of penicillin allergy and 39 000 with no penicillin allergic history concluded that many patients who present with a history of penicillin allergy do not have an immunologic reaction to penicillin.[166] The chemical structure of the cephalosporin determines the risk of cross-reactivity between specific agents.[165,168] The degree of cross-reactivity is higher between penicillins and first-generation cephalosporins but is negligible with the second- and third-generation cephalosporins. Because of the differences in the chemical structures, cefdinir, cefuroxime, cefpodoxime, and ceftriaxone are highly unlikely to be associated with cross-reactivity with penicillin.[165] Despite this, the Joint Task Force on Practice Parameters; American Academy of Allergy, Asthma and Immunology; American College of Allergy, Asthma and Immunology; and Joint Council of Allergy, Asthma and Immunology[169] stated that "cephalosporin treatment of patients with a history of penicillin allergy, selecting out those with severe reaction histories, show a reaction rate of 0.1%." They recommend a cephalosporin in cases without severe and/or recent penicillin allergy reaction history when skin test is not available.

Macrolides, such as erythromycin and azithromycin, have limited efficacy against both *H influenzae* and *S pneumoniae*.[130,147–149] Clindamycin lacks efficacy against *H influenzae*. Clindamycin alone (30–40 mg/kg per day in 3 divided doses) may be used for suspected penicillin-resistant *S pneumoniae*; however, the drug will likely not be effective for the multidrug-resistant serotypes.[130,158,166]

Several of these choices of antibiotic suspensions are barely palatable or frankly offensive and may lead to avoidance behaviors or active rejection by spitting out the suspension. Palatability of antibiotic suspensions has been compared in many studies.[170–172] Specific antibiotic suspensions such as cefuroxime, cefpodoxime, and clindamycin may benefit from adding taste-masking products, such as chocolate or strawberry flavoring agents, to obscure the initial bitter taste and the unpleasant aftertaste.[172,173] In the patient who is persistently vomiting or cannot otherwise tolerate oral medication, even when the taste is masked, ceftriaxone (50 mg/kg, administered intramuscularly in 1 or 2 sites in the anterior thigh, or intravenously) has been demonstrated to be effective for the initial or repeat antibiotic treatment of AOM.[174,175] Although a single injection of ceftriaxone is approved by the US FDA for the treatment of AOM, results of a double tympanocentesis study (before and 3 days after single dose ceftriaxone) by Leibovitz et al[175] suggest that more than 1 ceftriaxone dose may be required to prevent recurrence of the middle ear infection within 5 to 7 days after the initial dose.

Initial Antibiotic Treatment Failure

When antibiotics are prescribed for AOM, clinical improvement should be noted within 48 to 72 hours. During the 24 hours after the diagnosis of AOM, the child's symptoms may worsen slightly. In the next 24 hours, the patient's symptoms should begin to improve. If initially febrile, the temperature should decline within 48 to 72 hours. Irritability and fussiness should lessen or disappear, and sleeping and drinking patterns should normalize.[176,177] If the patient is not improved by 48 to 72 hours, another disease or concomitant viral infection may be present, or the causative bacteria may be resistant to the chosen therapy.

Some children with AOM and persistent symptoms after 48 to 72 hours of initial antibacterial treatment may have combined bacterial and viral infection, which would explain the persistence of ongoing symptoms despite appropriate antibiotic therapy.[109,178,179] Literature is conflicting on the correlation between clinical and bacteriologic outcomes. Some studies report good correlation ranging from 86% to 91%,[180,181] suggesting continued presence of bacteria in the middle ear in a high proportion of cases with persistent symptoms. Others report that middle ear fluid from children with AOM in whom symptoms are persistent is sterile in 42% to 49% of cases.[123,182] A change in antibiotic may not be required in some children with mild persistent symptoms.

In children with persistent, severe symptoms of AOM and unimproved otologic findings after initial treatment, the clinician may consider changing the antibiotic (Table 5). If the child was initially treated with amoxicillin and failed to improve, amoxicillin-clavulanate should be used. Patients who were given amoxicillin-clavulanate or oral third-generation cephalosporins may receive intramuscular ceftriaxone (50 mg/kg). In the treatment of AOM unresponsive to initial antibiotics, a 3-day course of ceftriaxone has been shown to be better than a 1-day regimen.[175]

Although trimethoprim-sulfamethoxazole and erythromycin-sulfisoxazole had been useful as therapy for patients with AOM, pneumococcal surveillance studies have indicated that resistance to these 2 combination agents is substantial.[130,149,183] Therefore, when patients fail to improve while receiving amoxicillin, neither trimethoprim-sulfamethoxazole[184] nor erythromycin-sulfisoxazole is appropriate therapy.

Tympanocentesis should be considered, and culture of middle ear fluid should be performed for bacteriologic diagnosis and susceptibility testing when a series of antibiotic drugs have failed to improve the clinical condition. If tympanocentesis is not available, a course of clindamycin may be used, with or without an antibiotic that covers nontypeable *H influenzae* and *M catarrhalis*, such as cefdinir, cefixime, or cefuroxime.

Because *S pneumoniae* serotype 19A is usually multidrug-resistant and may not be responsive to clindamycin,[104,149] newer antibiotics that are not approved by the FDA for treatment of AOM, such as levofloxacin or linezolid, may be indicated.[185–187] Levofloxacin is a quinolone antibiotic that is not approved by the FDA for use in children. Linezolid is effective against resistant Gram-positive bacteria. It is not approved by the FDA for AOM treatment and is expensive. In children with repeated treatment failures, every effort should be made for bacteriologic diagnosis by tympanocentesis with Gram stain, culture, and antibiotic susceptibility testing of the organism (s) present. The clinician may consider consulting with pediatric medical subspecialists, such as an otolaryngologist for possible tympanocentesis, drainage, and culture and an infectious disease expert, before use of unconventional drugs such as levofloxacin or linezolid.

When tympanocentesis is not available, 1 possible way to obtain information on the middle ear pathogens and their antimicrobial susceptibility is to obtain a nasopharyngeal specimen for bacterial culture. Almost all middle ear pathogens derive from the pathogens colonizing the nasopharynx, but not all nasopharyngeal pathogens enter the middle ear to cause AOM. The positive predictive value of nasopharyngeal culture during AOM (likelihood that bacteria cultured from the nasopharynx is the middle ear pathogen) ranges from 22% to 44% for *S pneumoniae*, 50% to 71% for nontypeable *H influenzae*, and 17% to 19% for *M catarrhalis*. The negative predictive value (likelihood that bacteria not found in the nasopharynx are not AOM pathogens) ranges from 95% to 99% for all 3 bacteria.[188,189] Therefore, if nasopharyngeal culture is negative for specific bacteria, that organism is likely not the AOM pathogen. A negative culture for *S pneumoniae*, for example, will help eliminate the concern for multidrug-resistant bacteria and the need for unconventional therapies, such as levofloxacin or linezolid. On the other hand, if *S pneumoniae* is cultured from the nasopharynx, the antimicrobial susceptibility pattern can help guide treatment.

Duration of Therapy

The optimal duration of therapy for patients with AOM is uncertain; the usual 10-day course of therapy was derived from the duration of treatment of streptococcal pharyngotonsillitis. Several studies favor standard 10-day therapy over shorter courses for children younger than 2 years.[162,190–194] Thus, for children younger than 2 years and children with severe symptoms, a standard 10-day course is recommended. A 7-day course of oral antibiotic appears to be equally effective in children 2 to 5 years of age with mild or moderate AOM. For children 6 years and older with mild to moderate symptoms, a 5- to 7-day course is adequate treatment.

Follow-up of the Patient With AOM

Once the child has shown clinical improvement, follow-up is based on the usual clinical course of AOM. There is little scientific evidence for a routine 10- to 14-day reevaluation visit for all children with an episode of AOM. The physician may choose to reassess some children, such as young children with severe symptoms or recurrent AOM or when specifically requested by the child's parent.

Persistent MEE is common and can be detected by pneumatic otoscopy (with or without verification by tympanometry) after resolution of acute symptoms. Two weeks after successful antibiotic treatment of AOM, 60% to 70% of children have MEE, decreasing to 40% at 1 month and 10% to 25% at 3 months after successful antibiotic treatment.[177,195] The presence of MEE without clinical symptoms is defined as OME. OME must be differentiated clinically from AOM and requires infrequent additional monitoring but not antibiotic therapy. Assurance that OME resolves is particularly important for parents of children with cognitive or developmental delays that may be affected adversely by transient hearing loss associated with MEE. Detailed recommendations for the management of the child with OME can be found in the evidence-based guideline from the AAP/AAFP/American Academy of Otolaryngology-Head and Neck Surgery published in 2004.[84,85]

Key Action Statement 5A

Clinicians should *NOT* prescribe prophylactic antibiotics to reduce the frequency of episodes of AOM in children with recurrent AOM. (Evidence Quality: Grade B, Rec. Strength: Recommendation)

Key Action Statement Profile: KAS 5A

Aggregate evidence quality	Grade B
Benefits	No adverse effects from antibiotic. Reduces potential for development of bacterial resistance. Reduced costs.
Risks, harms, cost	Small increase in episodes of AOM.
Benefit-harm assessment	Preponderance of benefit.
Value judgments	Potential harm outweighs the potential benefit.
Intentional vagueness	None.
Role of patient preferences	Limited.
Exclusions	Young children whose only alternative would be tympanostomy tubes.
Strength	**Recommendation**

Key Action Statement 5B

Clinicians may offer tympanostomy tubes for recurrent AOM (3 episodes in 6 months or 4 episodes in 1 year, with 1 episode in the preceding 6 months). (Evidence Quality: Grade B, Rec. Strength: Option)

Key Action Statement Profile: KAS 5B

Aggregate evidence quality	**Grade B**
Benefits	Decreased frequency of AOM. Ability to treat AOM with topical antibiotic therapy.
Risks, harms, cost	Risks of anesthesia or surgery. Cost. Scarring of TM, chronic perforation, cholesteatoma. Otorrhea.
Benefits-harms assessment	Equilibrium of benefit and harm.
Value judgments	None.
Intentional vagueness	Option based on limited evidence.
Role of patient preferences	Joint decision of parent and clinician.
Exclusions	Any contraindication to anesthesia and surgery.
Strength	**Option**

Purpose of This Section

Recurrent AOM has been defined as the occurrence of 3 or more episodes of AOM in a 6-month period or the occurrence of 4 or more episodes of AOM in a 12-month period that includes at least 1 episode in the preceding 6 months.[20] These episodes should be well documented and separate acute infections.[11]

Winter season, male gender, and passive exposure to smoking have been associated with an increased likelihood of recurrence. Half of children younger than 2 years treated for AOM will experience a recurrence within 6 months. Symptoms that last more than 10 days may also predict recurrence.[196]

Changes From AAP/AAFP 2004 AOM Guideline

Recurrent AOM was not addressed in the 2004 AOM guideline. This section addresses the literature on recurrent AOM.

Antibiotic Prophylaxis

Long-term, low-dose antibiotic use, referred to as antibiotic prophylaxis or chemoprophylaxis, has been used to treat children with recurrent AOM to prevent subsequent episodes.[85] A 2006 Cochrane review analyzed 16 studies of long-term antibiotic use for AOM and found such use prevented 1.5 episodes of AOM per year, reducing in half the number of AOM episodes during the period of treatment.[197] Randomized placebo-controlled trials of prophylaxis reported a decrease of 0.09 episodes per month in the frequency of AOM attributable to therapy (approximately 0.5 to 1.5 AOM episodes per year for 95% of children). An estimated 5 children would need to be treated for 1 year to prevent 1 episode of OM. The effect may be more substantial for children with 6 or more AOM episodes in the preceding year.[12]

This decrease in episodes of AOM occurred only while the prophylactic antibiotic was being given. The modest benefit afforded by a 6-month course of antibiotic prophylaxis does not have longer-lasting benefit after cessation of therapy. Teele showed no differences between children who received prophylactic antibiotics compared with those who received placebo in AOM recurrences or persistence of OME.[198]

Antibiotic prophylaxis is not appropriate for children with long-term MEE or for children with infrequent episodes of AOM. The small reduction in frequency of AOM with long-term antibiotic prophylaxis must be weighed against the cost of such therapy; the potential adverse effects of antibiotics, principally allergic reaction and gastrointestinal tract consequences, such as diarrhea; and their contribution to the emergence of bacterial resistance.

Surgery for Recurrent AOM

The use of tympanostomy tubes for treatment of ear disease in general, and for AOM in particular, has been controversial.[199] Most published studies of surgical intervention for OM focus on children with persistent MEE with or without AOM. The literature on surgery for recurrent AOM as defined here is scant. A lack of consensus among otolaryngologists regarding the role of surgery for recurrent AOM was reported in a survey of Canadian otolaryngologists in which 40% reported they would "never," 30% reported they would "sometimes," and 30% reported they would "often or always" place tympanostomy tubes for a hypothetical 2-year-old child with frequent OM without persistent MEE or hearing loss.[200]

Tympanostomy tubes, however, remain widely used in clinical practice for both OME and recurrent OM.[201] Recurrent

AOM remains a common indication for referral to an otolaryngologist.

Three randomized controlled trials have compared the number of episodes of AOM after tympanostomy tube placement or no surgery.[202] Two found significant improvement in mean number of AOM episodes after tympanostomy tubes during a 6-month follow-up period.[203,204] One study randomly assigned children with recurrent AOM to groups receiving placebo, amoxicillin prophylaxis, or tympanostomy tubes and followed them for 2 years.[205] Although prophylactic antibiotics reduced the rate of AOM, no difference in number of episodes of AOM was noted between the tympanostomy tube group and the placebo group over 2 years. A Cochrane review of studies of tympanostomy tubes for recurrent AOM analyzed 2 studies[204,206] that met inclusion criteria and found that tympanostomy tubes reduced the number of episodes of AOM by 1.5 episodes in the 6 months after surgery.[207] Tympanostomy tube insertion has been shown to improve disease-specific quality-of-life measures in children with OM.[208] One multicenter, nonrandomized observational study showed large improvements in a disease-specific quality-of-life instrument that measured psychosocial domains of physical suffering, hearing loss, speech impairment, emotional distress, activity limitations, and caregiver concerns that are associated with ear infections.[209] These benefits of tympanostomy tubes have been demonstrated in mixed populations of children that include children with OME as well as recurrent AOM.

Beyond the cost, insertion of tympanostomy tubes is associated with a small but finite surgical and anesthetic risk. A recent review looking at protocols to minimize operative risk reported no major complications, such as sensorineural hearing loss, vascular injury, or ossicular chain disruption, in 10 000 tube insertions performed primarily by residents, although minor complications such as TM tears or displaced tubes in the middle ear were seen in 0.016% of ears.[210] Long-term sequelae of tympanostomy tubes include TM structural changes including focal atrophy, tympanosclerosis, retraction pockets, and chronic perforation. One meta-analysis found tympanosclerosis in 32% of patients after placement of tympanostomy tubes and chronic perforations in 2.2% of patients who had short-term tubes and 16.6% of patients with long-term tubes.[211]

Adenoidectomy, without myringotomy and/or tympanostomy tubes, did not reduce the number of episodes of AOM when compared with chemoprophylaxis or placebo.[212] Adenoidectomy alone should not be used for prevention of AOM but may have benefit when performed with placement of tympanostomy tubes or in children with previous tympanostomy tube placement in OME.[213]

Prevention of AOM: Key Action Statement 6A

Pneumococcal Vaccine

Clinicians should recommend pneumococcal conjugate vaccine to all children according to the schedule of the Advisory Committee on Immunization Practices, AAP, and AAFP. (Evidence Quality: Grade B, Rec. Strength: Strong Recommendation)

Key Action Statement Profile: KAS 6A

Aggregate evidence quality	Grade B
Benefits	Reduced frequency of AOM attributable to vaccine serotypes. Reduced risk of serious pneumococcal systemic disease.
Risks, harms, cost	Potential vaccine side effects. Cost of vaccine.
Benefits-harms assessment	Preponderance of benefit.
Value judgments	Potential vaccine adverse effects are minimal.
Intentional vagueness	None.
Role of patient preferences	Some parents may choose to refuse the vaccine.
Exclusions	Severe allergic reaction (eg, anaphylaxis) to any component of pneumococcal vaccine or any diphtheria toxoid-containing vaccine.
Strength	**Strong Recommendation**

Key Action Statement 6B

Influenza Vaccine: Clinicians should recommend annual influenza vaccine to all children according to the schedule of the Advisory Committee on Immunization Practices, AAP, and AAFP. (Evidence Quality: Grade B, Rec. Strength: Recommendation)

Key Action Statement Profile: KAS 6B

Aggregate evidence quality	Grade B
Benefits	Reduced risk of influenza infection. Reduction in frequency of AOM associated with influenza.
Risks, harms, cost	Potential vaccine adverse effects. Cost of vaccine. Requires annual immunization.
Benefits-harms assessment	Preponderance of benefit.
Value judgments	Potential vaccine adverse effects are minimal.
Intentional vagueness	None
Role of patient preferences	Some parents may choose to refuse the vaccine.
Exclusions	See CDC guideline on contraindications (http://www.cdc.gov/flu/professionals/acip/shouldnot.htm).
Strength	**Recommendation**

Key Action Statement 6C

Breastfeeding: Clinicians should encourage exclusive breastfeeding for at least 6 months. (Evidence Quality: Grade B, Rec. Strength: Recommendation)

Key Action Statement Profile: KAS 6C

Aggregate evidence quality	Grade B
Benefits	May reduce the risk of early AOM. Multiple benefits of breastfeeding unrelated to AOM.
Risk, harm, cost	None
Benefit-harm assessment	Preponderance of benefit.
Value judgments	The intervention has value unrelated to AOM prevention.
Intentional vagueness	None
Role of patient preferences	Some parents choose to feed formula.
Exclusions	None
Strength	**Recommendation**

Key Action Statement 6D

Clinicians should encourage avoidance of tobacco smoke exposure. (Evidence Quality: Grade C, Rec. Strength: Recommendation)

Key Action Statement Profile: KAS 6D

Aggregate evidence quality	Grade C
Benefits	May reduce the risk of AOM.
Risks, harms, cost	None
Benefits-harms assessment	Preponderance of benefit.
Value judgments	Avoidance of tobacco exposure has inherent value unrelated to AOM.
Intentional vagueness	None
Role of patient preferences	Many parents/caregivers choose not to stop smoking. Some also remain addicted, and are unable to quit smoking.
Exclusions	None
Strength	**Recommendation**

Purpose of This Section

The 2004 AOM guideline noted data on immunizations, breastfeeding, and lifestyle changes that would reduce the risk of acquiring AOM. This section addresses new data published since 2004.

Changes From AAP/AAFP 2004 AOM Guideline

PCV7 has been in use in the United States since 2000. PCV13 was introduced in the United States in 2010. The 10-valent pneumococcal nontypeable *H influenzae* protein D-conjugate vaccine was recently licensed in Europe for prevention of diseases attributable to *S pneumoniae* and nontypeable *H influenzae*. Annual influenza immunization is now recommended for all children 6 months of age and older in the United States.[214,215] Updated information regarding these vaccines and their effect on the incidence of AOM is reviewed.

The AAP issued a new breastfeeding policy statement in February 2012.[216] This guideline also includes a recommendation regarding tobacco smoke exposure. Bottle propping, pacifier use, and child care are discussed, but no recommendations are made because of limited evidence. The use of xylitol, a possible adjunct to AOM prevention, is discussed; however, no recommendations are made.

Pneumococcal Vaccine

Pneumococcal conjugate vaccines have proven effective in preventing OM caused by pneumococcal serotypes contained in the vaccines. A meta-analysis of 5 studies with AOM as an outcome determined that there is a 29% reduction in AOM caused by all pneumococcal serotypes among children who received PCV7 before 24 months of age.[217] Although the overall benefit seen in clinical trials for all causes of AOM is small (6%–7%),[218–221] observational studies have shown that medical office visits for otitis were reduced by up to 40% comparing years before and after introduction of PCV7.[222–224] Grijvala[223] reported no effect, however, among children first vaccinated at older ages. Poehling et al[225] reported reductions of frequent AOM and PE tube use after introduction of PCV7. The observations by some of greater benefit observed in the community than in clinical trials is not fully understood but may be related to effects of herd immunity or may be attributed to secular trends or changes in AOM diagnosis patterns over time.[223,226–229] In a 2009 Cochrane review,[221] Jansen et al found that the overall reduction in AOM incidence may only be 6% to 7% but noted that even that small rate may have public health relevance. O'Brien et al concurred and noted in addition the potential for cost savings.[230] There is evidence that serotype replacement may reduce the long-term efficacy of pneumococcal conjugate vaccines against AOM,[231] but it is possible that new pneumococcal conjugate vaccines may demonstrate an increased effect on reduction in AOM.[232–234] Data on AOM reduction secondary to the PCV13 licensed in the United States in 2010 are not yet available.

The *H influenzae* protein D-conjugate vaccine recently licensed in Europe has potential benefit of protection against 10 serotypes of *S pneumoniae* and nontypeable *H influenzae*.[221,234]

Influenza Vaccine

Most cases of AOM follow upper respiratory tract infections caused by viruses, including influenza viruses. As many as two-thirds of young children with influenza may have AOM.[235] Investigators have studied the efficacy of trivalent inactivated influenza vaccine (TIV) and live-attenuated intranasal influenza vaccine (LAIV) in preventing AOM. Many studies have demonstrated 30% to 55% efficacy of influenza vaccine in prevention of AOM during the respiratory illness season.[6,235–239] One study reported no benefit of TIV in reducing AOM burden; however, 1 of the 2 respiratory illness seasons during which this study was conducted had a relatively low influenza activity. A pooled analysis[240] of 8 studies comparing LAIV versus TIV or placebo[241–248] showed a higher efficacy of LAIV compared with both placebo and with TIV. Influenza vaccination is now recommended for all children 6 months of age and older in the United States.[214,215]

Breastfeeding

Multiple studies provide evidence that breastfeeding for at least 4 to 6 months reduces episodes of AOM and recurrent AOM.[249–253] Two cohort studies, 1 retrospective study[250] and 1 prospective study,[253] suggest a dose response, with some protection from partial breastfeeding and the greatest protection from exclusive breastfeeding through 6 months of age. In multivariate analysis controlling for exposure to child care settings, the risk of nonrecurrent otitis is 0.61 (95% confidence interval [CI]: 0.4–0.92) comparing exclusive breastfeeding through 6 months of age with no breastfeeding or breastfeeding less than 4 months. In a prospective cohort, Scariatti[253] found a significant dose-response effect. In this study, OM was self-reported by parents. In a systematic review, McNiel et al[254] found that when exclusive breastfeeding was set as the normative standard, the recalculated odds ratios (ORs) revealed the risks of any formula use. For example, any formula use in the first 6 months of age was significantly associated with increased incidence of OM (OR: 1.78; 95% CI: 1.19–2.70; OR: 4.55; 95% CI: 1.64–12.50 in the available studies; pooled OR for any formula in the first 3 months of age, 2.00; 95% CI: 1.40–2.78). A number of studies[255–259] addressed the association of AOM and other infectious illness in infants with duration and exclusivity of breastfeeding, but all had limitations and none had a randomized controlled design. However, taken together, they continue to show a protective effect of exclusive breastfeeding. In all studies, there has been a predominance of white subjects, and child care attendance and smoking exposure may not have been completely controlled. Also, feeding methods were self-reported.

The consistent finding of a lower incidence of AOM and recurrent AOM with increased breastfeeding supports the AAP recommendation to encourage exclusive breastfeeding for the first 6 months of life and to continue for at least the first year and beyond for as long as mutually desired by mother and child.[216]

Lifestyle Changes

In addition to its many other benefits,[260] eliminating exposure to passive tobacco smoke has been postulated to reduce the incidence of AOM in infancy.[252,261–264] Bottles and pacifiers have been associated with AOM. Avoiding supine bottle feeding ("bottle propping") and reducing or eliminating pacifier use in the second 6 months of life may reduce AOM incidence.[265–267] In a recent cohort study, pacifier use was associated with AOM recurrence.[268]

During infancy and early childhood, reducing the incidence of upper respiratory tract infections by altering child care-center attendance patterns can reduce the incidence of recurrent AOM significantly.[249,269]

Xylitol

Xylitol, or birch sugar, is chemically a pentitol or 5-carbon polyol sugar alcohol. It is available as chewing gum, syrup, or lozenges. A 2011 Cochrane review[270] examined the evidence for the use of xylitol in preventing recurrent AOM. A statistically significant 25% reduction in the risk of occurrence of AOM among healthy children at child care centers in the xylitol group compared with the control group (relative risk: 0.75; 95% CI: 0.65 to 0.88; RD: –0.07; 95% CI: –0.12 to –0.03) in the 4 studies met criteria for analysis.[271–274] Chewing gum and lozenges containing xylitol appeared to be more effective than syrup. Children younger than 2 years, those at the greatest risk of having AOM, cannot safely use lozenges or chewing gum. Also, xylitol needs to be given 3 to 5 times a day to be effective. It is not effective for treating AOM and it must be taken daily throughout the respiratory illness season to have an effect. Sporadic or as-needed use is not effective.

Future Research

Despite advances in research partially stimulated by the 2004 AOM guideline, there are still many unanswered clinical questions in the field. Following are possible clinical research questions that still need to be resolved.

Diagnosis

There will probably never be a gold standard for diagnosis of AOM because of the continuum from OME to AOM. Conceivably, new techniques that could be used on the small amount of fluid obtained during tympanocentesis could identify inflammatory markers in addition to the presence of bacteria or viruses. However, performing tympanocentesis studies on children with uncomplicated otitis is likely not feasible because of ethical and other considerations.

Devices that more accurately identify the presence of MEE and bulging that are easier to use than tympanometry during office visits would be welcome, especially in the difficult-to-examine infant. Additional development of inexpensive, easy-to-use video pneumatic otoscopes is still a goal.

Initial Treatment

The recent studies of Hoberman[31] and Tähtinen[32] have addressed clinical and TM appearance by using stringent diagnostic criteria of AOM. However, the outcomes for less stringent diagnostic criteria, a combination of symptoms, MEE, and TM appearance not completely consistent with OME can only be inferred from earlier studies that used less stringent criteria but did not specify outcomes for various grades of findings. Randomized controlled trials on these less certain TM appearances using scales similar to the OS-8 scale[35] could clarify the benefit of initial antibiotics and initial observation for these less certain diagnoses. Such studies must also specify severity of illness, laterality, and otorrhea.

Appropriate end points must be established. Specifically is the appearance of the TM in patients without clinical symptoms at the end of a study significant for relapse, recurrence, or persistent MEE. Such a study would require randomization of patients with unimproved TM appearance to continued observation and antibiotic groups.

The most efficient and acceptable methods of initial observation should continue to be studied balancing the convenience and benefits with the potential risks to the patient.

Antibiotics

Amoxicillin-clavulanate has a broader spectrum than amoxicillin and may be a better initial antibiotic. However, because of cost and adverse effects, the subcommittee has chosen amoxicillin as first-line AOM treatment. Randomized controlled trials comparing the 2 with adequate power to differentiate clinical efficacy would clarify this choice. Stringent diagnostic criteria should be the standard for these studies. Antibiotic comparisons for AOM should now include an observation arm for patients with nonsevere illness to ensure a clinical benefit over placebo. Studies should also have enough patients to show small but meaningful differences.

Although there have been studies on the likelihood of resistant *S pneumoniae* or *H influenzae* in children in child care settings and with siblings younger than 5 years, studies are still needed to determine whether these and other risk factors would indicate a need for different initial treatment than noted in the guideline.

New antibiotics that are safe and effective are needed for use in AOM because of the development of multidrug-resistant organisms. Such new antibiotics must be tested against the currently available medications.

Randomized controlled trials using different durations of antibiotic therapy in different age groups are needed to optimize therapy with the possibility of decreasing duration of antibiotic use. These would need to be performed initially with amoxicillin and amoxicillin-clavulanate but should also be performed for any antibiotic used in AOM. Again, an observation arm should be included in nonsevere illness.

Recurrent AOM

There have been adequate studies regarding prophylactic antibiotic use in recurrent AOM. More and better controlled studies of tympanostomy tube placement would help determine its benefit versus harm.

Prevention

There should be additional development of vaccines targeted at common organisms associated with AOM.[275] Focused epidemiologic studies on the benefit of breastfeeding, specifically addressing AOM prevention, including duration of breastfeeding and partial versus exclusive breastfeeding, would clarify what is now a more general database. Likewise, more focused studies of the effects of lifestyle changes would help clarify their effect on AOM.

Complementary and Alternative Medicine

There are no well-designed randomized controlled trials of the usefulness of complementary and alternative medicine in AOM, yet a large number of families turn to these methods. Although most alternative therapies are relatively inexpensive, some may be costly. Such studies should compare the alternative therapy to observation rather than antibiotics and only use an antibiotic arm if the alternative therapy is shown to be better than observation. Such studies should focus on children with less stringent criteria of AOM but using the same descriptive criteria for the patients as noted above.

DISSEMINATION OF GUIDELINES

An Institute of Medicine Report notes that "Effective multifaceted implementation strategies targeting both individuals and healthcare systems should be employed by implementers to promote adherence to trustworthy [clinical practice guidelines]."[230]

Many studies of the effect of clinical practice guidelines have been performed. In general, the studies show little overt change in practice after a guideline is published. However, as was seen after the 2004 AOM guideline, the number of visits for AOM and the number of prescriptions for antibiotics for AOM had decreased publication. Studies of educational and dissemination methods both at the practicing physician level and especially at the resident level need to be examined.

SUBCOMMITTEE ON DIAGNOSIS AND MANAGEMENT OF ACUTE OTITIS MEDIA

Allan S. Lieberthal, MD, FAAP (Chair, general pediatrician, no conflicts)

Aaron E. Carroll, MD, MS, FAAP (Partnership for Policy Implementation [PPI] Informatician, general academic pediatrician, no conflicts)

Tasnee Chonmaitree, MD, FAAP (pediatric infectious disease physician, no financial conflicts; published research related to AOM)

Theodore G. Ganiats, MD (family physician, American Academy of Family Physicians, no conflicts)

Alejandro Hoberman, MD, FAAP (general academic pediatrician, no financial conflicts; published research related to AOM)

Mary Anne Jackson, MD, FAAP (pediatric infectious disease physician, AAP Committee on Infectious Disease, no conflicts)

Mark D. Joffe, MD, FAAP (pediatric emergency medicine physician, AAP Committee/Section on Pediatric Emergency Medicine, no conflicts)

Donald T. Miller, MD, MPH, FAAP (general pediatrician, no conflicts)

Richard M. Rosenfeld, MD, MPH, FAAP (otolaryngologist, AAP Section on Otolaryngology, Head and Neck Surgery, American Academy of Otolaryngology-Head and Neck Surgery, no financial conflicts; published research related to AOM)

Xavier D. Sevilla, MD, FAAP (general pediatrics, Quality Improvement Innovation Network, no conflicts)

Richard H. Schwartz, MD, FAAP (general pediatrician, no financial conflicts; published research related to AOM)

Pauline A. Thomas, MD, FAAP (epidemiologist, general pediatrician, no conflicts)

David E. Tunkel, MD, FAAP, FACS (otolaryngologist, AAP Section on Otolaryngology, Head and Neck Surgery, periodic consultant to Medtronic ENT)

CONSULTANT

Richard N. Shiffman, MD, FAAP, FACMI (informatician, guideline methodologist, general academic pediatrician, no conflicts)

STAFF

Caryn Davidson, MA

Oversight by the Steering Committee on Quality Improvement and Management, 2009–2012

REFERENCES

1. American Academy of Pediatrics Subcommittee on Management of Acute Otitis Media. Diagnosis and management of acute otitis media. *Pediatrics*. 2004;113(5):1451–1465
2. Grijalva CG, Nuorti JP, Griffin MR. Antibiotic prescription rates for acute respiratory tract infections in US ambulatory settings. *JAMA*. 2009;302(7):758–766
3. McCaig LF, Besser RE, Hughes JM. Trends in antimicrobial prescribing rates for children and adolescents. *JAMA*. 2002;287(23):3096–3102
4. Vernacchio L, Vezina RM, Mitchell AA. Management of acute otitis media by primary care physicians: trends since the release of the 2004 American Academy of Pediatrics/American Academy of Family Physicians clinical practice guideline. *Pediatrics*. 2007;120(2):281–287
5. Coco A, Vernacchio L, Horst M, Anderson A. Management of acute otitis media after publication of the 2004 AAP and AAFP clinical practice guideline. *Pediatrics*. 2010;125(2):214–220
6. Marchisio P, Mira E, Klersy C, et al. Medical education and attitudes about acute otitis media guidelines: a survey of Italian pediatricians and otolaryngologists. *Pediatr Infect Dis J*. 2009;28(1):1–4
7. Arkins ER, Koehler JM. Use of the observation option and compliance with guidelines in treatment of acute otitis media. *Ann Pharmacother*. 2008;42(5):726–727
8. Flores G, Lee M, Bauchner H, Kastner B. Pediatricians' attitudes, beliefs, and practices regarding clinical practice guidelines: a national survey. *Pediatrics*. 2000;105(3 pt 1):496–501
9. Bluestone CD. Definitions, terminology, and classification. In: Rosenfeld RM, Bluestone CD, eds. *Evidence-Based Otitis Media*. Hamilton, Canada: BC Decker; 2003:120–135
10. Bluestone CD, Klein JO. Definitions, terminology, and classification. In: Bluestone CD, Klein JO, eds. *Otitis Media in Infants and Children*. 4th ed. Hamilton, Canada: BC Decker; 2007:1–19
11. Dowell SF, Marcy MS, Phillips WR, et al. Otitis media: principles of judicious use of antimicrobial agents. *Pediatrics*. 1998;101(suppl):165–171
12. Rosenfeld RM. Clinical pathway for acute otitis media. In: Rosenfeld RM, Bluestone CD, eds. *Evidence-Based Otitis Media*. 2nd ed. Hamilton, Canada: BC Decker; 2003:280–302
13. Carlson LH, Carlson RD. Diagnosis. In: Rosenfeld RM, Bluestone CD, eds. *Evidence-Based Otitis Media*. Hamilton, Canada: BC Decker; 2003: 136–146
14. Bluestone CD, Klein JO. Diagnosis. In: *Otitis Media in Infants and Children*. 4th ed. Hamilton, Canada: BC Decker; 2007:147–212
15. University of Oxford, Centre for Evidence Based Medicine. Available at: www.cebm.net/index.aspx?o=1044. Accessed July 17, 2012
16. American Academy of Pediatrics Steering Committee on Quality Improvement and Management. Classifying recommendations for clinical practice guidelines. *Pediatrics*. 2004;114(3):874–877
17. Marcy M, Takata G, Shekelle P, et al. *Management of Acute Otitis Media*. Evidence Report/Technology Assessment No. 15. Rockville, MD: Agency for Healthcare Research and Quality; 2000

18. Chan LS, Takata GS, Shekelle P, Morton SC, Mason W, Marcy SM. Evidence assessment of management of acute otitis media: II. Research gaps and priorities for future research. *Pediatrics*. 2001;108(2): 248–254
19. Takata GS, Chan LS, Shekelle P, Morton SC, Mason W, Marcy SM. Evidence assessment of management of acute otitis media: I. The role of antibiotics in treatment of uncomplicated acute otitis media. *Pediatrics*. 2001;108(2):239–247
20. Shekelle PG, Takata G, Newberry SJ, et al. *Management of Acute Otitis Media: Update*. Evidence Report/Technology Assessment No. 198. Rockville, MD: Agency for Healthcare Research and Quality; 2010
21. Coker TR, Chan LS, Newberry SJ, et al. Diagnosis, microbial epidemiology, and antibiotic treatment of acute otitis media in children: a systematic review. *JAMA*. 2010;304(19):2161–2169
22. Jadad AR, Moore RA, Carroll D, et al. Assessing the quality of reports of randomized clinical trials: is blinding necessary? *Control Clin Trials*. 1996;17(1):1–12
23. Whiting P, Rutjes AW, Reitsma JB, Bossuyt PM, Kleijnen J. The development of QUADAS: a tool for the quality assessment of studies of diagnostic accuracy included in systematic reviews. *BMC Med Res Methodol*. 2003;3:25
24. Guyatt GH, Oxman AD, Vist GE, et al; GRADE Working Group. GRADE: an emerging consensus on rating quality of evidence and strength of recommendations. *BMJ*. 2008; 336(7650):924–926
25. Hoffman RN, Michel G, Rosenfeld RM, Davidson C. Building better guidelines with BRIDGE-Wiz: development and evaluation of a software assistant to promote clarity, transparency, and implementability. *J Am Med Inform Assoc*. 2012;19 (1):94–101
26. Kalu SU, Ataya RS, McCormick DP, Patel JA, Revai K, Chonmaitree T. Clinical spectrum of acute otitis media complicating upper respiratory tract viral infection. *Pediatr Infect Dis J*. 2011;30(2):95–99
27. Block SL, Harrison CJ. *Diagnosis and Management of Acute Otitis Media*. 3rd ed. Caddo, OK: Professional Communications; 2005:48–50
28. Wald ER. Acute otitis media: more trouble with the evidence. *Pediatr Infect Dis J*. 2003;22(2):103–104
29. Paradise JL, Rockette HE, Colborn DK, et al. Otitis media in 2253 Pittsburgh-area infants: prevalence and risk factors during the first two years of life. *Pediatrics*. 1997;99(3):318–333
30. McCormick DP, Chonmaitree T, Pittman C, et al. Nonsevere acute otitis media: a clinical trial comparing outcomes of watchful waiting versus immediate antibiotic treatment. *Pediatrics*. 2005;115(6): 1455–1465
31. Hoberman A, Paradise JL, Rockette HE, et al. Treatment of acute otitis media in children under 2 years of age. *N Engl J Med*. 2011;364(2):105–115
32. Tähtinen PA, Laine MK, Huovinen P, Jalava J, Ruuskanen O, Ruohola A. A placebo-controlled trial of antimicrobial treatment for acute otitis media. *N Engl J Med*. 2011;364(2):116–126
33. Shaikh N, Hoberman A, Paradise JL, et al. Development and preliminary evaluation of a parent-reported outcome instrument for clinical trials in acute otitis media. *Pediatr Infect Dis J*. 2009;28(1):5–8
34. Laine MK, Tähtinen PA, Ruuskanen O, Huovinen P, Ruohola A. Symptoms or symptom-based scores cannot predict acute otitis media at otitis-prone age. *Pediatrics*. 2010;125(5). Available at: www.pediatrics.org/cgi/content/full/125/5/e1154
35. Friedman NR, McCormick DP, Pittman C, et al. Development of a practical tool for assessing the severity of acute otitis media. *Pediatr Infect Dis J*. 2006;25(2):101–107
36. Rothman R, Owens T, Simel DL. Does this child have acute otitis media? *JAMA*. 2003; 290(12):1633–1640
37. Niemela M, Uhari M, Jounio-Ervasti K, Luotonen J, Alho OP, Vierimaa E. Lack of specific symptomatology in children with acute otitis media. *Pediatr Infect Dis J*. 1994;13(9):765–768
38. Heikkinen T, Ruuskanen O. Signs and symptoms predicting acute otitis media. *Arch Pediatr Adolesc Med*. 1995;149(1): 26–29
39. Ingvarsson L. Acute otalgia in children—findings and diagnosis. *Acta Paediatr Scand*. 1982;71(5):705–710
40. Kontiokari T, Koivunen P, Niemelä M, Pokka T, Uhari M. Symptoms of acute otitis media. *Pediatr Infect Dis J*. 1998;17(8):676–679
41. Wong DL, Baker CM. Pain in children: comparison of assessment scales. *Pediatr Nurs*. 1988;14(1):9–17
42. Shaikh N, Hoberman A, Paradise JL, et al. Responsiveness and construct validity of a symptom scale for acute otitis media. *Pediatr Infect Dis J*. 2009;28(1):9–12
43. Karma PH, Penttilä MA, Sipilä MM, Kataja MJ. Otoscopic diagnosis of middle ear effusion in acute and non-acute otitis media. I. The value of different otoscopic findings. *Int J Pediatr Otorhinolaryngol*. 1989;17(1):37–49
44. McCormick DP, Lim-Melia E, Saeed K, Baldwin CD, Chonmaitree T. Otitis media: can clinical findings predict bacterial or viral etiology? *Pediatr Infect Dis J*. 2000; 19(3):256–258
45. Schwartz RH, Stool SE, Rodriguez WJ, Grundfast KM. Acute otitis media: toward a more precise definition. *Clin Pediatr (Phila)*. 1981;20(9):549–554
46. Rosenfeld RM. Antibiotic prophylaxis for recurrent acute otitis media. In: Alper CM, Bluestone CD, eds. *Advanced Therapy of Otitis Media*. Hamilton, Canada: BC Decker; 2004
47. Paradise J, Bernard B, Colborn D, Smith C, Rockette H; Pittsburgh-area Child Development/Otitis Media Study Group. Otitis media with effusion: highly prevalent and often the forerunner of acute otitis media during the first year of life [abstract]. *Pediatr Res*. 1993;33:121A
48. Roland PS, Smith TL, Schwartz SR, et al. Clinical practice guideline: cerumen impaction. *Otolaryngol Head Neck Surg*. 2008;139(3 suppl 2):S1–S21
49. Shaikh N, Hoberman A, Kaleida PH, Ploof DL, Paradise JL. Videos in clinical medicine. Diagnosing otitis media—otoscopy and cerumen removal. *N Engl J Med*. 2010; 362(20):e62
50. Pichichero ME. Diagnostic accuracy, tympanocentesis training performance, and antibiotic selection by pediatric residents in management of otitis media. *Pediatrics*. 2002;110(6):1064–1070
51. Kaleida PH, Ploof DL, Kurs-Lasky M, et al. Mastering diagnostic skills: Enhancing Proficiency in Otitis Media, a model for diagnostic skills training. *Pediatrics*. 2009; 124(4). Available at: www.pediatrics.org/cgi/content/full/124/4/e714
52. Kaleida PH, Ploof D. ePROM: Enhancing Proficiency in Otitis Media. Pittsburgh, PA: University of Pittsburgh School of Medicine. Available at: http://pedsed.pitt.edu. Accessed December 31, 2011
53. Innovative Medical Education. *A View Through the Otoscope: Distinguishing Acute Otitis Media from Otitis Media with Effusion*. Paramus, NJ: Innovative Medical Education; 2000
54. American Academy of Pediatrics. Section on Infectious Diseases. A view through the otoscope: distinguishing acute otitis media from otitis media with effusion [video]. Available at: http://www2.aap.org/sections/infectdis/video.cfm. Accessed January 20, 2012
55. Hayden GF, Schwartz RH. Characteristics of earache among children with acute

otitis media. *Am J Dis Child*. 1985;139(7):721–723

56. Schechter NL. Management of pain associated with acute medical illness. In: Schechter NL, Berde CB, Yaster M, eds. *Pain in Infants, Children, and Adolescents*. Baltimore, MD: Williams & Wilkins; 1993:537–538
57. Rovers MM, Glasziou P, Appelman CL, et al. Predictors of pain and/or fever at 3 to 7 days for children with acute otitis media not treated initially with antibiotics: a meta-analysis of individual patient data. *Pediatrics*. 2007;119(3):579–585
58. Burke P, Bain J, Robinson D, Dunleavey J. Acute red ear in children: controlled trial of nonantibiotic treatment in children: controlled trial of nonantibiotic treatment in general practice. *BMJ*. 1991;303(6802):558–562
59. Sanders S, Glasziou PP, DelMar C, Rovers M. Antibiotics for acute otitis media in children [review]. *Cochrane Database Syst Rev*. 2009;(2):1–43
60. van Buchem FL, Dunk JH, van't Hof MA. Therapy of acute otitis media: myringotomy, antibiotics, or neither? A double-blind study in children. *Lancet*. 1981;2(8252):883–887
61. Thalin A, Densert O, Larsson A, et al. Is penicillin necessary in the treatment of acute otitis media? In: *Proceedings of the International Conference on Acute and Secretory Otitis Media. Part 1*. Amsterdam, Netherlands: Kugler Publications; 1986:441–446
62. Rovers MM, Glasziou P, Appelman CL, et al. Antibiotics for acute otitis media: an individual patient data meta-analysis. *Lancet*. 2006;368(9545):1429–1435
63. Bertin L, Pons G, d'Athis P, et al. A randomized, double-blind, multicentre controlled trial of ibuprofen versus acetaminophen and placebo for symptoms of acute otitis media in children. *Fundam Clin Pharmacol*. 1996;10(4):387–392
64. American Academy of Pediatrics. Committee on Psychosocial Aspects of Child and Family Health; Task Force on Pain in Infants, Children, and Adolescents. The assessment and management of acute pain in infants, children, and adolescents. *Pediatrics*. 2001;108(3):793–797
65. Bolt P, Barnett P, Babl FE, Sharwood LN. Topical lignocaine for pain relief in acute otitis media: results of a double-blind placebo-controlled randomised trial. *Arch Dis Child*. 2008;93(1):40–44
66. Foxlee R, Johansson AC, Wejfalk J, Dawkins J, Dooley L, Del Mar C. Topical analgesia for acute otitis media. *Cochrane Database Syst Rev*. 2006;(3):CD005657
67. Hoberman A, Paradise JL, Reynolds EA, Urkin J. Efficacy of Auralgan for treating ear pain in children with acute otitis media. *Arch Pediatr Adolesc Med*. 1997;151(7):675–678
68. Sarrell EM, Mandelberg A, Cohen HA. Efficacy of naturopathic extracts in the management of ear pain associated with acute otitis media. *Arch Pediatr Adolesc Med*. 2001;155(7):796–799
69. Sarrell EM, Cohen HA, Kahan E. Naturopathic treatment for ear pain in children. *Pediatrics*. 2003;111(5 pt 1):e574–e579
70. Adam D, Federspil P, Lukes M, Petrowicz O. Therapeutic properties and tolerance of procaine and phenazone containing ear drops in infants and very young children. *Arzneimittelforschung*. 2009;59(10):504–512
71. Barnett ED, Levatin JL, Chapman EH, et al. Challenges of evaluating homeopathic treatment of acute otitis media. *Pediatr Infect Dis J*. 2000;19(4):273–275
72. Jacobs J, Springer DA, Crothers D. Homeopathic treatment of acute otitis media in children: a preliminary randomized placebo-controlled trial. *Pediatr Infect Dis J*. 2001;20(2):177–183
73. Rosenfeld RM, Bluestone CD. Clinical efficacy of surgical therapy. In: Rosenfeld RM, Bluestone CD, eds. *Evidence-Based Otitis Media. 2003*. Hamilton, Canada: BC Decker; 2003:227–240
74. Rosenfeld RM. Observation option toolkit for acute otitis media. *Int J Pediatr Otorhinolaryngol*. 2001;58(1):1–8
75. Le Saux N, Gaboury I, Baird M, et al. A randomized, double-blind, placebo-controlled noninferiority trial of amoxicillin for clinically diagnosed acute otitis media in children 6 months to 5 years of age. *CMAJ*. 2005;172(3):335–341
76. Spiro DM, Tay KY, Arnold DH, Dziura JD, Baker MD, Shapiro ED. Wait-and-see prescription for the treatment of acute otitis media: a randomized controlled trial. *JAMA*. 2006;296(10):1235–1241
77. Neumark T, Mölstad S, Rosén C, et al. Evaluation of phenoxymethylpenicillin treatment of acute otitis media in children aged 2–16. *Scand J Prim Health Care*. 2007;25(3):166–171
78. Chao JH, Kunkov S, Reyes LB, Lichten S, Crain EF. Comparison of two approaches to observation therapy for acute otitis media in the emergency department. *Pediatrics*. 2008;121(5). Available at: www.pediatrics.org/cgi/content/full/121/5/e1352
79. Spurling GK, Del Mar CB, Dooley L, Foxlee R. Delayed antibiotics for respiratory infections. *Cochrane Database Syst Rev*. 2007;(3):CD004417
80. Koopman L, Hoes AW, Glasziou PP, et al. Antibiotic therapy to prevent the development of asymptomatic middle ear effusion in children with acute otitis media: a meta-analysis of individual patient data. *Arch Otolaryngol Head Neck Surg*. 2008;134(2):128–132
81. Marchetti F, Ronfani L, Nibali SC, Tamburlini G; Italian Study Group on Acute Otitis Media. Delayed prescription may reduce the use of antibiotics for acute otitis media: a prospective observational study in primary care. *Arch Pediatr Adolesc Med*. 2005;159(7):679–684
82. Ho D, Rotenberg BW, Berkowitz RG. The relationship between acute mastoiditis and antibiotic use for acute otitis media in children. *Arch Otolaryngol Head Neck Surg*. 2008;34(1):45–48
83. Thompson PL, Gilbert RE, Long PF, Saxena S, Sharland M, Wong IC. Effect of antibiotics for otitis media on mastoiditis in children: a retrospective cohort study using the United Kingdom general practice research database. *Pediatrics*. 2009;123(2):424–430
84. American Academy of Family Physicians; American Academy of Otolaryngology-Head and Neck Surgery; American Academy of Pediatrics Subcommittee on Otitis Media With Effusion. Otitis media with effusion. *Pediatrics*. 2004;113(5):1412–1429
85. Rosenfeld RM, Culpepper L, Doyle KJ, et al; American Academy of Pediatrics Subcommittee on Otitis Media with Effusion; American Academy of Family Physicians; American Academy of Otolaryngology—Head and Neck Surgery. Clinical practice guideline: otitis media with effusion. *Otolaryngol Head Neck Surg*. 2004;130(suppl 5):S95–S118
86. Appelman CL, Claessen JQ, Touw-Otten FW, Hordijk GJ, de Melker RA. Co-amoxiclav in recurrent acute otitis media: placebo controlled study. *BMJ*. 1991;303(6815):1450–1452
87. Burke P, Bain J, Robinson D, Dunleavey J. Acute red ear in children: controlled trial of nonantibiotic treatment in children: controlled trial of nonantibiotic treatment in general practice. *BMJ*. 1991;303(6802):558–562
88. van Balen FA, Hoes AW, Verheij TJ, de Melker RA. Primary care based randomized, double blind trial of amoxicillin versus placebo in children aged under 2 years. *BMJ*. 2000;320(7231):350–354

89. Little P, Gould C, Williamson I, Moore M, Warner G, Dunleavey J. Pragmatic randomised controlled trial of two prescribing strategies for childhood acute otitis media. *BMJ*. 2001;322(7282):336–342
90. Mygind N, Meistrup-Larsen K-I, Thomsen J, Thomsen VF, Josefsson K, Sørensen H. Penicillin in acute otitis media: a double-blind placebo-controlled trial. *Clin Otolaryngol Allied Sci*. 1981;6(1):5–13
91. Kaleida PH, Casselbrant ML, Rockette HE, et al. Amoxicillin or myringotomy or both for acute otitis media: results of a randomized clinical trial. *Pediatrics*. 1991;87 (4):466–474
92. Shaikh N, Hoberman A, Paradise JL, et al. Responsiveness and construct validity of a symptom scale for acute otitis media. *Pediatr Infect Dis J*. 2009;28(1):9–12
93. Heikkinen T, Chonmaitree T. Importance of respiratory viruses in acute otitis media. *Clin Microbiol Rev*. 2003;16(2):230–241
94. Halsted C, Lepow ML, Balassanian N, Emmerich J, Wolinsky E. Otitis media. Clinical observations, microbiology, and evaluation of therapy. *Am J Dis Child*. 1968;115(5):542–551
95. Rosenfeld RM, Vertrees J, Carr J, et al. Clinical efficacy of antimicrobials for acute otitis media: meta-analysis of 5,400 children from 33 randomized trials. *J Pediatr*. 1994;124(3):355–367
96. McCormick DP, Chandler SM, Chonmaitree T. Laterality of acute otitis media: different clinical and microbiologic characteristics. *Pediatr Infect Dis J*. 2007;26(7):583–588
97. Appelman CLM, Bossen PC, Dunk JHM, Lisdonk EH, de Melker RA, van Weert HCPM. NHG Standard Otitis Media Acuta (Guideline on acute otitis media of the Dutch College of General Practitioners). *Huisarts Wet*. 1990;33:242–245
98. Swedish Medical Research Council. Treatment for acute inflammation of the middle ear: consensus statement. Stockholm, Sweden: Swedish Medical Research Council; 2000. Available at: http://soapimg.icecube.snowfall.se/strama/Konsensut_ora_eng.pdf. Accessed July 18, 2012
99. Scottish Intercollegiate Guideline Network. Diagnosis and management of childhood otitis media in primary care. Edinburgh, Scotland: Scottish Intercollegiate Guideline Network; 2000. Available at: www.sign.ac.uk/guidelines/fulltext/66/index.html. Accessed July 18, 2012
100. National Institute for Health and Clinical Excellence, Centre for Clinical Practice. Respiratory tract infections—antibiotic prescribing: prescribing of antibiotics for self-limiting respiratory tract infections in adults and children in primary care. NICE Clinical Guideline 69. London, United Kingdom: National Institute for Health and Clinical Excellence; July 2008. Available at: www.nice.org.uk/CG069. Accessed July 18, 2012
101. Marchisio P, Bellussi L, Di Mauro G, et al. Acute otitis media: from diagnosis to prevention. Summary of the Italian guideline. *Int J Pediatr Otorhinolaryngol*. 2010;74(11):1209–1216
102. Siegel RM, Kiely M, Bien JP, et al. Treatment of otitis media with observation and a safety-net antibiotic prescription. *Pediatrics*. 2003;112(3 pt 1):527–531
103. Pshetizky Y, Naimer S, Shvartzman P. Acute otitis media—a brief explanation to parents and antibiotic use. *Fam Pract*. 2003;20(4):417–419
104. Pichichero ME, Casey JR. Emergence of a multiresistant serotype 19A pneumococcal strain not included in the 7-valent conjugate vaccine as an otopathogen in children. *JAMA*. 2007;298(15):1772–1778
105. Pichichero ME, Casey JR. Evolving microbiology and molecular epidemiology of acute otitis media in the pneumococcal conjugate vaccine era. *Pediatr Infect Dis J*. 2007;26(suppl 10):S12–S16
106. Nielsen HUK, Konradsen HB, Lous J, Frimodt-Møller N. Nasopharyngeal pathogens in children with acute otitis media in a low-antibiotic use country. *Int J Pediatr Otorhinolaryngol*. 2004;68(9):1149–1155
107. Pitkäranta A, Virolainen A, Jero J, Arruda E, Hayden FG. Detection of rhinovirus, respiratory syncytial virus, and coronavirus infections in acute otitis media by reverse transcriptase polymerase chain reaction. *Pediatrics*. 1998;102(2 pt 1):291–295
108. Heikkinen T, Thint M, Chonmaitree T. Prevalence of various respiratory viruses in the middle ear during acute otitis media. *N Engl J Med*. 1999;340(4):260–264
109. Chonmaitree T. Acute otitis media is not a pure bacterial disease. *Clin Infect Dis*. 2006;43(11):1423–1425
110. Williams JV, Tollefson SJ, Nair S, Chonmaitree T. Association of human metapneumovirus with acute otitis media. *Int J Pediatr Otorhinolaryngol*. 2006;70(7):1189–1193
111. Chonmaitree T, Heikkinen T. Role of viruses in middle-ear disease. *Ann N Y Acad Sci*. 1997;830:143–157
112. Klein JO, Bluestone CD. Otitis media. In: Feigin RD, Cherry JD, Demmler-Harrison GJ, Kaplan SL, eds. *Textbook of Pediatric Infectious Diseases*. 6th ed. Philadelphia, PA: Saunders; 2009:216–237
113. Chonmaitree T, Revai K, Grady JJ, et al. Viral upper respiratory tract infection and otitis media complication in young children. *Clin Infect Dis*. 2008;46(6):815–823
114. Ruohola A, Meurman O, Nikkari S, et al. Microbiology of acute otitis media in children with tympanostomy tubes: prevalences of bacteria and viruses. *Clin Infect Dis*. 2006; 43(11):1417–1422
115. Ruuskanen O, Arola M, Heikkinen T, Ziegler T. Viruses in acute otitis media: increasing evidence for clinical significance. *Pediatr Infect Dis J*. 1991;10(6):425–427
116. Chonmaitree T. Viral and bacterial interaction in acute otitis media. *Pediatr Infect Dis J*. 2000;19(suppl 5):S24–S30
117. Nokso-Koivisto J, Räty R, Blomqvist S, et al. Presence of specific viruses in the middle ear fluids and respiratory secretions of young children with acute otitis media. *J Med Virol*. 2004;72(2):241–248
118. Bluestone CD, Klein JO. Microbiology. In: Bluestone CD, Klein JO, eds. *Otitis Media in Infants and Children*. 4th ed. Hamilton, Canada: BC Decker; 2007:101–126
119. Del Beccaro MA, Mendelman PM, Inglis AF, et al. Bacteriology of acute otitis media: a new perspective. *J Pediatr*. 1992;120(1): 81–84
120. Block SL, Harrison CJ, Hedrick JA, et al. Penicillin-resistant *Streptococcus pneumoniae* in acute otitis media: risk factors, susceptibility patterns and antimicrobial management. *Pediatr Infect Dis J*. 1995;14 (9):751–759
121. Rodriguez WJ, Schwartz RH. *Streptococcus pneumoniae* causes otitis media with higher fever and more redness of tympanic membranes than *Haemophilus influenzae* or *Moraxella catarrhalis*. *Pediatr Infect Dis J*. 1999;18(10):942–944
122. Block SL, Hedrick J, Harrison CJ, et al. Community-wide vaccination with the heptavalent pneumococcal conjugate significantly alters the microbiology of acute otitis media. *Pediatr Infect Dis J*. 2004;23 (9):829–833
123. Casey JR, Pichichero ME. Changes in frequency and pathogens causing acute otitis media in 1995–2003. *Pediatr Infect Dis J*. 2004;23(9):824–828
124. McEllistrem MC, Adams JM, Patel K, et al. Acute otitis media due to penicillin-nonsusceptible *Streptococcus pneumoniae* before and after the introduction of the pneumococcal conjugate vaccine. *Clin Infect Dis*. 2005;40(12):1738–1744
125. Casey JR, Adlowitz DG, Pichichero ME. New patterns in the otopathogens causing acute otitis media six to eight years after introduction of pneumococcal conjugate vaccine. *Pediatr Infect Dis J*. 2010;29(4): 304–309

126. Grubb MS, Spaugh DC. Microbiology of acute otitis media, Puget Sound region, 2005–2009. *Clin Pediatr (Phila)*. 2010;49(8): 727–730
127. Revai K, McCormick DP, Patel J, Grady JJ, Saeed K, Chonmaitree T. Effect of pneumococcal conjugate vaccine on nasopharyngeal bacterial colonization during acute otitis media. *Pediatrics*. 2006;117(5): 1823–1829
128. Pettigrew MM, Gent JF, Revai K, Patel JA, Chonmaitree T. Microbial interactions during upper respiratory tract infections. *Emerg Infect Dis*. 2008;14(10):1584–1591
129. O'Brien KL, Millar EV, Zell ER, et al. Effect of pneumococcal conjugate vaccine on nasopharyngeal colonization among immunized and unimmunized children in a community-randomized trial. *J Infect Dis*. 2007;196(8):1211–1220
130. Jacobs MR, Bajaksouzian S, Windau A, Good C. Continued emergence of nonvaccine serotypes of *Streptococcus pneumoniae* in Cleveland. *Proceedings of the 49th Interscience Conference on Antimicrobial Agents and Chemotherapy*; 2009:G1-G1556
131. Hoberman A, Paradise JL, Shaikh N, et al. Pneumococcal resistance and serotype 19A in Pittsburgh-area children with acute otitis media before and after introduction of 7-valent pneumococcal polysaccharide vaccine. *Clin Pediatr (Phila)*. 2011;50(2): 114–120
132. Huang SS, Hinrichsen VL, Stevenson AE, et al. Continued impact of pneumococcal conjugate vaccine on carriage in young children. *Pediatrics*. 2009;124(1). Available at: www.pediatrics.org/cgi/content/full/124/1/e1
133. Centers for Disease Control and Prevention (CDC). Licensure of a 13-valent pneumococcal conjugate vaccine (PCV13) and recommendations for use among children—Advisory Committee on Immunization Practices (ACIP), 2010. *MMWR Morb Mortal Wkly Rep*. 2010;59(9):258–261
134. Segal N, Givon-Lavi N, Leibovitz E, Yagupsky P, Leiberman A, Dagan R. Acute otitis media caused by *Streptococcus pyogenes* in children. *Clin Infect Dis*. 2005;41(1):35–41
135. Luntz M, Brodsky A, Nusem S, et al. Acute mastoiditis—the antibiotic era: a multicenter study. *Int J Pediatr Otorhinolaryngol*. 2001;57(1):1–9
136. Nielsen JC. *Studies on the Aetiology of Acute Otitis Media*. Copenhagen, Denmark: Ejnar Mundsgaard Forlag; 1945
137. Palmu AA, Herva E, Savolainen H, Karma P, Mäkelä PH, Kilpi TM. Association of clinical signs and symptoms with bacterial findings in acute otitis media. *Clin Infect Dis*. 2004;38(2):234–242
138. Leibovitz E, Asher E, Piglansky L, et al. Is bilateral acute otitis media clinically different than unilateral acute otitis media? *Pediatr Infect Dis J*. 2007;26(7):589–592
139. Leibovitz E, Satran R, Piglansky L, et al. Can acute otitis media caused by *Haemophilus influenzae* be distinguished from that caused by *Streptococcus pneumoniae? Pediatr Infect Dis J*. 2003;22(6): 509–515
140. Palmu AA, Kotikoski MJ, Kaijalainen TH, Puhakka HJ. Bacterial etiology of acute myringitis in children less than two years of age. *Pediatr Infect Dis J*. 2001;20(6): 607–611
141. Bodor FF. Systemic antibiotics for treatment of the conjunctivitis-otitis media syndrome. *Pediatr Infect Dis J*. 1989;8(5): 287–290
142. Bingen E, Cohen R, Jourenkova N, Gehanno P. Epidemiologic study of conjunctivitis-otitis syndrome. *Pediatr Infect Dis J*. 2005;24(8):731–732
143. Barkai G, Leibovitz E, Givon-Lavi N, Dagan R. Potential contribution by nontypable *Haemophilus influenzae* in protracted and recurrent acute otitis media. *Pediatr Infect Dis J*. 2009;28(6):466–471
144. Howie VM, Ploussard JH. Efficacy of fixed combination antibiotics versus separate components in otitis media. Effectiveness of erythromycin estrolate, triple sulfonamide, ampicillin, erythromycin estolate-triple sulfonamide, and placebo in 280 patients with acute otitis media under two and one-half years of age. *Clin Pediatr (Phila)*. 1972;11(4):205–214
145. Klein JO. Microbiologic efficacy of antibacterial drugs for acute otitis media. *Pediatr Infect Dis J*. 1993;12(12): 973–975
146. Barnett ED, Klein JO. The problem of resistant bacteria for the management of acute otitis media. *Pediatr Clin North Am*. 1995;42(3):509–517
147. Tristram S, Jacobs MR, Appelbaum PC. Antimicrobial resistance in *Haemophilus influenzae. Clin Microbiol Rev*. 2007;20(2): 368–389
148. Critchley IA, Jacobs MR, Brown SD, Traczewski MM, Tillotson GS, Janjic N. Prevalence of serotype 19A *Streptococcus pneumoniae* among isolates from U.S. children in 2005≠2006 and activity of faropenem. *Antimicrob Agents Chemother*. 2008;52(7): 2639–2643
149. Jacobs MR, Good CE, Windau AR, et al. Activity of ceftaroline against emerging serotypes of Streptococcus pneumoniae. *Antimicrob Agents Chemother*. 2010;54(6): 2716–2719
150. Jacobs MR. Antimicrobial-resistant *Streptococcus pneumoniae:* trends and management. *Expert Rev Anti Infect Ther*. 2008;6(5):619–635
151. Piglansky L, Leibovitz E, Raiz S, et al. Bacteriologic and clinical efficacy of high dose amoxicillin for therapy of acute otitis media in children. *Pediatr Infect Dis J*. 2003;22(5):405–413
152. Dagan R, Johnson CE, McLinn S, et al. Bacteriologic and clinical efficacy of amoxicillin/clavulanate vs. azithromycin in acute otitis media. *Pediatr Infect Dis J*. 2000;19(2):95–104
153. Dagan R, Hoberman A, Johnson C, et al. Bacteriologic and clinical efficacy of high dose amoxicillin/clavulanate in children with acute otitis media. *Pediatr Infect Dis J*. 2001;20(9):829–837
154. Hoberman A, Dagan R, Leibovitz E, et al. Large dosage amoxicillin/clavulanate, compared with azithromycin, for the treatment of bacterial acute otitis media in children. *Pediatr Infect Dis J*. 2005;24 (6):525–532
155. De Wals P, Erickson L, Poirier B, Pépin J, Pichichero ME. How to compare the efficacy of conjugate vaccines to prevent acute otitis media? *Vaccine*. 2009;27(21): 2877–2883
156. Shouval DS, Greenberg D, Givon-Lavi N, Porat N, Dagan R. Serotype coverage of invasive and mucosal pneumococcal disease in Israeli children younger than 3 years by various pneumococcal conjugate vaccines. *Pediatr Infect Dis J*. 2009;28(4): 277–282
157. Jones RN, Farrell DJ, Mendes RE, Sader HS. Comparative ceftaroline activity tested against pathogens associated with community-acquired pneumonia: results from an international surveillance study. *J Antimicrob Chemother*. 2011;66(suppl 3): iii69–iii80
158. Harrison CJ, Woods C, Stout G, Martin B, Selvarangan R. Susceptibilities of Haemophilus influenzae, Streptococcus pneumoniae, including serotype 19A, and Moraxella catarrhalis paediatric isolates from 2005 to 2007 to commonly used antibiotics. *J Antimicrob Chemother*. 2009;63(3):511–519
159. Doern GV, Jones RN, Pfaller MA, Kugler K. *Haemophilus influenzae* and *Moraxella catarrhalis* from patients with community-acquired respiratory tract infections: antimicrobial susceptibility patterns from the SENTRY antimicrobial Surveillance Program (United States and Canada, 1997).

Antimicrob Agents Chemother. 1999;43(2):385–389

160. Nussinovitch M, Yoeli R, Elishkevitz K, Varsano I. Acute mastoiditis in children: epidemiologic, clinical, microbiologic, and therapeutic aspects over past years. *Clin Pediatr (Phila)*. 2004;43(3):261–267
161. Roddy MG, Glazier SS, Agrawal D. Pediatric mastoiditis in the pneumococcal conjugate vaccine era: symptom duration guides empiric antimicrobial therapy. *Pediatr Emerg Care*. 2007;23(11):779–784
162. Hoberman A, Paradise JL, Burch DJ, et al. Equivalent efficacy and reduced occurrence of diarrhea from a new formulation of amoxicillin/clavulanate potassium (Augmentin) for treatment of acute otitis media in children. *Pediatr Infect Dis J*. 1997;16(5):463–470
163. Arguedas A, Dagan R, Leibovitz E, Hoberman A, Pichichero M, Paris M. A multicenter, open label, double tympanocentesis study of high dose cefdinir in children with acute otitis media at high risk of persistent or recurrent infection. *Pediatr Infect Dis J*. 2006;25(3):211–218
164. Atanasković-Marković M, Velicković TC, Gavrović-Jankulović M, Vucković O, Nestorović B. Immediate allergic reactions to cephalosporins and penicillins and their cross-reactivity in children. *Pediatr Allergy Immunol*. 2005;16(4):341–347
165. Pichichero ME. Use of selected cephalosporins in penicillin-allergic patients: a paradigm shift. *Diagn Microbiol Infect Dis*. 2007;57(suppl 3):13S–18S
166. Pichichero ME, Casey JR. Safe use of selected cephalosporins in penicillin-allergic patients: a meta-analysis. *Otolaryngol Head Neck Surg*. 2007;136(3):340–347
167. DePestel DD, Benninger MS, Danziger L, et al. Cephalosporin use in treatment of patients with penicillin allergies. *J Am Pharm Assoc (2003)*. 2008;48(4):530–540
168. Fonacier L, Hirschberg R, Gerson S. Adverse drug reactions to a cephalosporins in hospitalized patients with a history of penicillin allergy. *Allergy Asthma Proc*. 2005;26(2):135–141
169. Joint Task Force on Practice Parameters; American Academy of Allergy, Asthma and Immunology; American College of Allergy, Asthma and Immunology; Joint Council of Allergy, Asthma and Immunology. Drug allergy: an updated practice parameter. *Ann Allergy Asthma Immunol*. 2010;105(4):259–273
170. Powers JL, Gooch WM, III, Oddo LP. Comparison of the palatability of the oral suspension of cefdinir vs. amoxicillin/clavulanate potassium, cefprozil and azithromycin in pediatric patients. *Pediatr Infect Dis J*. 2000;19(suppl 12):S174–S180
171. Steele RW, Thomas MP, Bégué RE. Compliance issues related to the selection of antibiotic suspensions for children. *Pediatr Infect Dis J*. 2001;20(1):1–5
172. Steele RW, Russo TM, Thomas MP. Adherence issues related to the selection of antistaphylococcal or antifungal antibiotic suspensions for children. *Clin Pediatr (Phila)*. 2006;45(3):245–250
173. Schwartz RH. Enhancing children's satisfaction with antibiotic therapy: a taste study of several antibiotic suspensions. *Curr Ther Res*. 2000;61(8):570–581
174. Green SM, Rothrock SG. Single-dose intramuscular ceftriaxone for acute otitis media in children. *Pediatrics*. 1993;91(1):23–30
175. Leibovitz E, Piglansky L, Raiz S, Press J, Leiberman A, Dagan R. Bacteriologic and clinical efficacy of one day vs. three day intramuscular ceftriaxone for treatment of nonresponsive acute otitis media in children. *Pediatr Infect Dis J*. 2000;19(11):1040–1045
176. Rosenfeld RM, Kay D. Natural history of untreated otitis media. *Laryngoscope*. 2003;113(10):1645–1657
177. Rosenfeld RM, Kay D. Natural history of untreated otitis media. In: Rosenfeld RM, Bluestone CD, eds. *Evidence-Based Otitis Media*. 2nd ed. Hamilton, Canada: BC Decker; 2003:180–198
178. Arola M, Ziegler T, Ruuskanen O. Respiratory virus infection as a cause of prolonged symptoms in acute otitis media. *J Pediatr*. 1990;116(5):697–701
179. Chonmaitree T, Owen MJ, Howie VM. Respiratory viruses interfere with bacteriologic response to antibiotic in children with acute otitis media. *J Infect Dis*. 1990;162(2):546–549
180. Dagan R, Leibovitz E, Greenberg D, Yagupsky P, Fliss DM, Leiberman A. Early eradication of pathogens from middle ear fluid during antibiotic treatment of acute otitis media is associated with improved clinical outcome. *Pediatr Infect Dis J*. 1998;17(9):776–782
181. Carlin SA, Marchant CD, Shurin PA, Johnson CE, Super DM, Rehmus JM. Host factors and early therapeutic response in acute otitis media. *J Pediatr*. 1991;118(2):178–183
182. Teele DW, Pelton SI, Klein JO. Bacteriology of acute otitis media unresponsive to initial antimicrobial therapy. *J Pediatr*. 1981;98(4):537–539
183. Doern GV, Pfaller MA, Kugler K, Freeman J, Jones RN. Prevalence of antimicrobial resistance among respiratory tract isolates of *Streptococcus pneumoniae* in North America: 1997 results from the SENTRY antimicrobial surveillance program. *Clin Infect Dis*. 1998;27(4):764–770
184. Leiberman A, Leibovitz E, Piglansky L, et al. Bacteriologic and clinical efficacy of trimethoprim-sulfamethoxazole for treatment of acute otitis media. *Pediatr Infect Dis J*. 2001;20(3):260–264
185. Humphrey WR, Shattuck MH, Zielinski RJ, et al. Pharmacokinetics and efficacy of linezolid in a gerbil model of *Streptococcus pneumoniae*-induced acute otitis media. *Antimicrob Agents Chemother*. 2003;47(4):1355–1363
186. Arguedas A, Dagan R, Pichichero M, et al. An open-label, double tympanocentesis study of levofloxacin therapy in children with, or at high risk for, recurrent or persistent acute otitis media. *Pediatr Infect Dis J*. 2006;25(12):1102–1109
187. Noel GJ, Blumer JL, Pichichero ME, et al. A randomized comparative study of levofloxacin versus amoxicillin/clavulanate for treatment of infants and young children with recurrent or persistent acute otitis media. *Pediatr Infect Dis J*. 2008;27(6):483–489
188. Howie VM, Ploussard JH. Simultaneous nasopharyngeal and middle ear exudate culture in otitis media. *Pediatr Digest*. 1971;13:31–35
189. Gehanno P, Lenoir G, Barry B, Bons J, Boucot I, Berche P. Evaluation of nasopharyngeal cultures for bacteriologic assessment of acute otitis media in children. *Pediatr Infect Dis J*. 1996;15(4):329–332
190. Cohen R, Levy C, Boucherat M, Langue J, de La Rocque F. A multicenter, randomized, double-blind trial of 5 versus 10 days of antibiotic therapy for acute otitis media in young children. *J Pediatr*. 1998;133(5):634–639
191. Pessey JJ, Gehanno P, Thoroddsen E, et al. Short course therapy with cefuroxime axetil for acute otitis media: results of a randomized multicenter comparison with amoxicillin/clavulanate. *Pediatr Infect Dis J*. 1999;18(10):854–859
192. Cohen R, Levy C, Boucherat M, et al. Five vs. ten days of antibiotic therapy for acute otitis media in young children. *Pediatr Infect Dis J*. 2000;19(5):458–463
193. Pichichero ME, Marsocci SM, Murphy ML, Hoeger W, Francis AB, Green JL. A prospective observational study of 5-, 7-, and 10-day antibiotic treatment for acute otitis media. *Otolaryngol Head Neck Surg*. 2001;124(4):381–387

194. Kozyrskyj AL, Klassen TP, Moffatt M, Harvey K. Short-course antibiotics for acute otitis media. *Cochrane Database Syst Rev.* 2010; (9):CD001095

195. Shurin PA, Pelton SI, Donner A, Klein JO. Persistence of middle-ear effusion after acute otitis media in children. *N Engl J Med.* 1979;300(20):1121–1123

196. Damoiseaux RA, Rovers MM, Van Balen FA, Hoes AW, de Melker RA. Long-term prognosis of acute otitis media in infancy: determinants of recurrent acute otitis media and persistent middle ear effusion. *Fam Pract.* 2006;23(1):40–45

197. Leach AJ, Morris PS. Antibiotics for the prevention of acute and chronic suppurative otitis media in children. *Cochrane Database Syst Rev.* 2006;(4):CD004401

198. Teele DW, Klein JO, Word BM, et al; Greater Boston Otitis Media Study Group. Antimicrobial prophylaxis for infants at risk for recurrent acute otitis media. *Vaccine.* 2000;19(suppl 1):S140–S143

199. Paradise JL. On tympanostomy tubes: rationale, results, reservations, and recommendations. *Pediatrics.* 1977;60(1):86–90

200. McIsaac WJ, Coyte PC, Croxford R, Asche CV, Friedberg J, Feldman W. Otolaryngologists' perceptions of the indications for tympanostomy tube insertion in children. *CMAJ.* 2000;162(9):1285–1288

201. Casselbrandt ML. Ventilation tubes for recurrent acute otitis media. In: Alper CM, Bluestone CD, eds. *Advanced Therapy of Otitis Media.* Hamilton, Canada: BC Decker; 2004:113–115

202. Shin JJ, Stinnett SS, Hartnick CJ. Pediatric recurrent acute otitis media. In: Shin JJ, Hartnick CJ, Randolph GW, eds. *Evidence-Based Otolaryngology.* New York, NY: Springer; 2008:91–95

203. Gonzalez C, Arnold JE, Woody EA, et al. Prevention of recurrent acute otitis media: chemoprophylaxis versus tympanostomy tubes. *Laryngoscope.* 1986;96(12): 1330–1334

204. Gebhart DE. Tympanostomy tubes in the otitis media prone child. *Laryngoscope.* 1981;91(6):849–866

205. Casselbrant ML, Kaleida PH, Rockette HE, et al. Efficacy of antimicrobial prophylaxis and of tympanostomy tube insertion for prevention of recurrent acute otitis media: results of a randomized clinical trial. *Pediatr Infect Dis J.* 1992;11(4):278–286

206. El-Sayed Y. Treatment of recurrent acute otitis media chemoprophylaxis versus ventilation tubes. *Aust J Otolaryngol.* 1996; 2(4):352–355

207. McDonald S, Langton Hewer CD, Nunez DA. Grommets (ventilation tubes) for recurrent acute otitis media in children. *Cochrane Database Syst Rev.* 2008;(4): CD004741

208. Rosenfeld RM, Bhaya MH, Bower CM, et al. Impact of tympanostomy tubes on child quality of life. *Arch Otolaryngol Head Neck Surg.* 2000;126(5):585–592

209. Witsell DL, Stewart MG, Monsell EM, et al. The Cooperative Outcomes Group for ENT: a multicenter prospective cohort study on the outcomes of tympanostomy tubes for children with otitis media. *Otolaryngol Head Neck Surg.* 2005;132(2):180–188

210. Isaacson G. Six Sigma tympanostomy tube insertion: achieving the highest safety levels during residency training. *Otolaryngol Head Neck Surg.* 2008;139(3):353–357

211. Kay DJ, Nelson M, Rosenfeld RM. Meta-analysis of tympanostomy tube sequelae. *Otolaryngol Head Neck Surg.* 2001;124(4): 374–380

212. Koivunen P, Uhari M, Luotonen J, et al. Adenoidectomy versus chemoprophylaxis and placebo for recurrent acute otitis media in children aged under 2 years: randomised controlled trial. *BMJ.* 2004; 328(7438):487

213. Rosenfeld RM. Surgical prevention of otitis media. *Vaccine.* 2000;19(suppl 1):S134–S139

214. Centers for Disease Control and Prevention (CDC). Prevention and control of influenza with vaccines: recommendations of the Advisory Committee on Immunization Practices (ACIP), 2011. *MMWR Morb Mortal Wkly Rep.* 2011;60(33):1128–1132

215. American Academy of Pediatrics Committee on Infectious Diseases. Recommendations for prevention and control of influenza in children, 2011–2012. *Pediatrics.* 2011;128(4):813–825

216. Section on Breastfeeding. Breastfeeding and the use of human milk. *Pediatrics.* 2012;129(3). Available at: www.pediatrics.org/cgi/content/full/129/3/e827

217. Pavia M, Bianco A, Nobile CG, Marinelli P, Angelillo IF. Efficacy of pneumococcal vaccination in children younger than 24 months: a meta-analysis. *Pediatrics.* 2009; 123(6). Available at: www.pediatrics.org/cgi/content/full/123/6/e1103

218. Eskola J, Kilpi T, Palmu A, et al; Finnish Otitis Media Study Group. Efficacy of a pneumococcal conjugate vaccine against acute otitis media. *N Engl J Med.* 2001;344(6):403–409

219. Black S, Shinefield H, Fireman B, et al; Northern California Kaiser Permanente Vaccine Study Center Group. Efficacy, safety and immunogenicity of heptavalent pneumococcal conjugate vaccine in children. *Pediatr Infect Dis J.* 2000;19(3): 187–195

220. Jacobs MR. Prevention of otitis media: role of pneumococcal conjugate vaccines in reducing incidence and antibiotic resistance. *J Pediatr.* 2002;141(2):287–293

221. Jansen AG, Hak E, Veenhoven RH, Damoiseaux RA, Schilder AG, Sanders EA. Pneumococcal conjugate vaccines for preventing otitis media. *Cochrane Database Syst Rev.* 2009;(2):CD001480

222. Fireman B, Black SB, Shinefield HR, Lee J, Lewis E, Ray P. Impact of the pneumococcal conjugate vaccine on otitis media. *Pediatr Infect Dis J.* 2003;22(1):10–16

223. Grijalva CG, Poehling KA, Nuorti JP, et al. National impact of universal childhood immunization with pneumococcal conjugate vaccine on otitis media. *Pediatr Infect Dis J.* 2006;118(3):865–873

224. Zhou F, Shefer A, Kong Y, Nuorti JP. Trends in acute otitis media-related health care utilization by privately insured young children in the United States, 1997–2004. *Pediatrics.* 2008;121(2):253–260

225. Poehling KA, Szilagyi PG, Grijalva CG, et al. Reduction of frequent otitis media and pressure-equalizing tube insertions in children after introduction of pneumococcal conjugate vaccine. *Pediatrics.* 2007; 119(4):707–715

226. Pelton SI. Prospects for prevention of otitis media. *Pediatr Infect Dis J.* 2007;26 (suppl 10):S20–S22

227. Pelton SI, Leibovitz E. Recent advances in otitis media. *Pediatr Infect Dis J.* 2009;28 (suppl 10):S133–S137

228. De Wals P, Erickson L, Poirier B, Pépin J, Pichichero ME. How to compare the efficacy of conjugate vaccines to prevent acute otitis media? *Vaccine.* 2009;27(21): 2877–2883

229. Plasschaert AI, Rovers MM, Schilder AG, Verheij TJ, Hak E. Trends in doctor consultations, antibiotic prescription, and specialist referrals for otitis media in children: 1995–2003. *Pediatrics.* 2006;117(6): 1879–1886

230. O'Brien MA, Prosser LA, Paradise JL, et al. New vaccines against otitis media: projected benefits and cost-effectiveness. *Pediatrics.* 2009;123(6):1452–1463

231. Hanage WP, Auranen K, Syrjänen R, et al. Ability of pneumococcal serotypes and clones to cause acute otitis media: implications for the prevention of otitis media by conjugate vaccines. *Infect Immun.* 2004; 72(1):76–81

232. Prymula R, Peeters P, Chrobok V, et al. Pneumococcal capsular polysaccharides

conjugated to protein D for prevention of acute otitis media caused by both Streptococcus pneumoniae and non-typable *Haemophilus influenzae*: a randomised double-blind efficacy study. *Lancet*. 2006; 367(9512):740–748

233. Prymula R, Schuerman L. 10-valent pneumococcal nontypeable *Haemophilus influenzae* PD conjugate vaccine: Synflorix. *Expert Rev Vaccines*. 2009;8(11):1479–1500
234. Schuerman L, Borys D, Hoet B, Forsgren A, Prymula R. Prevention of otitis media: now a reality? *Vaccine*. 2009;27(42):5748–5754
235. Heikkinen T, Ruuskanen O, Waris M, Ziegler T, Arola M, Halonen P. Influenza vaccination in the prevention of acute otitis media in children. *Am J Dis Child*. 1991;145(4):445–448
236. Clements DA, Langdon L, Bland C, Walter E. Influenza A vaccine decreases the incidence of otitis media in 6- to 30-month-old children in day care. *Arch Pediatr Adolesc Med*. 1995;149(10):1113–1117
237. Belshe RB, Gruber WC. Prevention of otitis media in children with live attenuated influenza vaccine given intranasally. *Pediatr Infect Dis J*. 2000;19(suppl 5):S66–S71
238. Marchisio P, Cavagna R, Maspes B, et al. Efficacy of intranasal virosomal influenza vaccine in the prevention of recurrent acute otitis media in children. *Clin Infect Dis*. 2002;35(2):168–174
239. Ozgur SK, Beyazova U, Kemaloglu YK, et al. Effectiveness of inactivated influenza vaccine for prevention of otitis media in children. *Pediatr Infect Dis J*. 2006;25(5): 401–404
240. Block SL, Heikkinen T, Toback SL, Zheng W, Ambrose CS. The efficacy of live attenuated influenza vaccine against influenza-associated acute otitis media in children. *Pediatr Infect Dis J*. 2011;30(3):203–207
241. Ashkenazi S, Vertruyen A, Arístegui J, et al; CAIV-T Study Group. Superior relative efficacy of live attenuated influenza vaccine compared with inactivated influenza vaccine in young children with recurrent respiratory tract infections. *Pediatr Infect Dis J*. 2006;25(10):870–879
242. Belshe RB, Edwards KM, Vesikari T, et al; CAIV-T Comparative Efficacy Study Group. Live attenuated versus inactivated influenza vaccine in infants and young children [published correction appears in *N Engl J Med*. 2007;356(12):1283]. *N Engl J Med*. 2007;356(7):685–696
243. Bracco Neto H, Farhat CK, Tregnaghi MW, et al; D153-P504 LAIV Study Group. Efficacy and safety of 1 and 2 doses of live attenuated influenza vaccine in vaccine-naive children. *Pediatr Infect Dis J*. 2009;28(5): 365–371
244. Tam JS, Capeding MR, Lum LC, et al; Pan-Asian CAIV-T Pediatric Efficacy Trial Network. Efficacy and safety of a live attenuated, cold-adapted influenza vaccine, trivalent against culture-confirmed influenza in young children in Asia. *Pediatr Infect Dis J*. 2007;26(7):619–628
245. Vesikari T, Fleming DM, Aristegui JF, et al; CAIV-T Pediatric Day Care Clinical Trial Network. Safety, efficacy, and effectiveness of cold-adapted influenza vaccine-trivalent against community-acquired, culture-confirmed influenza in young children attending day care. *Pediatrics*. 2006;118(6):2298–2312
246. Forrest BD, Pride MW, Dunning AJ, et al. Correlation of cellular immune responses with protection against culture-confirmed influenza virus in young children. *Clin Vaccine Immunol*. 2008;15(7): 1042–1053
247. Lum LC, Borja-Tabora CF, Breiman RF, et al. Influenza vaccine concurrently administered with a combination measles, mumps, and rubella vaccine to young children. *Vaccine*. 2010;28(6):1566–1574
248. Belshe RB, Mendelman PM, Treanor J, et al. The efficacy of live attenuated, cold-adapted, trivalent, intranasal influenzavirus vaccine in children. *N Engl J Med*. 1998;338(20): 1405–1412
249. Daly KA, Giebink GS. Clinical epidemiology of otitis media. *Pediatr Infect Dis J*. 2000; 19(suppl 5):S31–S36
250. Duncan B, Ey J, Holberg CJ, Wright AL, Martinez FD, Taussig LM. Exclusive breastfeeding for at least 4 months protects against otitis media. *Pediatrics*. 1993;91(5): 867–872
251. Duffy LC, Faden H, Wasielewski R, Wolf J, Krystofik D. Exclusive breastfeeding protects against bacterial colonization and day care exposure to otitis media. *Pediatrics*. 1997;100(4). Available at: www.pediatrics.org/cgi/content/full/100/4/e7
252. Paradise JL. Short-course antimicrobial treatment for acute otitis media: not best for infants and young children. *JAMA*. 1997;278(20):1640–1642
253. Scariati PD, Grummer-Strawn LM, Fein SB. A longitudinal analysis of infant morbidity and the extent of breastfeeding in the United States. *Pediatrics*. 1997;99(6). Available at: www.pediatrics.org/cgi/content/full/99/6/e5
254. McNiel ME, Labbok MH, Abrahams SW. What are the risks associated with formula feeding? A re-analysis and review. *Breastfeed Rev*. 2010;18(2):25–32
255. Chantry CJ, Howard CR, Auinger P. Full breastfeeding duration and associated decrease in respiratory tract infection in US children. *Pediatrics*. 2006;117(2):425–432
256. Hatakka K, Piirainen L, Pohjavuori S, Poussa T, Savilahti E, Korpela R. Factors associated with acute respiratory illness in day care children. *Scand J Infect Dis*. 2010;42(9):704–711
257. Ladomenou F, Kafatos A, Tselentis Y, Galanakis E. Predisposing factors for acute otitis media in infancy. *J Infect*. 2010;61(1):49–53
258. Ladomenou F, Moschandreas J, Kafatos A, Tselentis Y, Galanakis E. Protective effect of exclusive breastfeeding against infections during infancy: a prospective study. *Arch Dis Child*. 2010;95(12):1004–1008
259. Duijts L, Jaddoe VW, Hofman A, Moll HA. Prolonged and exclusive breastfeeding reduces the risk of infectious diseases in infancy. *Pediatrics*. 2010;126(1). Available at: www.pediatrics.org/cgi/content/full/126/1/e18
260. Best D; Committee on Environmental Health; Committee on Native American Child Health; Committee on Adolescence. From the American Academy of Pediatrics: technical report—secondhand and prenatal tobacco smoke exposure. *Pediatrics*. 2009;124(5). Available at: www.pediatrics.org/cgi/content/full/124/5/e1017
261. Etzel RA, Pattishall EN, Haley NJ, Fletcher RH, Henderson FW. Passive smoking and middle ear effusion among children in day care. *Pediatrics*. 1992;90(2 pt 1): 228–232
262. Ilicali OC, Keleş N, Değer K, Savaş I. Relationship of passive cigarette smoking to otitis media. *Arch Otolaryngol Head Neck Surg*. 1999;125(7):758–762
263. Wellington M, Hall CB. Pacifier as a risk factor for acute otitis media [letter]. *Pediatrics*. 2002;109(2):351–352, author reply 353
264. Kerstein R. Otitis media: prevention instead of prescription. *Br J Gen Pract*. 2008;58(550):364–365
265. Brown CE, Magnuson B. On the physics of the infant feeding bottle and middle ear sequela: ear disease in infants can be associated with bottle feeding. *Int J Pediatr Otorhinolaryngol*. 2000;54(1):13–20
266. Niemelä M, Pihakari O, Pokka T, Uhari M. Pacifier as a risk factor for acute otitis media: a randomized, controlled trial of parental counseling. *Pediatrics*. 2000;106(3): 483–488

267. Tully SB, Bar-Haim Y, Bradley RL. Abnormal tympanography after supine bottle feeding. *J Pediatr*. 1995;126(6):S105–S111

268. Rovers MM, Numans ME, Langenbach E, Grobbee DE, Verheij TJ, Schilder AG. Is pacifier use a risk factor for acute otitis media? A dynamic cohort study. *Fam Pract*. 2008;25(4):233–236

269. Adderson EE. Preventing otitis media: medical approaches. *Pediatr Ann*. 1998;27(2):101–107

270. Azarpazhooh A, Limeback H, Lawrence HP, Shah PS. Xylitol for preventing acute otitis media in children up to 12 years of age. *Cochrane Database Syst Rev*. 2011;(11):CD007095

271. Hautalahti O, Renko M, Tapiainen T, Kontiokari T, Pokka T, Uhari M. Failure of xylitol given three times a day for preventing acute otitis media. *Pediatr Infect Dis J*. 2007;26(5):423–427

272. Tapiainen T, Luotonen L, Kontiokari T, Renko M, Uhari M. Xylitol administered only during respiratory infections failed to prevent acute otitis media. *Pediatrics*. 2002;109(2). Available at: www.pediatrics.org/cgi/content/full/109/2/e19

273. Uhari M, Kontiokari T, Koskela M, Niemelä M. Xylitol chewing gum in prevention of acute otitis media: double blind randomised trial. *BMJ*. 1996;313(7066):1180–1184

274. Uhari M, Kontiokari T, Niemelä M. A novel use of xylitol sugar in preventing acute otitis media. *Pediatrics*. 1998;102(4 pt 1):879–884

275. O'Brien MA, Prosser LA, Paradise JL, et al. New vaccines against otitis media: projected benefits and cost-effectiveness. *Pediatrics*. 2009;123(6):1452–1463

(Continued from first page)

All clinical practice guidelines from the American Academy of Pediatrics automatically expire 5 years after publication unless reaffirmed, revised, or retired at or before that time.

www.pediatrics.org/cgi/doi/10.1542/peds.2012-3488

doi:10.1542/peds.2012-3488

PEDIATRICS (ISSN Numbers: Print, 0031-4005; Online, 1098-4275).

Otitis Media With Effusion

- *Clinical Practice Guideline*

AMERICAN ACADEMY OF PEDIATRICS

CLINICAL PRACTICE GUIDELINE

American Academy of Family Physicians, American Academy of Otolaryngology-Head and Neck Surgery, and American Academy of Pediatrics Subcommittee on Otitis Media With Effusion

Otitis Media With Effusion

ABSTRACT. The clinical practice guideline on otitis media with effusion (OME) provides evidence-based recommendations on diagnosing and managing OME in children. This is an update of the 1994 clinical practice guideline "Otitis Media With Effusion in Young Children," which was developed by the Agency for Healthcare Policy and Research (now the Agency for Healthcare Research and Quality). In contrast to the earlier guideline, which was limited to children 1 to 3 years old with no craniofacial or neurologic abnormalities or sensory deficits, the updated guideline applies to children aged 2 months through 12 years with or without developmental disabilities or underlying conditions that predispose to OME and its sequelae. The American Academy of Pediatrics, American Academy of Family Physicians, and American Academy of Otolaryngology-Head and Neck Surgery selected a subcommittee composed of experts in the fields of primary care, otolaryngology, infectious diseases, epidemiology, hearing, speech and language, and advanced-practice nursing to revise the OME guideline.

The subcommittee made a strong recommendation that clinicians use pneumatic otoscopy as the primary diagnostic method and distinguish OME from acute otitis media.

The subcommittee made recommendations that clinicians should 1) document the laterality, duration of effusion, and presence and severity of associated symptoms at each assessment of the child with OME, 2) distinguish the child with OME who is at risk for speech, language, or learning problems from other children with OME and more promptly evaluate hearing, speech, language, and need for intervention in children at risk, and 3) manage the child with OME who is not at risk with watchful waiting for 3 months from the date of effusion onset (if known) or diagnosis (if onset is unknown).

The subcommittee also made recommendations that 4) hearing testing be conducted when OME persists for 3 months or longer or at any time that language delay, learning problems, or a significant hearing loss is suspected in a child with OME, 5) children with persistent OME who are not at risk should be reexamined at 3- to 6-month intervals until the effusion is no longer present, significant hearing loss is identified, or structural abnormalities of the eardrum or middle ear are suspected, and 6) when a child becomes a surgical candidate (tympanostomy tube insertion is the preferred initial procedure). Adenoidectomy should not be performed unless a distinct indication exists (nasal obstruction, chronic adenoiditis); repeat surgery consists of adenoidectomy plus myringotomy with or without tubeinsertion. Tonsillectomy alone or myringotomy alone should not be used to treat OME.

The subcommittee made negative recommendations that 1) population-based screening programs for OME not be performed in healthy, asymptomatic children, and 2) because antihistamines and decongestants are ineffective for OME, they should not be used for treatment; antimicrobials and corticosteroids do not have long-term efficacy and should not be used for routine management.

The subcommittee gave as options that 1) tympanometry can be used to confirm the diagnosis of OME and 2) when children with OME are referred by the primary clinician for evaluation by an otolaryngologist, audiologist, or speech-language pathologist, the referring clinician should document the effusion duration and specific reason for referral (evaluation, surgery) and provide additional relevant information such as history of acute otitis media and developmental status of the child. The subcommittee made no recommendations for 1) complementary and alternative medicine as a treatment for OME, based on a lack of scientific evidence documenting efficacy, or 2) allergy management as a treatment for OME, based on insufficient evidence of therapeutic efficacy or a causal relationship between allergy and OME. Last, the panel compiled a list of research needs based on limitations of the evidence reviewed.

The purpose of this guideline is to inform clinicians of evidence-based methods to identify, monitor, and manage OME in children aged 2 months through 12 years. The guideline may not apply to children more than 12 years old, because OME is uncommon and the natural history is likely to differ from younger children who experience rapid developmental change. The target population includes children with or without developmental disabilities or underlying conditions that predispose to OME and its sequelae. The guideline is intended for use by providers of health care to children, including primary care and specialist physicians, nurses and nurse practitioners, physician assistants, audiologists, speech-language pathologists, and child-development specialists. The guideline is applicable to any setting in which children with OME would be identified, monitored, or managed.

This guideline is not intended as a sole source of guidance in evaluating children with OME. Rather, it is designed to assist primary care and other clinicians by providing an evidence-based framework for decision-making strategies. It is not intended to replace clinical judgment or establish a protocol for all children with this condition and may not provide the only appropriate approach to diagnosing and managing this problem. *Pediatrics* 2004;113:1412–1429; *acute otitis media, antibacterial, antibiotic.*

This document was approved by the American Academy of Otolaryngology–Head and Neck Surgery Foundation, Inc and the American Academy of Pediatrics, and is published in the May 2004 issue of *Otolaryngology-Head and Neck Surgery* and the May 2004 issue of *Pediatrics*.

ABBREVIATIONS. OME, otitis media with effusion; AOM, acute otitis media; AAP, American Academy of Pediatrics; AHRQ, Agency for Healthcare Research and Quality; EPC, Southern California Evidence-Based Practice Center; CAM, complementary and alternative medicine; HL, hearing level.

Otitis media with effusion (OME) as discussed in this guideline is defined as the presence of fluid in the middle ear without signs or symptoms of acute ear infection.[1,2] OME is considered distinct from acute otitis media (AOM), which is defined as a history of acute onset of signs and symptoms, the presence of middle-ear effusion, and signs and symptoms of middle-ear inflammation. Persistent middle-ear fluid from OME results in decreased mobility of the tympanic membrane and serves as a barrier to sound conduction.[3] Approximately 2.2 million diagnosed episodes of OME occur annually in the United States, yielding a combined direct and indirect annual cost estimate of $4.0 billion.[2]

OME may occur spontaneously because of poor eustachian tube function or as an inflammatory response following AOM. Approximately 90% of children (80% of individual ears) have OME at some time before school age,[4] most often between ages 6 months and 4 years.[5] In the first year of life, >50% of children will experience OME, increasing to >60% by 2 years.[6] Many episodes resolve spontaneously within 3 months, but ~30% to 40% of children have recurrent OME, and 5% to 10% of episodes last 1 year or longer.[1,4,7]

The primary outcomes considered in the guideline include hearing loss; effects on speech, language, and learning; physiologic sequelae; health care utilization (medical, surgical); and quality of life.[1,2] The high prevalence of OME, difficulties in diagnosis and assessing duration, increased risk of conductive hearing loss, potential impact on language and cognition, and significant practice variations in management[8] make OME an important condition for the use of up-to-date evidence-based practice guidelines.

METHODS

General Methods and Literature Search

In developing an evidence-based clinical practice guideline on managing OME, the American Academy of Pediatrics (AAP), American Academy of Family Physicians, and American Academy of Otolaryngology-Head and Neck Surgery worked with the Agency for Healthcare Research and Quality (AHRQ) and other organizations. This effort included representatives from each partnering organization along with liaisons from audiology, speech-language pathology, informatics, and advanced-practice nursing. The most current literature on managing children with OME was reviewed, and research questions were developed to guide the evidence-review process.

The AHRQ report on OME from the Southern California Evidence-Based Practice Center (EPC) focused on key questions of natural history, diagnostic methods, and long-term speech, language, and hearing outcomes.[2] Searches were conducted through January 2000 in Medline, Embase, and the Cochrane Library. Additional articles were identified by review of reference listings in proceedings, reports, and other guidelines. The EPC accepted 970 articles for full review after screening 3200 abstracts. The EPC reviewed articles by using established quality criteria[9,10] and included randomized trials, prospective cohorts, and validations of diagnostic tests (validating cohort studies).

The AAP subcommittee on OME updated the AHRQ review with articles identified by an electronic Medline search through April 2003 and with additional material identified manually by subcommittee members. Copies of relevant articles were distributed to the subcommittee for consideration. A specific search for articles relevant to complementary and alternative medicine (CAM) was performed by using Medline and the Allied and Complementary Medicine Database through April 2003. Articles relevant to allergy and OME were identified by using Medline through April 2003. The subcommittee met 3 times over a 1-year period, ending in May 2003, with interval electronic review and feedback on each guideline draft to ensure accuracy of content and consistency with standardized criteria for reporting clinical practice guidelines.[11]

In May 2003, the Guidelines Review Group of the Yale Center for Medical Informatics used the Guideline Elements Model[12] to categorize content of the present draft guideline. Policy statements were parsed into component decision variables and actions and then assessed for decidability and executability. Quality appraisal using established criteria[13] was performed with Guideline Elements Model-Q Online.[14,15] Implementation issues were predicted by using the Implementability Rating Profile, an instrument under development by the Yale Guidelines Review Group (R. Shiffman, MD, written communication, May 2003). OME subcommittee members received summary results and modified an advanced draft of the guideline.

The final draft practice guideline underwent extensive peer review by numerous entities identified by the subcommittee. Comments were compiled and reviewed by the subcommittee cochairpersons. The recommendations contained in the practice guideline are based on the best available published data through April 2003. Where data are lacking, a combination of clinical experience and expert consensus was used. A scheduled review process will occur 5 years from publication or sooner if new compelling evidence warrants earlier consideration.

Classification of Evidence-Based Statements

Guidelines are intended to reduce inappropriate variations in clinical care, produce optimal health outcomes for patients, and minimize harm. The evidence-based approach to guideline development requires that the evidence supporting a policy be identified, appraised, and summarized and that an explicit link between evidence and statements be defined. Evidence-based statements reflect the quality of evidence and the balance of benefit and harm that is anticipated when the statement is followed. The AAP definitions for evidence-based statements[16] are listed in Tables 1 and 2.

Guidelines are never intended to overrule professional judgment; rather, they may be viewed as a relative constraint on individual clinician discretion in a particular clinical circumstance. Less frequent variation in practice is expected for a strong recommendation than might be expected with a recommendation. Options offer the most opportunity for practice variability.[17] All clinicians should always act and decide in a way that they believe will best serve their patients' interests and needs regardless of guideline recommendations. Guidelines represent the best judgment of a team of experienced clinicians and methodologists addressing the scientific evidence for a particular topic.[16]

Making recommendations about health practices involves value judgments on the desirability of various outcomes associated with management options. Value judgments applied by the OME subcommittee were made in an effort to minimize harm and diminish unnecessary therapy. Emphasis was placed on promptly identifying and managing children at risk for speech, language, or learning problems to maximize opportunities for beneficial outcomes. Direct costs also were considered in the statements concerning diagnosis and screening and to a lesser extent in other statements.

1A. PNEUMATIC OTOSCOPY: CLINICIANS SHOULD USE PNEUMATIC OTOSCOPY AS THE PRIMARY DIAGNOSTIC METHOD FOR OME, AND OME SHOULD BE DISTINGUISHED FROM AOM

This is a strong recommendation based on systematic review of cohort studies and the preponderance of benefit over harm.

TABLE 1. Guideline Definitions for Evidence-Based Statements

Statement	Definition	Implication
Strong Recommendation	A strong recommendation means that the subcommittee believes that the benefits of the recommended approach clearly exceed the harms (or that the harms clearly exceed the benefits in the case of a strong negative recommendation) and that the quality of the supporting evidence is excellent (grade A or B).* In some clearly identified circumstances, strong recommendations may be made based on lesser evidence when high-quality evidence is impossible to obtain and the anticipated benefits strongly outweigh the harms.	Clinicians should follow a strong recommendation unless a clear and compelling rationale for an alternative approach is present.
Recommendation	A recommendation means that the subcommittee believes that the benefits exceed the harms (or that the harms exceed the benefits in the case of a negative recommendation), but the quality of evidence is not as strong (grade B or C).* In some clearly identified circumstances, recommendations may be made based on lesser evidence when high-quality evidence is impossible to obtain and the anticipated benefits outweigh the harms.	Clinicians also should generally follow a recommendation but should remain alert to new information and sensitive to patient preferences.
Option	An option means that either the quality of evidence that exists is suspect (grade D)* or that well-done studies (grade A, B, or C)* show little clear advantage to one approach versus another.	Clinicians should be flexible in their decision-making regarding appropriate practice, although they may set boundaries on alternatives; patient preference should have a substantial influencing role.
No Recommendation	No recommendation means that there is both a lack of pertinent evidence (grade D)* and an unclear balance between benefits and harms.	Clinicians should feel little constraint in their decision-making and be alert to new published evidence that clarifies the balance of benefit versus harm; patient preference should have a substantial influencing role.

* See Table 2 for the definitions of evidence grades.

TABLE 2. Evidence Quality for Grades of Evidence

Grade	Evidence Quality
A	Well-designed, randomized, controlled trials or diagnostic studies performed on a population similar to the guideline's target population
B	Randomized, controlled trials or diagnostic studies with minor limitations; overwhelmingly consistent evidence from observational studies
C	Observational studies (case-control and cohort design)
D	Expert opinion, case reports, or reasoning from first principles (bench research or animal studies)

1B. TYMPANOMETRY: TYMPANOMETRY CAN BE USED TO CONFIRM THE DIAGNOSIS OF OME

This option is based on cohort studies and a balance of benefit and harm.

Diagnosing OME correctly is fundamental to proper management. Moreover, OME must be differentiated from AOM to avoid unnecessary antimicrobial use.[18,19]

OME is defined as fluid in the middle ear without signs or symptoms of acute ear infection.[2] The tympanic membrane is often cloudy with distinctly impaired mobility,[20] and an air-fluid level or bubble may be visible in the middle ear. Conversely, diagnosing AOM requires a history of acute onset of signs and symptoms, the presence of middle-ear effusion, and signs and symptoms of middle-ear inflammation. The critical distinguishing feature is that only AOM has acute signs and symptoms. Distinct redness of the tympanic membrane should not be a criterion for prescribing antibiotics, because it has poor predictive value for AOM and is present in ~5% of ears with OME.[20]

The AHRQ evidence report[2] systematically reviewed the sensitivity, specificity, and predictive values of 9 diagnostic methods for OME. Pneumatic otoscopy had the best balance of sensitivity and specificity, consistent with the 1994 guideline.[1] Meta-analysis revealed a pooled sensitivity of 94% (95% confidence interval: 91%–96%) and specificity of 80% (95% confidence interval: 75%–86%) for validated observers using pneumatic otoscopy versus myringotomy as the gold standard. Pneumatic otoscopy therefore should remain the primary method of OME diagnosis, because the instrument is readily available

in practice settings, cost-effective, and accurate in experienced hands. Non–pneumatic otoscopy is not advised for primary diagnosis.

The accuracy of pneumatic otoscopy in routine clinical practice may be less than that shown in published results, because clinicians have varying training and experience.[21,22] When the diagnosis of OME is uncertain, tympanometry or acoustic reflectometry should be considered as an adjunct to pneumatic otoscopy. Tympanometry with a standard 226-Hz probe tone is reliable for infants 4 months old or older and has good interobserver agreement of curve patterns in routine clinical practice.[23,24] Younger infants require specialized equipment with a higher probe tone frequency. Tympanometry generates costs related to instrument purchase, annual calibration, and test administration. Acoustic reflectometry with spectral gradient analysis is a low-cost alternative to tympanometry that does not require an airtight seal in the ear canal; however, validation studies primarily have used children 2 years old or older with a high prevalence of OME.[25–27]

Although no research studies have examined whether pneumatic otoscopy causes discomfort, expert consensus suggests that the procedure does not have to be painful, especially when symptoms of acute infection (AOM) are absent. A nontraumatic examination is facilitated by using a gentle touch, restraining the child properly when necessary, and inserting the speculum only into the outer one third (cartilaginous portion) of the ear canal.[28] The pneumatic bulb should be compressed slightly before insertion, because OME often is associated with a negative middle-ear pressure, which can be assessed more accurately by releasing the already compressed bulb. The otoscope must be fully charged, the bulb (halogen or xenon) bright and luminescent,[29] and the insufflator bulb attached tightly to the head to avoid the loss of an air seal. The window must also be sealed.

Evidence Profile: Pneumatic Otoscopy

- Aggregate evidence quality: A, diagnostic studies in relevant populations.
- Benefit: improved diagnostic accuracy; inexpensive equipment.
- Harm: cost of training clinicians in pneumatic otoscopy.
- Benefits-harms assessment: preponderance of benefit over harm.
- Policy level: strong recommendation.

Evidence Profile: Tympanometry

- Aggregate evidence quality: B, diagnostic studies with minor limitations.
- Benefit: increased diagnostic accuracy beyond pneumatic otoscopy; documentation.
- Harm: acquisition cost, administrative burden, and recalibration.
- Benefits-harms assessment: balance of benefit and harm.
- Policy level: option.

1C. SCREENING: POPULATION-BASED SCREENING PROGRAMS FOR OME ARE NOT RECOMMENDED IN HEALTHY, ASYMPTOMATIC CHILDREN

This recommendation is based on randomized, controlled trials and cohort studies, with a preponderance of harm over benefit.

This recommendation concerns population-based screening programs of all children in a community or a school without regard to any preexisting symptoms or history of disease. This recommendation does not address hearing screening or monitoring of specific children with previous or recurrent OME.

OME is highly prevalent in young children. Screening surveys of healthy children ranging in age from infancy to 5 years old show a 15% to 40% point prevalence of middle-ear effusion.[5,7,30–36] Among children examined at regular intervals for a year, ~50% to 60% of child care center attendees[32] and 25% of school-aged children[37] were found to have a middle-ear effusion at some time during the examination period, with peak incidence during the winter months.

Population-based screening has not been found to influence short-term language outcomes,[33] and its long-term effects have not been evaluated in a randomized, clinical trial. Therefore, the recommendation against screening is based not only on the ability to identify OME but more importantly on a lack of demonstrable benefits from treating children so identified that exceed the favorable natural history of the disease. The New Zealand Health Technology Assessment[38] could not determine whether preschool screening for OME was effective. More recently, the Canadian Task Force on Preventive Health Care[39] reported that insufficient evidence was available to recommend including or excluding routine early screening for OME. Although screening for OME is not inherently harmful, potential risks include inaccurate diagnoses, overtreating self-limited disease, parental anxiety, and the costs of screening and unnecessary treatment.

Population-based screening is appropriate for conditions that are common, can be detected by a sensitive and specific test, and benefit from early detection and treatment.[40] The first 2 requirements are fulfilled by OME, which affects up to 80% of children by school entry[2,5,7] and can be screened easily with tympanometry (see recommendation 1B). Early detection and treatment of OME identified by screening, however, have not been shown to improve intelligence, receptive language, or expressive language.[2,39,41,42] Therefore, population-based screening for early detection of OME in asymptomatic children has not been shown to improve outcomes and is not recommended.

Evidence Profile: Screening

- Aggregate evidence quality: B, randomized, controlled trials with minor limitations and consistent evidence from observational studies.
- Benefit: potentially improved developmental outcomes, which have not been demonstrated in the best current evidence.

- Harm: inaccurate diagnosis (false-positive or false-negative), overtreating self-limited disease, parental anxiety, cost of screening, and/or unnecessary treatment.
- Benefits-harms assessment: preponderance of harm over benefit.
- Policy level: recommendation against.

2. DOCUMENTATION: CLINICIANS SHOULD DOCUMENT THE LATERALITY, DURATION OF EFFUSION, AND PRESENCE AND SEVERITY OF ASSOCIATED SYMPTOMS AT EACH ASSESSMENT OF THE CHILD WITH OME

This recommendation is based on observational studies and strong preponderance of benefit over harm.

Documentation in the medical record facilitates diagnosis and treatment and communicates pertinent information to other clinicians to ensure patient safety and reduce medical errors.[43] Management decisions in children with OME depend on effusion duration and laterality plus the nature and severity of associated symptoms. Therefore, these features should be documented at every medical encounter for OME. Although no studies have addressed documentation for OME specifically, there is room for improvement in documentation of ambulatory care medical records.[44]

Ideally, the time of onset and laterality of OME can be defined through diagnosis of an antecedent AOM, a history of acute onset of signs or symptoms directly referable to fluid in the middle ear, or the presence of an abnormal audiogram or tympanogram closely after a previously normal test. Unfortunately, these conditions are often lacking, and the clinician is forced to speculate on the onset and duration of fluid in the middle ear(s) in a child found to have OME at a routine office visit or school screening audiometry.

In ~40% to 50% of cases of OME, neither the affected children nor their parents or caregivers describe significant complaints referable to a middle-ear effusion.[45,46] In some children, however, OME may have associated signs and symptoms caused by inflammation or the presence of effusion (not acute infection) that should be documented, such as

- Mild intermittent ear pain, fullness, or "popping"
- Secondary manifestations of ear pain in infants, which may include ear rubbing, excessive irritability, and sleep disturbances
- Failure of infants to respond appropriately to voices or environmental sounds, such as not turning accurately toward the sound source
- Hearing loss, even when not specifically described by the child, suggested by seeming lack of attentiveness, behavioral changes, failure to respond to normal conversational-level speech, or the need for excessively high sound levels when using audio equipment or viewing television
- Recurrent episodes of AOM with persistent OME between episodes
- Problems with school performance
- Balance problems, unexplained clumsiness, or delayed gross motor development[47–50]
- Delayed speech or language development

The laterality (unilateral versus bilateral), duration of effusion, and presence and severity of associated symptoms should be documented in the medical record at each assessment of the child with OME. When OME duration is uncertain, the clinician must take whatever evidence is at hand and make a reasonable estimate.

Evidence Profile: Documentation

- Aggregate evidence quality: C, observational studies.
- Benefits: defines severity, duration has prognostic value, facilitates future communication with other clinicians, supports appropriate timing of intervention, and, if consistently unilateral, may identify a problem with specific ear other than OME (eg, retraction pocket or cholesteatoma).
- Harm: administrative burden.
- Benefits-harms assessment: preponderance of benefit over harm.
- Policy level: recommendation.

3. CHILD AT RISK: CLINICIANS SHOULD DISTINGUISH THE CHILD WITH OME WHO IS AT RISK FOR SPEECH, LANGUAGE, OR LEARNING PROBLEMS FROM OTHER CHILDREN WITH OME AND SHOULD EVALUATE HEARING, SPEECH, LANGUAGE, AND NEED FOR INTERVENTION MORE PROMPTLY

This recommendation is based on case series, the preponderance of benefit over harm, and ethical limitations in studying children with OME who are at risk.

The panel defines the child at risk as one who is at increased risk for developmental difficulties (delay or disorder) because of sensory, physical, cognitive, or behavioral factors listed in Table 3. These factors are not caused by OME but can make the child less tolerant of hearing loss or vestibular problems secondary to middle-ear effusion. In contrast the child with OME who is not at risk is otherwise healthy and does not have any of the factors shown in Table 3.

Earlier guidelines for managing OME have applied only to young children who are healthy and exhibit no developmental delays.[1] Studies of the relationship between OME and hearing loss or speech/language development typically exclude children with craniofacial anomalies, genetic syndromes, and other developmental disorders. Therefore, the available literature mainly applies to otherwise healthy children who meet inclusion criteria for randomized,

TABLE 3. Risk Factors for Developmental Difficulties*

Permanent hearing loss independent of OME
Suspected or diagnosed speech and language delay or disorder
Autism-spectrum disorder and other pervasive developmental disorders
Syndromes (eg, Down) or craniofacial disorders that include cognitive, speech, and language delays
Blindness or uncorrectable visual impairment
Cleft palate with or without associated syndrome
Developmental delay

* Sensory, physical, cognitive, or behavioral factors that place children who have OME at an increased risk for developmental difficulties (delay or disorder).

controlled trials. Few, if any, existing studies dealing with developmental sequelae caused by hearing loss from OME can be generalized to children who are at risk.

Children who are at risk for speech or language delay would likely be affected additionally by hearing problems from OME,[51] although definitive studies are lacking. For example, small comparative studies of children or adolescents with Down syndrome[52] or cerebral palsy[53] show poorer articulation and receptive language associated with a history of early otitis media. Large studies are unlikely to be forthcoming because of methodologic and ethical difficulties inherent in studying children who are delayed or at risk for further delays. Therefore, clinicians who manage children with OME should determine whether other conditions coexist that put a child at risk for developmental delay (Table 3) and then take these conditions into consideration when planning assessment and management.

Children with craniofacial anomalies (eg, cleft palate; Down syndrome; Robin sequence; coloboma, heart defect, choanal atresia, retarded growth and development, genital anomaly, and ear defect with deafness [CHARGE] association) have a higher prevalence of chronic OME, hearing loss (conductive and sensorineural), and speech or language delay than do children without these anomalies.[54–57] Other children may not be more prone to OME but are likely to have speech and language disorders, such as those children with permanent hearing loss independent of OME,[58,59] specific language impairment,[60] autism-spectrum disorders,[61] or syndromes that adversely affect cognitive and linguistic development. Some retrospective studies[52,62,63] have found that hearing loss caused by OME in children with cognitive delays, such as Down syndrome, has been associated with lower language levels. Children with language delays or disorders with OME histories perform more poorly on speech-perception tasks than do children with OME histories alone.[64,65]

Children with severe visual impairments may be more susceptible to the effects of OME, because they depend on hearing more than children with normal vision.[51] Any decrease in their most important remaining sensory input for language (hearing) may significantly compromise language development and their ability to interact and communicate with others. All children with severe visual impairments should be considered more vulnerable to OME sequelae, especially in the areas of balance, sound localization, and communication.

Management of the child with OME who is at increased risk for developmental delays should include hearing testing and speech and language evaluation and may include speech and language therapy concurrent with managing OME, hearing aids or other amplification devices for hearing loss independent of OME, tympanostomy tube insertion,[54,63,66,67] and hearing testing after OME resolves to document improvement, because OME can mask a permanent underlying hearing loss and delay detection.[59,68,69]

Evidence Profile: Child at Risk

- Aggregate evidence quality: C, observational studies of children at risk; D, expert opinion on the ability of prompt assessment and management to alter outcomes.
- Benefits: optimizing conditions for hearing, speech, and language; enabling children with special needs to reach their potential; avoiding limitations on the benefits of educational interventions because of hearing problems from OME.
- Harm: cost, time, and specific risks of medications or surgery.
- Benefits-harms assessment: exceptional preponderance of benefits over harm based on subcommittee consensus because of circumstances to date precluding randomized trials.
- Policy level: recommendation.

4. WATCHFUL WAITING: CLINICIANS SHOULD MANAGE THE CHILD WITH OME WHO IS NOT AT RISK WITH WATCHFUL WAITING FOR 3 MONTHS FROM THE DATE OF EFFUSION ONSET (IF KNOWN) OR DIAGNOSIS (IF ONSET IS UNKNOWN)

This recommendation is based on systematic review of cohort studies and the preponderance of benefit over harm.

This recommendation is based on the self-limited nature of most OME, which has been well documented in cohort studies and in control groups of randomized trials.[2,70]

The likelihood of spontaneous resolution of OME is determined by the cause and duration of effusion.[70] For example, ~75% to 90% of residual OME after an AOM episode resolves spontaneously by 3 months.[71–73] Similar outcomes of defined onset during a period of surveillance in a cohort study are observed for OME.[32,37] Another favorable situation involves improvement (not resolution) of newly detected OME defined as change in tympanogram from type B (flat curve) to non-B (anything other than a flat curve). Approximately 55% of children so defined improve by 3 months,[70] but one third will have OME relapse within the next 3 months.[4] Although a type B tympanogram is an imperfect measure of OME (81% sensitivity and 74% specificity versus myringotomy), it is the most widely reported measure suitable for deriving pooled resolution rates.[2,70]

Approximately 25% of newly detected OME of unknown prior duration in children 2 to 4 years old resolves by 3 months when resolution is defined as a change in tympanogram from type B to type A/C1 (peak pressure >200 daPa).[2,70,74–77] Resolution rates may be higher for infants and young children in whom the preexisting duration of effusion is generally shorter, and particularly for those observed prospectively in studies or in the course of well-child care. Documented bilateral OME of 3 months' duration or longer resolves spontaneously after 6 to 12 months in ~30% of children primarily 2 years old or older, with only marginal benefits if observed longer.[70]

Any intervention for OME (medical or surgical) other than observation carries some inherent harm. There is little harm associated with a specified period of observation in the child who is not at risk for speech, language, or learning problems. When observing children with OME, clinicians should inform the parent or caregiver that the child may experience reduced hearing until the effusion resolves, especially if it is bilateral. Clinicians may discuss strategies for optimizing the listening and learning environment until the effusion resolves. These strategies include speaking in close proximity to the child, facing the child and speaking clearly, repeating phrases when misunderstood, and providing preferential classroom seating.[78,79]

The recommendation for a 3-month period of observation is based on a clear preponderance of benefit over harm and is consistent with the original OME guideline intent of avoiding unnecessary surgery.[1] At the discretion of the clinician, this 3-month period of watchful waiting may include interval visits at which OME is monitored by using pneumatic otoscopy, tympanometry, or both. Factors to consider in determining the optimal interval(s) for follow-up include clinical judgment, parental comfort level, unique characteristics of the child and/or his environment, access to a health care system, and hearing levels (HLs) if known.

After documented resolution of OME in all affected ears, additional follow-up is unnecessary.

Evidence Profile: Watchful Waiting

- Aggregate evidence quality: B, systematic review of cohort studies.
- Benefit: avoid unnecessary interventions, take advantage of favorable natural history, and avoid unnecessary referrals and evaluations.
- Harm: delays in therapy for OME that will not resolve with observation; prolongation of hearing loss.
- Benefits-harms assessment: preponderance of benefit over harm.
- Policy level: recommendation.

5. MEDICATION: ANTIHISTAMINES AND DECONGESTANTS ARE INEFFECTIVE FOR OME AND ARE NOT RECOMMENDED FOR TREATMENT; ANTIMICROBIALS AND CORTICOSTEROIDS DO NOT HAVE LONG-TERM EFFICACY AND ARE NOT RECOMMENDED FOR ROUTINE MANAGEMENT

This recommendation is based on systematic review of randomized, controlled trials and the preponderance of harm over benefit.

Therapy for OME is appropriate only if persistent and clinically significant benefits can be achieved beyond spontaneous resolution. Although statistically significant benefits have been demonstrated for some medications, they are short-term and relatively small in magnitude. Moreover, significant adverse events may occur with all medical therapies.

The prior OME guideline[1] found no data supporting antihistamine-decongestant combinations in treating OME. Meta-analysis of 4 randomized trials showed no significant benefit for antihistamines or decongestants versus placebo. No additional studies have been published since 1994 to change this recommendation. Adverse effects of antihistamines and decongestants include insomnia, hyperactivity, drowsiness, behavioral change, and blood-pressure variability.

Long-term benefits of antimicrobial therapy for OME are unproved despite a modest short-term benefit for 2 to 8 weeks in randomized trials.[1,80,81] Initial benefits, however, can become nonsignificant within 2 weeks of stopping the medication.[82] Moreover, ~7 children would need to be treated with antimicrobials to achieve one short-term response.[1] Adverse effects of antimicrobials are significant and may include rashes, vomiting, diarrhea, allergic reactions, alteration of the child's nasopharyngeal flora, development of bacterial resistance,[83] and cost. Societal consequences include direct transmission of resistant bacterial pathogens in homes and child care centers.[84]

The prior OME guideline[1] did not recommend oral steroids for treating OME in children. A later meta-analysis[85] showed no benefit for oral steroid versus placebo within 2 weeks but did show a short-term benefit for oral steroid plus antimicrobial versus antimicrobial alone in 1 of 3 children treated. This benefit became nonsignificant after several weeks in a prior meta-analysis[1] and in a large, randomized trial.[86] Oral steroids can produce behavioral changes, increased appetite, and weight gain.[1] Additional adverse effects may include adrenal suppression, fatal varicella infection, and avascular necrosis of the femoral head.[3] Although intranasal steroids have fewer adverse effects, one randomized trial[87] showed statistically equivalent outcomes at 12 weeks for intranasal beclomethasone plus antimicrobials versus antimicrobials alone for OME.

Antimicrobial therapy with or without steroids has not been demonstrated to be effective in long-term resolution of OME, but in some cases this therapy can be considered an option because of short-term benefit in randomized trials, when the parent or caregiver expresses a strong aversion to impending surgery. In this circumstance, a single course of therapy for 10 to 14 days may be used. The likelihood that the OME will resolve long-term with these regimens is small, and prolonged or repetitive courses of antimicrobials or steroids are strongly not recommended.

Other nonsurgical therapies that are discussed in the OME literature include autoinflation of the eustachian tube, oral or intratympanic use of mucolytics, and systemic use of pharmacologic agents other than antimicrobials, steroids, and antihistamine-decongestants. Insufficient data exist for any of these therapies to be recommended in treating OME.[3]

Evidence Profile: Medication

- Aggregate evidence quality: A, systematic review of well-designed, randomized, controlled trials.

- Benefit: avoid side effects and reduce cost by not administering medications; avoid delays in definitive therapy caused by short-term improvement then relapse.
- Harm: adverse effects of specific medications as listed previously; societal impact of antimicrobial therapy on bacterial resistance and transmission of resistant pathogens.
- Benefits-harms assessment: preponderance of harm over benefit.
- Policy level: recommendation against.

6. HEARING AND LANGUAGE: HEARING TESTING IS RECOMMENDED WHEN OME PERSISTS FOR 3 MONTHS OR LONGER OR AT ANY TIME THAT LANGUAGE DELAY, LEARNING PROBLEMS, OR A SIGNIFICANT HEARING LOSS IS SUSPECTED IN A CHILD WITH OME; LANGUAGE TESTING SHOULD BE CONDUCTED FOR CHILDREN WITH HEARING LOSS

This recommendation is based on cohort studies and the preponderance of benefit over risk.

Hearing Testing

Hearing testing is recommended when OME persists for 3 months or longer or at any time that language delay, learning problems, or a significant hearing loss is suspected. Conductive hearing loss often accompanies OME[1,88] and may adversely affect binaural processing,[89] sound localization,[90] and speech perception in noise.[91–94] Hearing loss caused by OME may impair early language acquisition,[95–97] but the child's home environment has a greater impact on outcomes[98]; recent randomized trials[41,99,100] suggest no impact on children with OME who are not at risk as identified by screening or surveillance.

Studies examining hearing sensitivity in children with OME report that average pure-tone hearing loss at 4 frequencies (500, 1000, 2000, and 4000 Hz) ranges from normal hearing to moderate hearing loss (0–55 dB). The 50th percentile is an ~25-dB HL, and ~20% of ears exceed 35-dB HL.[101,102] Unilateral OME with hearing loss results in overall poorer binaural hearing than in infants with normal middle-ear function bilaterally.[103,104] However, based on limited research, there is evidence that children experiencing the greatest conductive hearing loss for the longest periods may be more likely to exhibit developmental and academic sequelae.[1,95,105]

Initial hearing testing for children 4 years old or older can be done in the primary care setting.[106] Testing should be performed in a quiet environment, preferably in a separate closed or sound-proofed area set aside specifically for that purpose. Conventional audiometry with earphones is performed with a fail criterion of more than 20-dB HL at 1 or more frequencies (500, 1000, 2000, and 4000 Hz) in either ear.[106,107] Methods not recommended as substitutes for primary care hearing testing include tympanometry and pneumatic otoscopy,[102] caregiver judgment regarding hearing loss,[108,109] speech audiometry, and tuning forks, acoustic reflectometry, and behavioral observation.[1]

Comprehensive audiologic evaluation is recommended for children who fail primary care testing, are less than 4 years old, or cannot be tested in the primary care setting. Audiologic assessment includes evaluating air-conduction and bone-conduction thresholds for pure tones, speech-detection or speech-recognition thresholds,[102] and measuring speech understanding if possible.[94] The method of assessment depends on the developmental age of the child and might include visual reinforcement or conditioned orienting-response audiometry for infants 6 to 24 months old, play audiometry for children 24 to 48 months old, or conventional screening audiometry for children 4 years old and older.[106] The auditory brainstem response and otoacoustic emission are tests of auditory pathway structural integrity, not hearing, and should not substitute for behavioral pure-tone audiometry.[106]

Language Testing

Language testing should be conducted for children with hearing loss (pure-tone average more than 20-dB HL on comprehensive audiometric evaluation). Testing for language delays is important, because communication is integral to all aspects of human functioning. Young children with speech and language delays during the preschool years are at risk for continued communication problems and later delays in reading and writing.[110–112] In one study, 6% to 8% of children 3 years old and 2% to 13% of kindergartners had language impairment.[113] Language intervention can improve communication and other functional outcomes for children with histories of OME.[114]

Children who experience repeated and persistent episodes of OME and associated hearing loss during early childhood may be at a disadvantage for learning speech and language.[79,115] Although Shekelle et al[2] concluded that there was no evidence to support the concern that OME during the first 3 years of life was related to later receptive or expressive language, this meta-analysis should be interpreted cautiously, because it did not examine specific language domains such as vocabulary and the independent variable was OME and not hearing loss. Other meta-analyses[79,115] have suggested at most a small negative association of OME and hearing loss on children's receptive and expressive language through the elementary school years. The clinical significance of these effects for language and learning is unclear for the child not at risk. For example, in one randomized trial,[100] prompt insertion of tympanostomy tubes for OME did not improve developmental outcomes at 3 years old regardless of baseline hearing. In another randomized trial,[116] however, prompt tube insertion achieved small benefits for children with bilateral OME and hearing loss.

Clinicians should ask the parent or caregiver about specific concerns regarding their child's language development. Children's speech and language can be tested at ages 6 to 36 months by direct engagement of a child and interviewing the parent using the Early Language Milestone Scale.[117] Other approaches require interviewing only the child's parent or caregiver, such

as the MacArthur Communicative Development Inventory[118] and the Language Development Survey.[119] For older children, the Denver Developmental Screening Test II[120] can be used to screen general development including speech and language. Comprehensive speech and language evaluation is recommended for children who fail testing or whenever the child's parent or caregiver expresses concern.[121]

Evidence Profile: Hearing and Language

- Aggregate evidence quality: B, diagnostic studies with minor limitations; C, observational studies.
- Benefit: to detect hearing loss and language delay and identify strategies or interventions to improve developmental outcomes.
- Harm: parental anxiety, direct and indirect costs of assessment, and/or false-positive results.
- Balance of benefit and harm: preponderance of benefit over harm.
- Policy level: recommendation.

7. SURVEILLANCE: CHILDREN WITH PERSISTENT OME WHO ARE NOT AT RISK SHOULD BE REEXAMINED AT 3- TO 6-MONTH INTERVALS UNTIL THE EFFUSION IS NO LONGER PRESENT, SIGNIFICANT HEARING LOSS IS IDENTIFIED, OR STRUCTURAL ABNORMALITIES OF THE EARDRUM OR MIDDLE EAR ARE SUSPECTED

This recommendation is based on randomized, controlled trials and observational studies with a preponderance of benefit over harm.

If OME is asymptomatic and is likely to resolve spontaneously, intervention is unnecessary even if OME persists for more than 3 months. The clinician should determine whether risk factors exist that would predispose the child to undesirable sequelae or predict nonresolution of the effusion. As long as OME persists, the child is at risk for sequelae and must be reevaluated periodically for factors that would prompt intervention.

The 1994 OME guideline[1] recommended surgery for OME persisting 4 to 6 months with hearing loss but requires reconsideration because of later data on tubes and developmental sequelae.[122] For example, selecting surgical candidates using duration-based criteria (eg, OME >3 months or exceeding a cumulative threshold) does not improve developmental outcomes in infants and toddlers who are not at risk.[41,42,99,100] Additionally, the 1994 OME guideline did not specifically address managing effusion without significant hearing loss persisting more than 6 months.

Asymptomatic OME usually resolves spontaneously, but resolution rates decrease the longer the effusion has been present,[36,76,77] and relapse is common.[123] Risk factors that make spontaneous resolution less likely include[124,125]:

- Onset of OME in the summer or fall season
- Hearing loss more than 30-dB HL in the better-hearing ear
- History of prior tympanostomy tubes
- Not having had an adenoidectomy

Children with chronic OME are at risk for structural damage of the tympanic membrane[126] because the effusion contains leukotrienes, prostaglandins, and arachidonic acid metabolites that invoke a local inflammatory response.[127] Reactive changes may occur in the adjacent tympanic membrane and mucosal linings. A relative underventilation of the middle ear produces a negative pressure that predisposes to focal retraction pockets, generalized atelectasis of the tympanic membrane, and cholesteatoma.

Structural integrity is assessed by carefully examining the entire tympanic membrane, which, in many cases, can be accomplished by the primary care clinician using a handheld pneumatic otoscope. A search should be made for retraction pockets, ossicular erosion, and areas of atelectasis or atrophy. If there is any uncertainty that all observed structures are normal, the patient should be examined by using an otomicroscope. All children with these tympanic membrane conditions, regardless of OME duration, should have a comprehensive audiologic evaluation.

Conditions of the tympanic membrane that generally mandate inserting a tympanostomy tube are posterosuperior retraction pockets, ossicular erosion, adhesive atelectasis, and retraction pockets that accumulate keratin debris. Ongoing surveillance is mandatory, because the incidence of structural damage increases with effusion duration.[128]

As noted in recommendation 6, children with persistent OME for 3 months or longer should have their hearing tested. Based on these results, clinicians can identify 3 levels of action based on HLs obtained for the better-hearing ear using earphones or in sound field using speakers if the child is too young for ear-specific testing.

1. HLs of ≥40 dB (at least a moderate hearing loss): A comprehensive audiologic evaluation is indicated if not previously performed. If moderate hearing loss is documented and persists at this level, surgery is recommended, because persistent hearing loss of this magnitude that is permanent in nature has been shown to impact speech, language, and academic performance.[129–131]
2. HLs of 21 to 39 dB (mild hearing loss): A comprehensive audiologic evaluation is indicated if not previously performed. Mild sensorineural hearing loss has been associated with difficulties in speech, language, and academic performance in school,[129,132] and persistent mild conductive hearing loss from OME may have a similar impact. Further management should be individualized based on effusion duration, severity of hearing loss, and parent or caregiver preference and may include strategies to optimize the listening and learning environment (Table 4) or surgery. Repeat hearing testing should be performed in 3 to 6 months if OME persists at follow-up evaluation or tympanostomy tubes have not been placed.
3. HLs of ≤20 dB (normal hearing): A repeat hearing test should be performed in 3 to 6 months if OME persists at follow-up evaluation.

TABLE 4. Strategies for Optimizing the Listening-Learning Environment for Children With OME and Hearing Loss*

Get within 3 feet of the child before speaking.
Turn off competing audio signals such as unnecessary music and television in the background.
Face the child and speak clearly, using visual clues (hands, pictures) in addition to speech.
Slow the rate, raise the level, and enunciate speech directed at the child.
Read to or with the child, explaining pictures and asking questions.
Repeat words, phrases, and questions when misunderstood.
Assign preferential seating in the classroom near the teacher.
Use a frequency-modulated personal- or sound-field-amplification system in the classroom.

* Modified with permission from Roberts et al.[78,79]

In addition to hearing loss and speech or language delay, other factors may influence the decision to intervene for persistent OME. Roberts et al[98,133] showed that the caregiving environment is more strongly related to school outcome than was OME or hearing loss. Risk factors for delays in speech and language development caused by a poor caregiving environment included low maternal educational level, unfavorable child care environment, and low socioeconomic status. In such cases, these factors may be additive to the hearing loss in affecting lower school performance and classroom behavior problems.

Persistent OME may be associated with physical or behavioral symptoms including hyperactivity, poor attention, and behavioral problems in some studies[134–136] and reduced child quality of life.[46] Conversely, young children randomized to early versus late tube insertion for persistent OME showed no behavioral benefits from early surgery.[41,100] Children with chronic OME also have significantly poorer vestibular function and gross motor proficiency when compared with non-OME controls.[48–50] Moreover, vestibular function, behavior, and quality of life can improve after tympanostomy tube insertion.[47,137,138] Other physical symptoms of OME that, if present and persistent, may warrant surgery include otalgia, unexplained sleep disturbance, and coexisting recurrent AOM. Tubes reduce the absolute incidence of recurrent AOM by ~1 episode per child per year, but the relative risk reduction is 56%.[139]

The risks of continued observation of children with OME must be balanced against the risks of surgery. Children with persistent OME examined regularly at 3- to 6-month intervals, or sooner if OME-related symptoms develop, are most likely at low risk for physical, behavioral, or developmental sequelae of OME. Conversely, prolonged watchful waiting of OME is not appropriate when regular surveillance is impossible or when the child is at risk for developmental sequelae of OME because of comorbidities (Table 3). For these children, the risks of anesthesia and surgery (see recommendation 9) may be less than those of continued observation.

Evidence Profile: Surveillance

- Aggregate evidence quality: C, observational studies and some randomized trials.
- Benefit: avoiding interventions that do not improve outcomes.
- Harm: allowing structural abnormalities to develop in the tympanic membrane, underestimating the impact of hearing loss on a child, and/or failing to detect significant signs or symptoms that require intervention.
- Balance of benefit and harm: preponderance of benefit over harm.
- Policy level: recommendation.

8. REFERRAL: WHEN CHILDREN WITH OME ARE REFERRED BY THE PRIMARY CARE CLINICIAN FOR EVALUATION BY AN OTOLARYNGOLOGIST, AUDIOLOGIST, OR SPEECH-LANGUAGE PATHOLOGIST, THE REFERRING CLINICIAN SHOULD DOCUMENT THE EFFUSION DURATION AND SPECIFIC REASON FOR REFERRAL (EVALUATION, SURGERY) AND PROVIDE ADDITIONAL RELEVANT INFORMATION SUCH AS HISTORY OF AOM AND DEVELOPMENTAL STATUS OF THE CHILD

This option is based on panel consensus and a preponderance of benefit over harm.

This recommendation emphasizes the importance of communication between the referring primary care clinician and the otolaryngologist, audiologist, and speech-language pathologist. Parents and caregivers may be confused and frustrated when a recommendation for surgery is made for their child because of conflicting information about alternative management strategies. Choosing among management options is facilitated when primary care physicians and advanced-practice nurses who best know the patient's history of ear problems and general medical status provide the specialist with accurate information. Although there are no studies showing improved outcomes from better documentation of OME histories, there is a clear need for better mechanisms to convey information and expectations from primary care clinicians to consultants and subspecialists.[140–142]

When referring a child for evaluation to an otolaryngologist, the primary care physician should explain the following to the parent or caregiver of the patient:

- Reason for referral: Explain that the child is seeing an otolaryngologist for evaluation, which is likely to include ear examination and audiologic testing, and not necessarily simply to be scheduled for surgery.
- What to expect: Explain that surgery may be recommended, and let the parent know that the otolaryngologist will explain the options, benefits, and risks further.
- Decision-making process: Explain that there are many alternatives for management and that surgical decisions are elective; the parent or caregiver should be encouraged to express to the surgeonany concerns he or she may have about the recommendations made.

When referring a child to an otolaryngologist, audiologist, or speech-language pathologist, the mini-

mum information that should be conveyed in writing includes:

- Duration of OME: State how long fluid has been present.
- Laterality of OME: State whether one or both ears have been affected.
- Results of prior hearing testing or tympanometry.
- Suspected speech or language problems: State whether there had been a delay in speech and language development or whether the parent or a caregiver has expressed concerns about the child's communication abilities, school achievement, or attentiveness.
- Conditions that might exacerbate the deleterious effects of OME: State whether the child has conditions such as permanent hearing loss, impaired cognition, developmental delays, cleft lip or palate, or an unstable or nonsupportive family or home environment.
- AOM history: State whether the child has a history of recurrent AOM.

Additional medical information that should be provided to the otolaryngologist by the primary care clinician includes:

- Parental attitude toward surgery: State whether the parents have expressed a strong preference for or against surgery as a management option.
- Related conditions that might require concomitant surgery: State whether there have been other conditions that might warrant surgery if the child is going to have general anesthesia (eg, nasal obstruction and snoring that might be an indication for adenoidectomy or obstructive breathing during sleep that might mean tonsillectomy is indicated).
- General health status: State whether there are any conditions that might present problems for surgery or administering general anesthesia, such as congenital heart abnormality, bleeding disorder, asthma or reactive airway disease, or family history of malignant hyperthermia.

After evaluating the child, the otolaryngologist, audiologist, or speech-language pathologist should inform the referring physician regarding his or her diagnostic impression, plans for additional assessment, and recommendations for ongoing monitoring and management.

Evidence Profile: Referral

- Aggregate evidence quality: C, observational studies.
- Benefit: better communication and improved decision-making.
- Harm: confidentiality concerns, administrative burden, and/or increased parent or caregiver anxiety.
- Benefits-harms assessment: balance of benefit and harm.
- Policy level: option.

9. SURGERY: WHEN A CHILD BECOMES A SURGICAL CANDIDATE, TYMPANOSTOMY TUBE INSERTION IS THE PREFERRED INITIAL PROCEDURE; ADENOIDECTOMY SHOULD NOT BE PERFORMED UNLESS A DISTINCT INDICATION EXISTS (NASAL OBSTRUCTION, CHRONIC ADENOIDITIS). REPEAT SURGERY CONSISTS OF ADENOIDECTOMY PLUS MYRINGOTOMY, WITH OR WITHOUT TUBE INSERTION. TONSILLECTOMY ALONE OR MYRINGOTOMY ALONE SHOULD NOT BE USED TO TREAT OME

This recommendation is based on randomized, controlled trials with a preponderance of benefit over harm.

Surgical candidacy for OME largely depends on hearing status, associated symptoms, the child's developmental risk (Table 3), and the anticipated chance of timely spontaneous resolution of the effusion. Candidates for surgery include children with OME lasting 4 months or longer with persistent hearing loss or other signs and symptoms, recurrent or persistent OME in children at risk regardless of hearing status, and OME and structural damage to the tympanic membrane or middle ear. Ultimately, the recommendation for surgery must be individualized based on consensus between the primary care physician, otolaryngologist, and parent or caregiver that a particular child would benefit from intervention. Children with OME of any duration who are at risk are candidates for earlier surgery.

Tympanostomy tubes are recommended for initial surgery because randomized trials show a mean 62% relative decrease in effusion prevalence and an absolute decrease of 128 effusion days per child during the next year.[139,143–145] HLs improve by a mean of 6 to 12 dB while the tubes remain patent.[146,147] Adenoidectomy plus myringotomy (without tube insertion) has comparable efficacy in children 4 years old or older[143] but is more invasive, with additional surgical and anesthetic risks. Similarly, the added risk of adenoidectomy outweighs the limited, short-term benefit for children 3 years old or older without prior tubes.[148] Consequently, adenoidectomy is not recommended for initial OME surgery unless a distinct indication exists, such as adenoiditis, postnasal obstruction, or chronic sinusitis.

Approximately 20% to 50% of children who have had tympanostomy tubes have OME relapse after tube extrusion that may require additional surgery.[144,145,149] When a child needs repeat surgery for OME, adenoidectomy is recommended (unless the child has an overt or submucous cleft palate), because it confers a 50% reduction in the need for future operations.[143,150,151] The benefit of adenoidectomy is apparent at 2 years old,[150] greatest for children 3 years old or older, and independent of adenoid size.[143,151,152] Myringotomy is performed concurrent with adenoidectomy. Myringotomy plus adenoidectomy is effective for children 4 years old or older,[143] but tube insertion is advised for younger children, when potential relapse of effusion must be minimized (eg, children at risk) or pronounced inflammation of the tympanic membrane and middle-ear mucosa is present.

Tonsillectomy or myringotomy alone (without adenoidectomy) is not recommended to treat OME. Although tonsillectomy is either ineffective[152] or of limited efficacy,[148,150] the risks of hemorrhage (~2%) and additional hospitalization outweigh any potential benefits unless a distinct indication for tonsillectomy exists. Myringotomy alone, without tube placement or adenoidectomy, is ineffective for chronic OME,[144,145] because the incision closes within several days. Laser-assisted myringotomy extends the ventilation period several weeks,[153] but randomized trials with concurrent controls have not been conducted to establish efficacy. In contrast, tympanostomy tubes ventilate the middle ear for an average of 12 to 14 months.[144,145]

Anesthesia mortality has been reported to be ~1: 50 000 for ambulatory surgery,[154] but the current fatality rate may be lower.[155] Laryngospasm and bronchospasm occur more often in children receiving anesthesia than adults. Tympanostomy tube sequelae are common[156] but are generally transient (otorrhea) or do not affect function (tympanosclerosis, focal atrophy, or shallow retraction pocket). Tympanic membrane perforations, which may require repair, are seen in 2% of children after placement of short-term (grommet-type) tubes and 17% after long-term tubes.[156] Adenoidectomy has a 0.2% to 0.5% incidence of hemorrhage[150,157] and 2% incidence of transient velopharyngeal insufficiency.[148] Other potential risks of adenoidectomy, such as nasopharyngeal stenosis and persistent velopharyngeal insufficiency, can be minimized with appropriate patient selection and surgical technique.

There is a clear preponderance of benefit over harm when considering the impact of surgery for OME on effusion prevalence, HLs, subsequent incidence of AOM, and the need for reoperation after adenoidectomy. Information about adenoidectomy in children less than 4 years old, however, remains limited. Although the cost of surgery and anesthesia is nontrivial, it is offset by reduced OME and AOM after tube placement and by reduced need for reoperation after adenoidectomy. Approximately 8 adenoidectomies are needed to avoid a single instance of tube reinsertion; however, each avoided surgery probably represents a larger reduction in the number of AOM and OME episodes, including those in children who did not require additional surgery.[150]

Evidence Profile: Surgery

- Aggregate evidence quality: B, randomized, controlled trials with minor limitations.
- Benefit: improved hearing, reduced prevalence of OME, reduced incidence of AOM, and less need for additional tube insertion (after adenoidectomy).
- Harm: risks of anesthesia and specific surgical procedures; sequelae of tympanostomy tubes.
- Benefits-harms assessment: preponderance of benefit over harm.
- Policy level: recommendation.

10. CAM: NO RECOMMENDATION IS MADE REGARDING CAM AS A TREATMENT FOR OME

There is no recommendation based on lack of scientific evidence documenting efficacy and an uncertain balance of harm and benefit.

The 1994 OME guideline[1] made no recommendation regarding CAM as a treatment for OME, and no subsequent controlled studies have been published to change this conclusion. The current statement of "no recommendation" is based on the lack of scientific evidence documenting efficacy plus the balance of benefit and harm.

Evidence concerning CAM is insufficient to determine whether the outcomes achieved for OME differ from those achieved by watchful waiting and spontaneous resolution. There are no randomized, controlled trials with adequate sample sizes on the efficacy of CAM for OME. Although many case reports and subjective reviews on CAM treatment of AOM were found, little is published on OME treatment or prevention. Homeopathy[158] and chiropractic treatments[159] were assessed in pilot studies with small numbers of patients that failed to show clinically or statistically significant benefits. Consequently, there is no research base on which to develop a recommendation concerning CAM for OME.

The natural history of OME in childhood (discussed previously) is such that almost any intervention can be "shown" to have helped in an anecdotal, uncontrolled report or case series. The efficacy of CAM or any other intervention for OME can only be shown with parallel-group, randomized, controlled trials with valid diagnostic methods and adequate sample sizes. Unproved modalities that have been claimed to provide benefit in middle-ear disease include osteopathic and chiropractic manipulation, dietary exclusions (such as dairy), herbal and other dietary supplements, acupuncture, traditional Chinese medicine, and homeopathy. None of these modalities, however, have been subjected yet to a published, peer-reviewed, clinical trial.

The absence of any published clinical trials also means that all reports of CAM adverse effects are anecdotal. A systematic review of recent evidence[160] found significant serious adverse effects of unconventional therapies for children, most of which were associated with inadequately regulated herbal medicines. One report on malpractice liability associated with CAM therapies[161] did not address childhood issues specifically. Allergic reactions to echinacea occur but seem to be rare in children.[162] A general concern about herbal products is the lack of any governmental oversight into product quality or purity.[160,163,164] Additionally, herbal products may alter blood levels of allopathic medications, including anticoagulants. A possible concern with homeopathy is the worsening of symptoms, which is viewed as a positive, early sign of homeopathic efficacy. The adverse effects of manipulative therapies (such as chiropractic treatments and osteopathy) in children are difficult to assess because of scant evidence, but a case series of 332 children treated for AOM or OME with chiropractic manipulation did not mention any

side effects.[165] Quadriplegia has been reported, however, after spinal manipulation in an infant with torticollis.[166]

Evidence Profile: CAM

- Aggregate evidence quality: D, case series without controls.
- Benefit: not established.
- Harm: potentially significant depending on the intervention.
- Benefits-harms assessment: uncertain balance of benefit and harm.
- Policy level: no recommendation.

11. ALLERGY MANAGEMENT: NO RECOMMENDATION IS MADE REGARDING ALLERGY MANAGEMENT AS A TREATMENT FOR OME

There is no recommendation based on insufficient evidence of therapeutic efficacy or a causal relationship between allergy and OME.

The 1994 OME guideline[1] made no recommendation regarding allergy management as a treatment for OME, and no subsequent controlled studies have been published to change this conclusion. The current statement of "no recommendation" is based on insufficient evidence of therapeutic efficacy or a causal relationship between allergy and OME plus the balance of benefit and harm.

A linkage between allergy and OME has long been speculated but to date remains unquantified. The prevalence of allergy among OME patients has been reported to range from less than 10% to more than 80%.[167] Allergy has long been postulated to cause OME through its contribution to eustachian tube dysfunction.[168] The cellular response of respiratory mucosa to allergens has been well studied. Therefore, similar to other parts of respiratory mucosa, the mucosa lining the middle-ear cleft is capable of an allergic response.[169,170] Sensitivity to allergens varies among individuals, and atopy may involve neutrophils in type I allergic reactions that enhance the inflammatory response.[171]

The correlation between OME and allergy has been widely reported, but no prospective studies have examined the effects of immunotherapy compared with observation alone or other management options. Reports of OME cure after immunotherapy or food-elimination diets[172] are impossible to interpret without concurrent control groups because of the favorable natural history of most untreated OME. The documentation of allergy in published reports has been defined inconsistently (medical history, physical examination, skin-prick testing, nasal smears, serum immunoglobulin E and eosinophil counts, inflammatory mediators in effusions). Study groups have been drawn primarily from specialist offices, likely lack heterogeneity, and are not representative of general medical practice.

Evidence Profile: Allergy Management

- Aggregate evidence quality: D, case series without controls.
- Benefit: not established.
- Harm: adverse effects and cost of medication, physician evaluation, elimination diets, and desensitization.
- Benefits-harms assessment: balance of benefit and harm.
- Policy level: no recommendation.

RESEARCH NEEDS

Diagnosis

- Further standardize the definition of OME.
- Assess the performance characteristics of pneumatic otoscopy as a diagnostic test for OME when performed by primary care physicians and advanced-practice nurses in the routine office setting.
- Determine the optimal methods for teaching pneumatic otoscopy to residents and clinicians.
- Develop a brief, reliable, objective method for diagnosing OME.
- Develop a classification method for identifying the presence of OME for practical use by clinicians that is based on quantifiable tympanometric characteristics.
- Assess the usefulness of algorithms combining pneumatic otoscopy and tympanometry for detecting OME in clinical practice.
- Conduct additional validating cohort studies of acoustic reflectometry as a diagnostic method for OME, particularly in children less than 2 years old.

Child At Risk

- Better define the child with OME who is at risk for speech, language, and learning problems.
- Conduct large, multicenter, observational cohort studies to identify the child at risk who is most susceptible to potential adverse sequelae of OME.
- Conduct large, multicenter, observational cohort studies to analyze outcomes achieved with alternative management strategies for OME in children at risk.

Watchful Waiting

- Define the spontaneous resolution of OME in infants and young children (existing data are limited primarily to children 2 years old or older).
- Conduct large-scale, prospective cohort studies to obtain current data on the spontaneous resolution of newly diagnosed OME of unknown prior duration (existing data are primarily from the late 1970s and early 1980s).
- Develop prognostic indicators to identify the best candidates for watchful waiting.
- Determine whether the lack of impact from prompt insertion of tympanostomy tubes on speech and language outcomes seen in asymptomatic young children with OME identified by screening or intense surveillance can be generalized to older children with OME or to symptomatic children with OME referred for evaluation.

Medication

- Clarify which children, if any, should receive antimicrobials, steroids, or both for OME.
- Conduct a randomized, placebo-controlled trial on the efficacy of antimicrobial therapy, with or without concurrent oral steroid, in avoiding surgery in children with OME who are surgical candidates and have not received recent antimicrobials.
- Investigate the role of mucosal surface biofilms in refractory or recurrent OME and develop targeted interventions.

Hearing and Language

- Conduct longitudinal studies on the natural history of hearing loss accompanying OME.
- Develop improved methods for describing and quantifying the fluctuations in hearing of children with OME over time.
- Conduct prospective controlled studies on the relation of hearing loss associated with OME to later auditory, speech, language, behavioral, and academic sequelae.
- Develop reliable, brief, objective methods for estimating hearing loss associated with OME.
- Develop reliable, brief, objective methods for estimating speech or language delay associated with OME.
- Evaluate the benefits and administrative burden of language testing by primary care clinicians.
- Agree on the aspects of language that are vulnerable to or affected by hearing loss caused by OME, and reach a consensus on the best tools for measurement.
- Determine whether OME and associated hearing loss place children from special populations at greater risk for speech and language delays.

Surveillance

- Develop better tools for monitoring children with OME that are suitable for routine clinical care.
- Assess the value of new strategies for monitoring OME, such as acoustic reflectometry performed at home by the parent or caregiver, in optimizing surveillance.
- Improve our ability to identify children who would benefit from early surgery instead of prolonged surveillance.
- Promote early detection of structural abnormalities in the tympanic membrane associated with OME that may require surgery to prevent complications.
- Clarify and quantify the role of parent or caregiver education, socioeconomic status, and quality of the caregiving environment as modifiers of OME developmental outcomes.
- Develop methods for minimizing loss to follow-up during OME surveillance.

Surgery

- Define the role of adenoidectomy in children 3 years old or younger as a specific OME therapy.
- Conduct controlled trials on the efficacy of tympanostomy tubes for developmental outcomes in children with hearing loss, other symptoms, or speech and language delay.
- Conduct randomized, controlled trials of surgery versus no surgery that emphasize patient-based outcome measures (quality of life, functional health status) in addition to objective measures (effusion prevalence, HLs, AOM incidence, reoperation).
- Identify the optimal ways to incorporate parent or caregiver preference into surgical decision-making.

CAM

- Conduct randomized, controlled trials on the efficacy of CAM modalities for OME.
- Develop strategies to identify parents or caregivers who use CAM therapies for their child's OME, and encourage surveillance by the primary care clinician.

Allergy Management

- Evaluate the causal role of atopy in OME.
- Conduct randomized, controlled trials on the efficacy of allergy therapy for OME that are generalizable to the primary care setting.

CONCLUSIONS

This evidence-based practice guideline offers recommendations for identifying, monitoring, and managing the child with OME. The guideline emphasizes appropriate diagnosis and provides options for various management strategies including observation, medical intervention, and referral for surgical intervention. These recommendations should provide primary care physicians and other health care providers with assistance in managing children with OME.

Subcommittee on Otitis Media With Effusion
Richard M. Rosenfeld, MD, MPH, Cochairperson
American Academy of Pediatrics
American Academy of Otolaryngology-Head and Neck Surgery
Larry Culpepper, MD, MPH, Cochairperson
American Academy of Family Physicians
Karen J. Doyle, MD, PhD
American Academy of Otolaryngology-Head and Neck Surgery
Kenneth M. Grundfast, MD
American Academy of Otolaryngology-Head and Neck Surgery
Alejandro Hoberman, MD
American Academy of Pediatrics
Margaret A. Kenna, MD
American Academy of Otolaryngology-Head and Neck Surgery
Allan S. Lieberthal, MD
American Academy of Pediatrics
Martin Mahoney, MD, PhD
American Academy of Family Physicians
Richard A. Wahl, MD
American Academy of Pediatrics
Charles R. Woods, Jr, MD, MS
American Academy of Pediatrics

Barbara Yawn, MD, MSc
American Academy of Family Physicians

Consultants
S. Michael Marcy, MD
Richard N. Shiffman, MD

Liaisons
Linda Carlson, MS, CPNP
National Association of Pediatric Nurse Practitioners
Judith Gravel, PhD
American Academy of Audiology
Joanne Roberts, PhD
American Speech-Language-Hearing Association
Staff
Maureen Hannley, PhD
American Academy of Otolaryngology-Head and Neck Surgery
Carla T. Herrerias, MPH
American Academy of Pediatrics
Bellinda K. Schoof, MHA, CPHQ
American Academy of Family Physicians

ACKNOWLEDGMENTS

Dr Marcy serves as a consultant to Abbott Laboratories GlaxoSmithKline (vaccines).

REFERENCES

1. Stool SE, Berg AO, Berman S, et al. *Otitis Media With Effusion in Young Children. Clinical Practice Guideline, Number 12.* AHCPR Publication No. 94-0622. Rockville, MD: Agency for Health Care Policy and Research, Public Health Service, US Department of Health and Human Services; 1994
2. Shekelle P, Takata G, Chan LS, et al. *Diagnosis, Natural History, and Late Effects of Otitis Media With Effusion. Evidence Report/Technology Assessment No. 55.* AHRQ Publication No. 03-E023. Rockville, MD: Agency for Healthcare Research and Quality; 2003
3. Williamson I. Otitis media with effusion. *Clin Evid.* 2002;7:469–476
4. Tos M. Epidemiology and natural history of secretory otitis. *Am J Otol.* 1984;5:459–462
5. Paradise JL, Rockette HE, Colborn DK, et al. Otitis media in 2253 Pittsburgh area infants: prevalence and risk factors during the first two years of life. *Pediatrics.* 1997;99:318–333
6. Casselbrant ML, Mandel EM. Epidemiology. In: Rosenfeld RM, Bluestone CD, eds. *Evidence-Based Otitis Media.* 2nd ed. Hamilton, Ontario: BC Decker; 2003:147–162
7. Williamson IG, Dunleavy J, Baine J, Robinson D. The natural history of otitis media with effusion—a three-year study of the incidence and prevalence of abnormal tympanograms in four South West Hampshire infant and first schools. *J Laryngol Otol.* 1994;108:930–934
8. Coyte PC, Croxford R, Asche CV, To T, Feldman W, Friedberg J. Physician and population determinants of rates of middle-ear surgery in Ontario. *JAMA.* 2001;286:2128–2135
9. Tugwell P. How to read clinical journals: III. To learn the clinical course and prognosis of disease. *Can Med Assoc J.* 1981;124:869–872
10. Jaeschke R, Guyatt G, Sackett DL. Users' guides to the medical literature. III. How to use an article about a diagnostic test. A. Are the results of the study valid? Evidence-Based Medicine Working Group. *JAMA.* 1994;271:389–391
11. Shiffman RN, Shekelle P, Overhage JM, Slutsky J, Grimshaw J, Deshpande AM. Standardized reporting of clinical practice guidelines: a proposal from the Conference on Guideline Standardization. *Ann Intern Med.* 2003;139:493–498
12. Shiffman RN, Karras BT, Agrawal A, Chen R, Marenco L, Nath S. GEM: a proposal for a more comprehensive guideline document model using XML. *J Am Med Inform Assoc.* 2000;7:488–498
13. Shaneyfelt TM, Mayo-Smith MF, Rothwangl J. Are guidelines following guidelines? The methodological quality of clinical practice guidelines in the peer-reviewed medical literature. *JAMA.* 1999;281:1900–1905
14. Agrawal A, Shiffman RN. Evaluation of guideline quality using GEM-Q. *Medinfo.* 2001;10:1097–1101
15. Yale Center for Medical Informatics. GEM: The Guideline Elements Model. Available at: http://ycmi.med.yale.edu/GEM/. Accessed December 8, 2003
16. American Academy of Pediatrics, Steering Committee on Quality Improvement and Management. A taxonomy of recommendations for clinical practice guidelines. *Pediatrics.* 2004; In press
17. Eddy DM. *A Manual for Assessing Health Practices and Designing Practice Policies: The Explicit Approach.* Philadelphia, PA: American College of Physicians; 1992
18. Dowell SF, Marcy MS, Phillips WR, Gerber MA, Schwartz B. Otitis media—principles of judicious use of antimicrobial agents. *Pediatrics.* 1998;101:165–171
19. Dowell SF, Butler JC, Giebink GS, et al. Acute otitis media: management and surveillance in an era of pneumococcal resistance—a report from the Drug-Resistant *Streptococcus pneumoniae* Therapeutic Working Group. *Pediatr Infect Dis J.* 1999;18:1–9
20. Karma PH, Penttila MA, Sipila MM, Kataja MJ. Otoscopic diagnosis of middle ear effusion in acute and non-acute otitis media. I. The value of different otoscopic findings. *Int J Pediatr Otorhinolaryngol.* 1989;17:37–49
21. Pichichero ME, Poole MD. Assessing diagnostic accuracy and tympanocentesis skills in the management of otitis media. *Arch Pediatr Adolesc Med.* 2001;155:1137–1142
22. Steinbach WJ, Sectish TC. Pediatric resident training in the diagnosis and treatment of acute otitis media. *Pediatrics.* 2002;109:404–408
23. Palmu A, Puhakka H, Rahko T, Takala AK. Diagnostic value of tympanometry in infants in clinical practice. *Int J Pediatr Otorhinolaryngol.* 1999;49:207–213
24. van Balen FA, Aarts AM, De Melker RA. Tympanometry by general practitioners: reliable? *Int J Pediatr Otorhinolaryngol.* 1999;48:117–123
25. Block SL, Mandel E, McLinn S, et al. Spectral gradient acoustic reflectometry for the detection of middle ear effusion by pediatricians and parents. *Pediatr Infect Dis J.* 1998;17:560–564, 580
26. Barnett ED, Klein JO, Hawkins KA, Cabral HJ, Kenna M, Healy G. Comparison of spectral gradient acoustic reflectometry and other diagnostic techniques for detection of middle ear effusion in children with middle ear disease. *Pediatr Infect Dis J.* 1998;17:556–559, 580
27. Block SL, Pichichero ME, McLinn S, Aronovitz G, Kimball S. Spectral gradient acoustic reflectometry: detection of middle ear effusion by pediatricians in suppurative acute otitis media. *Pediatr Infect Dis J.* 1999;18:741–744
28. Schwartz RH. A practical approach to the otitis prone child. *Contemp Pediatr.* 1987;4:30–54
29. Barriga F, Schwartz RH, Hayden GF. Adequate illumination for otoscopy. Variations due to power source, bulb, and head and speculum design. *Am J Dis Child.* 1986;140:1237–1240
30. Sorenson CH, Jensen SH, Tos M. The post-winter prevalence of middle-ear effusion in four-year-old children, judged by tympanometry. *Int J Pediatr Otorhinolaryngol.* 1981;3:119–128
31. Fiellau-Nikolajsen M. Epidemiology of secretory otitis media. A descriptive cohort study. *Ann Otol Rhinol Laryngol.* 1983;92:172–177
32. Casselbrant ML, Brostoff LM, Cantekin EI, et al. Otitis media with effusion in preschool children. *Laryngoscope.* 1985;95:428–436
33. Zielhuis GA, Rach GH, van den Broek P. Screening for otitis media with effusion in preschool children. *Lancet.* 1989;1:311–314
34. Poulsen G, Tos M. Repetitive tympanometric screenings of two-year-old children. *Scand Audiol.* 1980;9:21–28
35. Tos M, Holm-Jensen S, Sorensen CH. Changes in prevalence of secretory otitis from summer to winter in four-year-old children. *Am J Otol.* 1981;2:324–327
36. Thomsen J, Tos M. Spontaneous improvement of secretory otitis. A long-term study. *Acta Otolaryngol.* 1981;92:493–499
37. Lous J, Fiellau-Nikolajsen M. Epidemiology of middle ear effusion and tubal dysfunction. A one-year prospective study comprising monthly tympanometry in 387 non-selected seven-year-old children. *Int J Pediatr Otorhinolaryngol.* 1981;3:303–317
38. New Zealand Health Technology Assessment. *Screening Programmes for the Detection of Otitis Media With Effusion and Conductive Hearing Loss in Pre-School and New Entrant School Children: A Critical Appraisal of the Literature.* Christchurch, New Zealand: New Zealand Health Technology Assessment; 1998:61
39. Canadian Task Force on Preventive Health Care. Screening for otitis media with effusion: recommendation statement from the Canadian Task Force on Preventive Health Care. *CMAJ.* 2001;165:1092–1093
40. US Preventive Services Task Force. *Guide to Clinical Preventive Services.* 2nd ed. Baltimore, MD: Williams & Wilkins; 1995
41. Paradise JL, Feldman HM, Campbell TF, et al. Effect of early or delayed insertion of tympanostomy tubes for persistent otitis media on

developmental outcomes at the age of three years. *N Engl J Med.* 2001;344:1179–1187
42. Rovers MM, Krabble PF, Straatman H, Ingels K, van der Wilt GJ, Zielhuis GA. Randomized controlled trial of the effect of ventilation tubes (grommets) on quality of life at age 1–2 years. *Arch Dis Child.* 2001;84:45–49
43. Wood DL. Documentation guidelines: evolution, future direction, and compliance. *Am J Med.* 2001;110:332–334
44. Soto CM, Kleinman KP, Simon SR. Quality and correlates of medical record documentation in the ambulatory care setting. *BMC Health Serv Res.* 2002;2:22–35
45. Marchant CD, Shurin PA, Turczyk VA, Wasikowski DE, Tutihasi MA, Kinney SE. Course and outcome of otitis media in early infancy: a prospective study. *J Pediatr.* 1984;104:826–831
46. Rosenfeld RM, Goldsmith AJ, Tetlus L, Balzano A. Quality of life for children with otitis media. *Arch Otolaryngol Head Neck Surg.* 1997;123:1049–1054
47. Casselbrant ML, Furman JM, Rubenstein E, Mandel EM. Effect of otitis media on the vestibular system in children. *Ann Otol Rhinol Laryngol.* 1995;104:620–624
48. Orlin MN, Effgen SK, Handler SD. Effect of otitis media with effusion on gross motor ability in preschool-aged children: preliminary findings. *Pediatrics.* 1997;99:334–337
49. Golz A, Angel-Yeger B, Parush S. Evaluation of balance disturbances in children with middle ear effusion. *Int J Pediatr Otorhinolaryngol.* 1998;43:21–26
50. Casselbrant ML, Redfern MS, Furman JM, Fall PA, Mandel EM. Visual-induced postural sway in children with and without otitis media. *Ann Otol Rhinol Laryngol.* 1998;107:401–405
51. Ruben R. Host susceptibility to otitis media sequelae. In: Rosenfeld RM, Bluestone CD, eds. *Evidence-Based Otitis Media*. 2nd ed. Hamilton, ON, Canada: BC Decker; 2003:505–514
52. Whiteman BC, Simpson GB, Compton WC. Relationship of otitis media and language impairment on adolescents with Down syndrome. *Ment Retard.* 1986;24:353–356
53. van der Vyver M, van der Merwe A, Tesner HE. The effects of otitis media on articulation in children with cerebral palsy. *Int J Rehabil Res.* 1988;11:386–389
54. Paradise JL, Bluestone CD. Early treatment of the universal otitis media of infants with cleft palate. *Pediatrics.* 1974;53:48–54
55. Schwartz DM, Schwartz RH. Acoustic impedance and otoscopic findings in young children with Down's syndrome. *Arch Otolaryngol.* 1978;104:652–656
56. Corey JP, Caldarelli DD, Gould HJ. Otopathology in cranial facial dysostosis. *Am J Otol.* 1987;8:14–17
57. Schonweiler R, Schonweiler B, Schmelzeisen R. Hearing capacity and speech production in 417 children with facial cleft abnormalities [in German]. *HNO.* 1994;42:691–696
58. Ruben RJ, Math R. Serous otitis media associated with sensorineural hearing loss in children. *Laryngoscope.* 1978;88:1139–1154
59. Brookhouser PE, Worthington DW, Kelly WJ. Middle ear disease in young children with sensorineural hearing loss. *Laryngoscope.* 1993;103:371–378
60. Rice ML. Specific language impairments: in search of diagnostic markers and genetic contributions. *Ment Retard Dev Disabil Res Rev.* 1997;3:350–357
61. Rosenhall U, Nordin V, Sandstrom M, Ahlsen G, Gillberg C. Autism and hearing loss. *J Autism Dev Disord.* 1999;29:349–357
62. Cunningham C, McArthur K. Hearing loss and treatment in young Down's syndrome children. *Child Care Health Dev.* 1981;7:357–374
63. Shott SR, Joseph A, Heithaus D. Hearing loss in children with Down syndrome. *Int J Pediatr Otorhinolaryngol.* 2001;61:199–205
64. Clarkson RL, Eimas PD, Marean GC. Speech perception in children with histories of recurrent otitis media. *J Acoust Soc Am.* 1989;85:926–933
65. Groenen P, Crul T, Maassen B, van Bon W. Perception of voicing cues by children with early otitis media with and without language impairment. *J Speech Hear Res.* 1996;39:43–54
66. Hubbard TW, Paradise JL, McWilliams BJ, Elster BA, Taylor FH. Consequences of unremitting middle-ear disease in early life. Otologic, audiologic, and developmental findings in children with cleft palate. *N Engl J Med.* 1985;312:1529–1534
67. Nunn DR, Derkay CS, Darrow DH, Magee W, Strasnick B. The effect of very early cleft palate closure on the need for ventilation tubes in the first years of life. *Laryngoscope.* 1995;105:905–908
68. Pappas DG, Flexer C, Shackelford L. Otological and habilitative management of children with Down syndrome. *Laryngoscope.* 1994;104:1065–1070
69. Vartiainen E. Otitis media with effusion in children with congenital or early-onset hearing impairment. *J Otolaryngol.* 2000;29:221–223
70. Rosenfeld RM, Kay D. Natural history of untreated otitis media. *Laryngoscope.* 2003;113:1645–1657
71. Teele DW, Klein JO, Rosner BA. Epidemiology of otitis media in children. *Ann Otol Rhinol Laryngol Suppl.* 1980;89:5–6
72. Mygind N, Meistrup-Larsen KI, Thomsen J, Thomsen VF, Josefsson K, Sorensen H. Penicillin in acute otitis media: a double-blind, placebo-controlled trial. *Clin Otolaryngol.* 1981;6:5–13
73. Burke P, Bain J, Robinson D, Dunleavey J. Acute red ear in children: controlled trial of nonantibiotic treatment in general practice. *BMJ.* 1991;303:558–562
74. Fiellau-Nikolajsen M, Lous J. Prospective tympanometry in 3-year-old children. A study of the spontaneous course of tympanometry types in a nonselected population. *Arch Otolaryngol.* 1979;105:461–466
75. Fiellau-Nikolajsen M. Tympanometry in 3-year-old children. Type of care as an epidemiological factor in secretory otitis media and tubal dysfunction in unselected populations of 3-year-old children. *ORL J Otorhinolaryngol Relat Spec.* 1979;41:193–205
76. Tos M. Spontaneous improvement of secretory otitis and impedance screening. *Arch Otolaryngol.* 1980;106:345–349
77. Tos M, Holm-Jensen S, Sorensen CH, Mogensen C. Spontaneous course and frequency of secretory otitis in 4-year-old children. *Arch Otolaryngol.* 1982;108:4–10
78. Roberts JE, Zeisel SA. *Ear Infections and Language Development*. Rockville, MD: American Speech-Language-Hearing Association and the National Center for Early Development and Learning; 2000
79. Roberts JE, Rosenfeld RM, Zeisel SA. Otitis media and speech and language: a meta-analysis of prospective studies. *Pediatrics*. 2004;113(3). Available at: www.pediatrics.org/cgi/content/full/113/3/e238
80. Williams RL, Chalmers TC, Stange KC, Chalmers FT, Bowlin SJ. Use of antibiotics in preventing recurrent otitis media and in treating otitis media with effusion. A meta-analytic attempt to resolve the brouhaha. *JAMA.* 1993;270:1344–1351
81. Rosenfeld RM, Post JC. Meta-analysis of antibiotics for the treatment of otitis media with effusion. *Otolaryngol Head Neck Surg.* 1992;106:378–386
82. Mandel EM, Rockette HE, Bluestone CD, Paradise JL, Nozza RJ. Efficacy of amoxicillin with and without decongestant-antihistamine for otitis media with effusion in children. Results of a double-blind, randomized trial. *N Engl J Med.* 1987;316:432–437
83. McCormick AW, Whitney CG, Farley MM, et al. Geographic diversity and temporal trends of antimicrobial resistance in *Streptococcus pneumoniae* in the United States. *Nat Med.* 2003;9:424–430
84. Levy SB. *The Antibiotic Paradox. How the Misuse of Antibiotic Destroys Their Curative Powers*. Cambridge, MA: Perseus Publishing; 2002
85. Butler CC, van der Voort JH. Oral or topical nasal steroids for hearing loss associated with otitis media with effusion in children. *Cochrane Database Syst Rev.* 2002;4:CD001935
86. Mandel EM, Casselbrant ML, Rockette HE, Fireman P, Kurs-Lasky M, Bluestone CD. Systemic steroid for chronic otitis media with effusion in children. *Pediatrics.* 2002;110:1071–1080
87. Tracy JM, Demain JG, Hoffman KM, Goetz DW. Intranasal beclomethasone as an adjunct to treatment of chronic middle ear effusion. *Ann Allergy Asthma Immunol.* 1998;80:198–206
88. Joint Committee on Infant Hearing. Year 2000 position statement: principles and guidelines for early hearing detection and intervention programs. *Am J Audiol.* 2000;9:9–29
89. Pillsbury HC, Grose JH, Hall JW III. Otitis media with effusion in children. Binaural hearing before and after corrective surgery. *Arch Otolaryngol Head Neck Surg.* 1991;117:718–723
90. Besing J, Koehnke J A test of virtual auditory localization. *Ear Hear.* 1995;16:220–229
91. Jerger S, Jerger J, Alford BR, Abrams S. Development of speech intelligibility in children with recurrent otitis media. *Ear Hear.* 1983;4:138–145
92. Gravel JS, Wallace IF. Listening and language at 4 years of age: effects of early otitis media. *J Speech Hear Res.* 1992;35:588–595
93. Schilder AG, Snik AF, Straatman H, van den Broek P. The effect of otitis media with effusion at preschool age on some aspects of auditory perception at school age. *Ear Hear.* 1994;15:224–231
94. Rosenfeld RM, Madell JR, McMahon A. Auditory function in normal-hearing children with middle ear effusion. In: Lim DJ, Bluestone CD, Casselbrant M, Klein JO, Ogra PL, eds. *Recent Advances in Otitis Media: Proceedings of the 6th International Symposium*. Hamilton, ON, Canada: BC Decker; 1996:354–356

95. Friel-Patti S, Finitzo T. Language learning in a prospective study of otitis media with effusion in the first two years of life. *J Speech Hear Res.* 1990;33:188–194
96. Wallace IF, Gravel JS, McCarton CM, Stapells DR, Bernstein RS, Ruben RJ. Otitis media, auditory sensitivity, and language outcomes at one year. *Laryngoscope.* 1988;98:64–70
97. Roberts JE, Burchinal MR, Medley LP, et al. Otitis media, hearing sensitivity, and maternal responsiveness in relation to language during infancy. *J Pediatr.* 1995;126:481–489
98. Roberts JE, Burchinal MR, Zeisel SA. Otitis media in early childhood in relation to children's school-age language and academic skills. *Pediatrics.* 2002;110:696–706
99. Rovers MM, Straatman H, Ingels K, van der Wilt GJ, van den Broek P, Zielhuis GA. The effect of ventilation tubes on language development in infants with otitis media with effusion: a randomized trial. *Pediatrics*. 2000;106(3). Available at: www.pediatrics.org/cgi/content/full/106/3/e42
100. Paradise JL, Feldman HM, Campbell TF, et al. Early versus delayed insertion of tympanostomy tubes for persistent otitis media: developmental outcomes at the age of three years in relation to prerandomization illness patterns and hearing levels. *Pediatr Infect Dis J.* 2003;22:309–314
101. Kokko E. Chronic secretory otitis media in children. A clinical study. *Acta Otolaryngol Suppl.* 1974;327:1–44
102. Fria TJ, Cantekin EI, Eichler JA. Hearing acuity of children with otitis media with effusion. *Arch Otolaryngol.* 1985;111:10–16
103. Gravel JS, Wallace IF. Effects of otitis media with effusion on hearing in the first three years of life. *J Speech Lang Hear Res.* 2000;43:631–644
104. Roberts JE, Burchinal MR, Zeisel S, et al. Otitis media, the caregiving environment, and language and cognitive outcomes at 2 years. *Pediatrics.* 1998;102:346–354
105. Gravel JS, Wallace IF, Ruben RJ. Early otitis media and later educational risk. *Acta Otolaryngol.* 1995;115:279–281
106. Cunningham M, Cox EO; American Academy of Pediatrics, Committee on Practice and Ambulatory Medicine, Section on Otolaryngology and Bronchoesophagology. Hearing assessment in infants and children: recommendations beyond neonatal screening. *Pediatrics.* 2003;111:436–440
107. American Speech-Language-Hearing Association Panel on Audiologic Assessment. *Guidelines for Audiologic Screening*. Rockville, MD: American Speech-Language-Hearing Association; 1996
108. Rosenfeld RM, Goldsmith AJ, Madell JR. How accurate is parent rating of hearing for children with otitis media? *Arch Otolaryngol Head Neck Surg.* 1998;124:989–992
109. Brody R, Rosenfeld RM, Goldsmith AJ, Madell JR. Parents cannot detect mild hearing loss in children. *Otolaryngol Head Neck Surg.* 1999;121:681–686
110. Catts HW, Fey ME, Zhang X, Tomblin JB. Language basis of reading and reading disabilities: evidence from a longitudinal investigation. *Sci Stud Read.* 1999;3:331–362
111. Johnson CJ, Beitchman JH, Young A, et al. Fourteen-year follow-up of children with and without speech/language impairments: speech/language stability and outcomes. *J Speech Lang Hear Res.* 1999;42:744–760
112. Scarborough H, Dobrich W. Development of children with early language delay. *J Speech Hear Res.* 1990;33:70–83
113. Tomblin JB, Records NL, Buckwalter P, Zhang X, Smith E, O'Brien M. Prevalence of specific language impairment in kindergarten children. *J Speech Lang Hear Res.* 1997;40:1245–1260
114. Glade MJ. *Diagnostic and Therapeutic Technology Assessment: Speech Therapy in Patients With a Prior History of Recurrent Acute or Chronic Otitis Media With Effusion*. Chicago, IL: American Medical Association; 1996:1–14
115. Casby MW. Otitis media and language development: a meta-analysis. *Am J Speech Lang Pathol.* 2001;10:65–80
116. Maw R, Wilks J, Harvey I, Peters TJ, Golding J. Early surgery compared with watchful waiting for glue ear and effect on language development in preschool children: a randomised trial. *Lancet.* 1999;353:960–963
117. Coplan J. *Early Language Milestone Scale*. 2nd ed. Austin, TX: PRO-ED; 1983
118. Fenson L, Dale PS, Reznick JS, et al. *MacArthur Communicative Development Inventories. User's Guide and Technical Manual*. San Diego, CA: Singular Publishing Group; 1993
119. Rescoria L. The Language Development Survey: a screening tool for delayed language in toddlers. *J Speech Hear Dis.* 1989;54:587–599
120. Frankenburg WK, Dodds JA, Faucal A, et al. *Denver Developmental Screening Test II*. Denver, CO: University of Colorado Press; 1990
121. Klee T, Pearce K, Carson DK. Improving the positive predictive value of screening for developmental language disorder. *J Speech Lang Hear Res.* 2000;43:821–833
122. Shekelle PG, Ortiz E, Rhodes S, et al. Validity of the Agency for Healthcare Research and Quality clinical practice guidelines: how quickly do guidelines become outdated? *JAMA.* 2001;286:1461–1467
123. Zielhuis GA, Straatman H, Rach GH, van den Broek P. Analysis and presentation of data on the natural course of otitis media with effusion in children. *Int J Epidemiol.* 1990;19:1037–1044
124. MRC Multi-centre Otitis Media Study Group. Risk factors for persistence of bilateral otitis media with effusion. *Clin Otolaryngol.* 2001;26:147–156
125. van Balen FA, De Melker RA. Persistent otitis media with effusion: can it be predicted? A family practice follow-up study in children aged 6 months to 6 years. *J Fam Pract.* 2000;49:605–611
126. Sano S, Kamide Y, Schachern PA, Paparella MM. Micropathologic changes of pars tensa in children with otitis media with effusion. *Arch Otolaryngol Head Neck Surg.* 1994;120:815–819
127. Yellon RF, Doyle WJ, Whiteside TL, Diven WF, March AR, Fireman P. Cytokines, immunoglobulins, and bacterial pathogens in middle ear effusions. *Arch Otolaryngol Head Neck Surg.* 1995;121:865–869
128. Maw RA, Bawden R. Tympanic membrane atrophy, scarring, atelectasis and attic retraction in persistent, untreated otitis media with effusion and following ventilation tube insertion. *Int J Pediatr Otorhinolaryngol.* 1994;30:189–204
129. Davis JM, Elfenbein J, Schum R, Bentler RA. Effects of mild and moderate hearing impairment on language, educational, and psychosocial behavior of children. *J Speech Hear Disord.* 1986;51:53–62
130. Carney AE, Moeller MP. Treatment efficacy: hearing loss in children. *J Speech Lang Hear Res.* 1998;41:S61–S84
131. Karchmer MA, Allen TE. The functional assessment of deaf and hard of hearing students. *Am Ann Deaf.* 1999;144:68–77
132. Bess FH, Dodd-Murphy J, Parker RA. Children with minimal sensorineural hearing loss: prevalence, educational performance, and functional status. *Ear Hear.* 1998;19:339–354
133. Roberts JE, Burchinal MR, Jackson SC, et al. Otitis media in early childhood in relation to preschool language and school readiness skills among black children. *Pediatrics.* 2000;106:725–735
134. Haggard MP, Birkin JA, Browning GG, Gatehouse S, Lewis S. Behavior problems in otitis media. *Pediatr Infect Dis J.* 1994;13:S43–S50
135. Bennett KE, Haggard MP. Behaviour and cognitive outcomes from middle ear disease. *Arch Dis Child.* 1999;80:28–35
136. Bennett KE, Haggard MP, Silva PA, Stewart IA. Behaviour and developmental effects of otitis media with effusion into the teens. *Arch Dis Child.* 2001;85:91–95
137. Wilks J, Maw R, Peters TJ, Harvey I, Golding J. Randomised controlled trial of early surgery versus watchful waiting for glue ear: the effect on behavioural problems in pre-school children. *Clin Otolaryngol.* 2000;25:209–214
138. Rosenfeld RM, Bhaya MH, Bower CM, et al. Impact of tympanostomy tubes on child quality of life. *Arch Otolaryngol Head Neck Surg.* 2000;126:585–592
139. Rosenfeld RM, Bluestone CD. Clinical efficacy of surgical therapy. In: Rosenfeld RM, Bluestone CD, eds. *Evidence-Based Otitis Media*. 2nd ed. Hamilton, ON, Canada: BC Decker; 2003:227–240
140. Kuyvenhoven MM, De Melker RA. Referrals to specialists. An exploratory investigation of referrals by 13 general practitioners to medical and surgical departments. *Scand J Prim Health Care.* 1990;8:53–57
141. Haldis TA, Blankenship JC. Telephone reporting in the consultant-generalist relationship. *J Eval Clin Pract.* 2002;8:31–35
142. Reichman S. The generalist's patient and the subspecialist. *Am J Manag Care.* 2002;8:79–82
143. Gates GA, Avery CA, Prihoda TJ, Cooper JC Jr. Effectiveness of adenoidectomy and tympanostomy tubes in the treatment of chronic otitis media with effusion. *N Engl J Med.* 1987;317:1444–1451
144. Mandel EM, Rockette HE, Bluestone CD, Paradise JL, Nozza RJ. Myringotomy with and without tympanostomy tubes for chronic otitis media with effusion. *Arch Otolaryngol Head Neck Surg.* 1989;115:1217–1224
145. Mandel EM, Rockette HE, Bluestone CD, Paradise JL, Nozza RJ. Efficacy of myringotomy with and without tympanostomy tubes for chronic otitis media with effusion. *Pediatr Infect Dis J.* 1992;11:270–277
146. University of York Centre for Reviews and Dissemination. The treatment of persistent glue ear in children. *Eff Health Care.* 1992;4:1–16
147. Rovers MM, Straatman H, Ingels K, van der Wilt GJ, van den Broek P, Zielhuis GA. The effect of short-term ventilation tubes versus watchful waiting on hearing in young children with persistent otitis media with effusion: a randomized trial. *Ear Hear.* 2001;22:191–199

148. Paradise JL, Bluestone CD, Colborn DK, et al. Adenoidectomy and adenotonsillectomy for recurrent acute otitis media: parallel randomized clinical trials in children not previously treated with tympanostomy tubes. *JAMA.* 1999;282:945–953
149. Boston M, McCook J, Burke B, Derkay C. Incidence of and risk factors for additional tympanostomy tube insertion in children. *Arch Otolaryngol Head Neck Surg.* 2003;129:293–296
150. Coyte PC, Croxford R, McIsaac W, Feldman W, Friedberg J. The role of adjuvant adenoidectomy and tonsillectomy in the outcome of insertion of tympanostomy tubes. *N Engl J Med.* 2001;344:1188–1195
151. Paradise JL, Bluestone CD, Rogers KD, et al. Efficacy of adenoidectomy for recurrent otitis media in children previously treated with tympanostomy-tube placement. Results of parallel randomized and nonrandomized trials. *JAMA.* 1990;263:2066–2073
152. Maw AR. Chronic otitis media with effusion (glue ear) and adenotonsillectomy: prospective randomised controlled study. *Br Med J (Clin Res Ed).* 1983;287:1586–1588
153. Cohen D, Schechter Y, Slatkine M, Gatt N, Perez R. Laser myringotomy in different age groups. *Arch Otolaryngol Head Neck Surg.* 2001;127:260–264
154. Holzman RS. Morbidity and mortality in pediatric anesthesia. *Pediatr Clin North Am.* 1994;41:239–256
155. Cottrell JE, Golden S. *Under the Mask: A Guide to Feeling Secure and Comfortable During Anesthesia and Surgery*. New Brunswick, NJ: Rutgers University Press; 2001
156. Kay DJ, Nelson M, Rosenfeld RM. Meta-analysis of tympanostomy tube sequelae. *Otolaryngol Head Neck Surg.* 2001;124:374–380
157. Crysdale WS, Russel D. Complications of tonsillectomy and adenoidectomy in 9409 children observed overnight. *CMAJ.* 1986;135:1139–1142
158. Harrison H, Fixsen A, Vickers A. A randomized comparison of homeopathic and standard care for the treatment of glue ear in children. *Complement Ther Med.* 1999;7:132–135
159. Sawyer CE, Evans RL, Boline PD, Branson R, Spicer A. A feasibility study of chiropractic spinal manipulation versus sham spinal manipulation for chronic otitis media with effusion in children. *J Manipulative Physiol Ther.* 1999;22:292–298
160. Ernst E. Serious adverse effects of unconventional therapies for children and adolescents: a systematic review of recent evidence. *Eur J Pediatr.* 2003;162:72–80
161. Cohen MH, Eisenberg DM. Potential physician malpractice liability associated with complementary and integrative medical therapies. *Ann Intern Med.* 2002;136:596–603
162. Mullins RJ, Heddle R. Adverse reactions associated with echinacea: the Australian experience. *Ann Allergy Asthma Immunol.* 2002;88:42–51
163. Miller LG, Hume A, Harris IM, et al. White paper on herbal products. American College of Clinical Pharmacy. *Pharmacotherapy.* 2000;20:877–891
164. Angell M, Kassirer JP. Alternative medicine—the risks of untested and unregulated remedies. *N Engl J Med.* 1998;339:839–841
165. Fallon JM. The role of chiropractic adjustment in the care and treatment of 332 children with otitis media. *J Clin Chiropractic Pediatr.* 1997;2:167–183
166. Shafrir Y, Kaufman BA. Quadriplegia after chiropractic manipulation in an infant with congenital torticollis caused by a spinal cord astrocytoma. *J Pediatr.* 1992;120:266–269
167. Corey JP, Adham RE, Abbass AH, Seligman I. The role of IgE-mediated hypersensitivity in otitis media with effusion. *Am J Otolaryngol.* 1994;15:138–144
168. Bernstein JM. Role of allergy in eustachian tube blockage and otitis media with effusion: a review. *Otolaryngol Head Neck Surg.* 1996;114:562–568
169. Ishii TM, Toriyama M, Suzuki JI. Histopathological study of otitis media with effusion. *Ann Otol Rhinol Laryngol.* 1980;89(suppl):83–86
170. Hurst DS, Venge P. Evidence of eosinophil, neutrophil, and mast-cell mediators in the effusion of OME patients with and without atopy. *Allergy.* 2000;55:435–441
171. Hurst DS, Venge P. The impact of atopy on neutrophil activity in middle ear effusion from children and adults with chronic otitis media. *Arch Otolaryngol Head Neck Surg.* 2002;128:561–566
172. Hurst DS. Allergy management of refractory serous otitis media. *Otolaryngol Head Neck Surg.* 1990;102:664–669

Otitis Media Clinical Practice Guidelines Quick Reference Tools

Action Statement Summary

The Diagnosis and Management of Acute Otitis Media

Key Action Statement 1A
Clinicians should diagnose acute otitis media (AOM) in children who present with moderate to severe bulging of the tympanic membrane (TM) *or* new onset of otorrhea not due to acute otitis externa. Evidence Quality: Grade B. Strength: Recommendation.

Key Action Statement 1B
Clinicians should diagnose AOM in children who present with mild bulging of the TM *and* recent (less than 48 hours) onset of ear pain (holding, tugging, rubbing of the ear in a nonverbal child) or intense erythema of the TM. Evidence Quality: Grade C. Strength: Recommendation.

Key Action Statement 1C
Clinicians should not diagnose AOM in children who do not have middle ear effusion (MEE) (based on pneumatic otoscopy and/or tympanometry). Evidence Quality: Grade B. Strength: Recommendation.

Key Action Statement 2
The management of AOM should include an assessment of pain. If pain is present, the clinician should recommend treatment to reduce pain. Evidence Quality: Grade B. Strength: Strong Recommendation.

Key Action Statement 3A
Severe AOM: The clinician should prescribe antibiotic therapy for AOM (bilateral or unilateral) in children 6 months and older with severe signs or symptoms (ie, moderate or severe otalgia or otalgia for at least 48 hours or temperature 39°C [102.2°F] or higher). Evidence Quality: Grade B. Strength: Strong Recommendation.

Key Action Statement 3B
Nonsevere bilateral AOM in young children: The clinician should prescribe antibiotic therapy for bilateral AOM in children 6 months through 23 months of age without severe signs or symptoms (ie, mild otalgia for less than 48 hours and temperature less than 39°C [102.2°F]). Evidence Quality: Grade B. Strength: Recommendation.

Key Action Statement 3C
Nonsevere unilateral AOM in young children: The clinician should either prescribe antibiotic therapy *or* offer observation with close follow-up based on joint decision-making with the parent(s)/caregiver for unilateral AOM in children 6 months to 23 months of age without severe signs or symptoms (ie, mild otalgia for less than 48 hours and temperature less than 39°C [102.2°F]). When observation is used, a mechanism must be in place to ensure follow-up and begin antibiotic therapy if the child worsens or fails to improve within 48 to 72 hours of onset of symptoms. Evidence Quality: Grade B. Strength: Recommendation.

Key Action Statement 3D
Nonsevere AOM in older children: The clinician should either prescribe antibiotic therapy *or* offer observation with close follow-up based on joint decision-making with the parent(s)/caregiver for AOM (bilateral or unilateral) in children 24 months or older without severe signs or symptoms (ie, mild otalgia for less than 48 hours and temperature less than 39°C [102.2°F]). When observation is used, a mechanism must be in place to ensure follow-up and begin antibiotic therapy if the child worsens or fails to improve within 48 to 72 hours of onset of symptoms. Evidence Quality: Grade B. Strength: Recommendation.

Key Action Statement 4A
Clinicians should prescribe amoxicillin for AOM when a decision to treat with antibiotics has been made *and* the child has not received amoxicillin in the past 30 days *or* the child does not have concurrent purulent conjunctivitis *or* the child is not allergic to penicillin. Evidence Quality: Grade B. Strength: Recommendation.

Key Action Statement 4B
Clinicians should prescribe an antibiotic with additional β-lactamase coverage for AOM when a decision to treat with antibiotics has been made, *and* the child has received amoxicillin in the last 30 days *or* has concurrent purulent conjunctivitis, *or* has a history of recurrent AOM unresponsive to amoxicillin. Evidence Quality: Grade C. Strength: Recommendation.

Key Action Statement 4C
Clinicians should reassess the patient if the caregiver reports that the child's symptoms have worsened or failed to respond to the initial antibiotic treatment within 48 to 72 hours and determine whether a change in therapy is needed. Evidence Quality: Grade B. Strength: Recommendation.

Key Action Statement 5A
Clinicians should not prescribe prophylactic antibiotics to reduce the frequency of episodes of AOM in children with recurrent AOM. Evidence Quality: Grade B. Strength: Recommendation.

Key Action Statement 5B
Clinicians may offer tympanostomy tubes for recurrent AOM (3 episodes in 6 months or 4 episodes in 1 year with 1 episode in the preceding 6 months). Evidence Quality: Grade B. Strength: Option.

Key Action Statement 6A
Clinicians should recommend pneumococcal conjugate vaccine to all children according to the schedule of the Advisory Committee on Immunization Practices of the Centers for Disease Control and prevention, American Academy of Pediatrics (AAP), and American Academy of Family Physicians (AAFP). Evidence Quality: Grade B. Strength: Strong Recommendation.

Otitis Media With Effusion

1A. Pneumatic Otoscopy
Clinicians should use pneumatic otoscopy as the primary diagnostic method for OME, and OME should be distinguished from AOM.

This is a strong recommendation based on systematic review of cohort studies and the preponderance of benefit over harm.

1B. Tympanometry
Tympanometry can be used to confirm the diagnosis a of OME.

This option is based on cohort studies and a balance of benefit and harm.

1C. Screening
Population-based screening programs for OME are not recommended in healthy, asymptomatic children.

This recommendation is based on randomized, controlled trials and cohort studies, with a preponderance of harm over benefit.

2. Documentation
Clinicians should document the laterality, duration of effusion, and presence and severity of associated symptoms at each assessment of the child with OME.

This recommendation is based on observational studies and strong preponderance of benefit over harm.

3. Child at Risk
Clinicians should distinguish the child with OME who is at risk for speech, language, or learning problems from other children with OME and should evaluate hearing, speech, language, and need for intervention more promptly.

This recommendation is based on case series, the preponderance of benefit over harm, and ethical limitations in studying children with OME who are at risk.

4. Watchful Waiting
Clinicians should manage the child with OME who is not at risk with watchful waiting for 3 months from the date of effusion onset (if known) or diagnosis (if onset is unknown).

This recommendation is based on systematic review of cohort studies and the preponderance of benefit over harm.

5. Medication
Antihistamines and decongestants are ineffective for OME and are not recommended for treatment; antimicrobials and corticosteroids do not have long-term efficacy and are not recommended for routine management.

This recommendation is based on systematic review of randomized, controlled trials and the preponderance of harm over benefit.

6. Hearing and Language
Hearing testing is recommended when OME persists for 3 months or longer or at any time that language delay, learning problems, or a significant hearing loss is suspected in a child with OME; language testing should be conducted for children with hearing loss.

This recommendation is based on cohort studies and the preponderance of benefit over risk.

7. Surveillance
Children with persistent OME who are not at risk should be reexamined at 3- to 6-month intervals until the effusion is no longer present, significant hearing loss is identified, or structural abnormalities of the eardrum or middle ear are suspected.

This recommendation is based on randomized, controlled trials and observational studies with a preponderance of benefit over harm.

8. Referral
When children with OME are referred by the primary care clinician for evaluation by an otolaryngologist, audiologist, or speech-language pathologist, the referring clinician should document the effusion duration and specific reason for referral (evaluation, surgery) and provide additional relevant information such as history of AOM and developmental status of the child.

This option is based on panel consensus and a preponderance of benefit over harm.

9. Surgery
When a child becomes a surgical candidate, tympanostomy tube insertion is the preferred initial procedure; adenoidectomy should not be performed unless a distinct indication exists (nasal obstruction, chronic adenoiditis). Repeat surgery consists of adenoidectomy plus myringotomy, with or without tube insertion. tonsillectomy alone or myringotomy alone should not be used to treat OME.

This recommendation is based on randomized, controlled trials with a preponderance of benefit over harm.

10. CAM
No recommendation is made regarding CAM as a treatment for OME.

There is no recommendation based on lack of scientific evidence documenting efficacy and an uncertain balance of harm and benefit.

11. Allergy Management
No recommendation is made regarding allergy management as a treatment for OME.

There is no recommendation based on insufficient evidence of therapeutic efficacy or a causal relationship between allergy and OME.

Coding Quick Reference for Otitis Media

ICD-10-CM

H65.01	Acute serous otitis media, right ear
H65.02	Left ear
H65.03	Bilateral
H65.04	Recurrent, right ear
H65.05	Recurrent, left ear
H65.06	Recurrent, bilateral
H65.21	Chronic serous otitis media, right ear
H65.22	Left ear
H65.23	Bilateral
H65.91	Unspecified nonsuppurative otitis media, right ear
H65.92	Left ear
H65.93	Bilateral
H66.001	Acute suppurative otitis media without spontaneous rupture of ear drum, right ear
H66.002	Left ear
H66.003	Bilateral
H66.004	Recurrent, right ear
H66.005	Recurrent, left ear
H66.006	Recurrent, bilateral
H66.011	Acute suppurative otitis media with spontaneous rupture of ear drum, right ear
H66.012	Left ear
H66.013	Bilateral
H66.014	Recurrent, right ear
H66.015	Recurrent, left ear
H66.016	Recurrent, bilateral
H67.1	Otitis media in diseases classified elsewhere, right ear
H67.2	Left ear
H67.3	Bilateral
H66.3X1	Other chronic suppurative otitis media, right ear
H66.3X2	Left ear
H66.3X3	Bilateral

Continuum Model for Otitis Media

Code selection at any level above **99211** *may be based on the complexity of MDM or the total time spent by the physician or other qualified health care professional on the date of the encounter. (Code* **99211** *is not included due to lack of indication for follow-up by clinical staff.)*

CPT Code With Total Physician Time and Vignette	MDM (2 of 3 elements required)		
	Number and Complexity of Problems Addressed	Amount and/or Complexity of Data Reviewed and Analyzed	Risk of Complications and/or Morbidity or Mortality of Patient Management
99212 (Time: 10–19 min) Follow-up otitis media, uncomplicated	**Minimal:** Follow-up otitis media, evaluation of effusion and hearing	**Limited:** Tympanometry, audiometry, and/or assessment requiring an independent historian	**Minimal:** Risk associated with diagnostic testing and treatment
99213 (Time: 20–29 min) 2-year-old presents with tugging at her right ear. Afebrile. Mild otitis media.	**Low:** 1 acute, uncomplicated illness or injury	**Limited:** Assessment requiring an independent historian	**Moderate:** Prescription drug management, delayed prescribing
99214 (Time: 30–39 min) Infant presents with fever and cough and suspected third episode of otitis media within 3 months.	**Moderate:** 1 acute illness with systemic symptoms	**Limited:** Assessment requiring an independent historian	**Moderate:** Prescription drug management
99215 (Time: 40–54 min) 6-month-old presents with high fever, vomiting, and irritability. After tests, antipyretics, and fluid, infant is stable.	**High:** 1 acute illness that poses a threat to life or bodily function	**Moderate:** Orders and/or review of laboratory tests, chest radiograph, and possible lumbar puncture. Assessment requiring an independent historian.	**High:** Decision about hospitalization (Hospitalization discussed with parents and decision made for care at home with strict instructions and close follow-up.)

Abbreviations: *CPT*, *Current Procedural Terminology*; MDM, medical decision-making.

Acute Ear Infections and Your Child

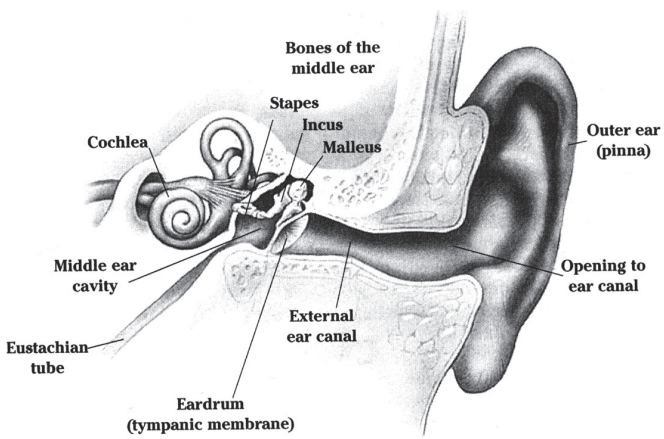
Next to the common cold, an ear infection is the most common childhood illness. In fact, most children have at least one ear infection by the time they are 3 years old. Many ear infections clear up without causing any lasting problems.

The following is information from the American Academy of Pediatrics about the symptoms, treatments, and possible complications of acute *otitis media*, a common infection of the middle ear.

How do ear infections develop?

The ear has 3 parts—the outer ear, middle ear, and inner ear. A narrow channel (eustachian tube) connects the middle ear to the back of the nose. When a child has a cold, nose or throat infection, or allergy, the mucus and fluid can enter the eustachian tube causing a buildup of fluid in the middle ear. If bacteria or a virus infects this fluid, it can cause swelling and pain in the ear. This type of ear infection is called *acute otitis media* (*middle ear inflammation*).

Often after the symptoms of acute otitis media clear up, fluid remains in the ear, creating another kind of ear problem called *otitis media with effusion* (*middle ear fluid*). This condition is harder to detect than acute otitis media because except for the fluid and usually some mild hearing loss, there is often no pain or other symptoms present. This fluid may last several months and, in most cases, disappears on its own. The child's hearing then returns to normal.



Cross-Section of the Ear

Is my child at risk for developing an ear infection?

Risk factors for developing childhood ear infections include

- **Age.** Infants and young children are more likely to get ear infections than older children. The size and shape of an infant's eustachian tube makes it easier for an infection to develop. Ear infections occur most often in children between 6 months and 3 years of age. Also, the younger a child is at the time of the first ear infection, the greater the chance he will have repeated infections.
- **Family history.** Ear infections can run in families. Children are more likely to have repeated middle ear infections if a parent or sibling also had repeated ear infections.
- **Colds.** Colds often lead to ear infections. Children in group child care settings have a higher chance of passing their colds to each other because they are exposed to more viruses from the other children.
- **Tobacco smoke.** Children who breathe in someone else's tobacco smoke have a higher risk of developing health problems, including ear infections.

How can I reduce the risk of an ear infection?

Some things you can do to help reduce your child's risk of getting an ear infection are

- Breastfeed instead of bottle-feed. Breastfeeding may decrease the risk of frequent colds and ear infections.
- Keep your child away from tobacco smoke, especially in your home or car.
- Throw away pacifiers or limit to daytime use, *if your child is older than 1 year*.
- Keep vaccinations up to date. Vaccines against bacteria (such as pneumococcal vaccine) and viruses (such as influenza vaccine) reduce the number of ear infections in children with frequent infections.

What are the symptoms of an ear infection?

Your child may have many symptoms during an ear infection. Talk with your pediatrician about the best way to treat your child's symptoms.

- **Pain.** The most common symptom of an ear infection is pain. Older children can tell you that their ears hurt. Younger children may only seem irritable and cry. You may notice this more during feedings because sucking and swallowing may cause painful pressure changes in the middle ear.
- **Loss of appetite.** Your child may have less of an appetite because of the ear pain.
- **Trouble sleeping.** Your child may have trouble sleeping because of the ear pain.
- **Fever.** Your child may have a temperature ranging from 100°F (normal) to 104°F.

- **Ear drainage.** You might notice yellow or white fluid, possibly blood-tinged, draining from your child's ear. The fluid may have a foul odor and will look different from normal earwax (which is orange-yellow or reddish-brown). Pain and pressure often decrease after this drainage begins, but this doesn't always mean that the infection is going away. If this happens it's not an emergency, but your child will need to see your pediatrician.
- **Trouble hearing.** During and after an ear infection, your child may have trouble hearing for several weeks. This occurs because the fluid behind the eardrum gets in the way of sound transmission. This is usually temporary and clears up after the fluid from the middle ear drains away.

Important: Your doctor *cannot* diagnose an ear infection over the phone; your child's eardrum must be examined by your doctor to confirm fluid buildup and signs of inflammation.

What causes ear pain?

There are other reasons why your child's ears may hurt besides an ear infection. The following can cause ear pain:

- An infection of the skin of the ear canal, often called "swimmer's ear"
- Reduced pressure in the middle ear from colds or allergies
- A sore throat
- Teething or sore gums
- Inflammation of the eardrum alone during a cold (without fluid buildup)

How are ear infections treated?

Because pain is often the first and most uncomfortable symptom of an ear infection, it's important to help comfort your child by giving her pain medicine. Acetaminophen and ibuprofen are over-the-counter (OTC) pain medicines that may help decrease much of the pain. Be sure to use the right dosage for your child's age and size. *Don't give aspirin to your child.* It has been associated with Reye syndrome, a disease that affects the liver and brain. There are also ear drops that may relieve ear pain for a short time. Ask your pediatrician whether these drops should be used. There is no need to use OTC cold medicines (decongestants and antihistamines), because they don't help clear up ear infections.

Not all ear infections require antibiotics. Some children who don't have a high fever and aren't severely ill may be observed without antibiotics. In most cases, pain and fever will improve in the first 1 to 2 days.

If your child is younger than 2 years, has drainage from the ear, has a fever higher than 102.5°F, seems to be in a lot of pain, is unable to sleep, isn't eating, or is acting ill, it's important to call your pediatrician. If your child is older than 2 years and your child's symptoms are mild, you may wait a couple of days to see if she improves.

Your child's ear pain and fever should improve or go away within 3 days of their onset. If your child's condition doesn't improve within 3 days, or worsens at any time, call your pediatrician. Your pediatrician may wish to see your child and may prescribe an antibiotic to take by mouth, if one wasn't given initially. If an antibiotic was already started, your child may need a different antibiotic. Be sure to follow your pediatrician's instructions closely.

If an antibiotic was prescribed, make sure your child finishes the entire prescription. If you stop the medicine too soon, some of the bacteria that caused the ear infection may still be present and cause an infection to start all over again.

As the infection starts to clear up, your child might feel a "popping" in the ears. This is a normal sign of healing. Children with ear infections don't need to stay home if they are feeling well, as long as a child care provider or someone at school can give them their medicine properly, if needed. If your child needs to travel in an airplane, or wants to swim, contact your pediatrician for specific instructions.

What are signs of hearing problems?

Because your child can have trouble hearing without other symptoms of an ear infection, watch for the following changes in behavior (especially during or after a cold):

- Talking more loudly or softly than usual
- Saying "huh?" or "what?" more than usual
- Not responding to sounds
- Having trouble understanding speech in noisy rooms
- Listening with the TV or radio turned up louder than usual

If you think your child may have difficulty hearing, call your pediatrician. Being able to hear and listen to others talk helps a child learn speech and language. This is especially important during the first few years of life.

Are there complications from ear infections?

Although it's very rare, complications from ear infections can develop, including the following:

- An infection of the inner ear that causes dizziness and imbalance (labyrinthitis)
- An infection of the skull behind the ear (mastoiditis)
- Scarring or thickening of the eardrum
- Loss of feeling or movement in the face (facial paralysis)
- Permanent hearing loss

It's normal for children to have several ear infections when they are young—even as many as 2 separate infections within a few months. Most ear infections that develop in children are minor. Recurring ear infections may be a nuisance, but they usually clear up without any lasting problems. With proper care and treatment, ear infections can usually be managed successfully. But, if your child has one ear infection after another for several months, you may want to talk about other treatment options with your pediatrician.

From your doctor

American Academy of Pediatrics

DEDICATED TO THE HEALTH OF ALL CHILDREN™

The American Academy of Pediatrics is an organization of 66,000 primary care pediatricians, pediatric medical subspecialists, and pediatric surgical specialists dedicated to the health, safety, and well-being of infants, children, adolescents, and young adults.

American Academy of Pediatrics
Web site — www.HealthyChildren.org

Middle Ear Fluid and Your Child

The *middle* ear is the space behind the eardrum that is usually filled with air. When a child has middle ear fluid (otitis media with effusion), it means that a watery or mucus-like fluid has collected in the middle ear. *Otitis media* means *middle ear inflammation*, and *effusion* means *fluid*.

Middle ear fluid is **not** the same as an ear infection. An ear infection occurs when middle ear fluid is infected with viruses, bacteria, or both, often during a cold. Children with middle ear fluid have no signs or symptoms of infection. Most children don't have fever or severe pain, but may have mild discomfort or trouble hearing. About 90% of children get middle ear fluid at some time before age 5.

The following is information from the American Academy of Pediatrics about the causes, symptoms, risk reduction, testing, and treatments for middle ear fluid, as well as how middle ear fluid may affect your child's learning.

What causes middle ear fluid?

There is no one cause for middle ear fluid. Often your child's doctor may not know the cause. Middle ear fluid could be caused by

- A past ear infection
- A cold or flu
- Blockage of the eustachian tube (a narrow channel that connects the middle ear to the back of the nose)

What are the symptoms of middle ear fluid?

Many healthy children with middle ear fluid have little or no problems. They usually get better on their own. Often middle ear fluid is found at a regular checkup. Ear discomfort, if present, is usually mild. Your child may be irritable, rub his ears, or have trouble sleeping. Other symptoms include hearing loss, irritability, sleep problems, clumsiness, speech or language problems, and poor school performance. You may notice your child sitting closer to the TV or turning the sound up louder than usual. Sometimes it may seem like your child isn't paying attention to you, especially when at the playground or in a noisy environment.

Talk with your child's doctor if you are concerned about your child's hearing. Keep a record of your child's ear problems. Write down your child's name, child's doctor's name and number, date and type of ear problem or infection, treatment, and results. This may help your child's doctor find the cause of the middle ear fluid.

Can middle ear fluid affect my child's learning?

Some children with middle ear fluid are at risk for delays in speaking or may have problems with learning or schoolwork, especially children with

- Permanent hearing loss not caused by middle ear fluid
- Speech and language delays or disorders
- Developmental delay of social and communication skills disorders (for example, autism spectrum disorders)
- Syndromes that affect cognitive, speech, and language delays (for example, Down syndrome)
- Craniofacial disorders that affect cognitive, speech, and language delays (for example, cleft palate)
- Blindness or visual loss that can't be corrected

If your child is at risk and has ongoing middle ear fluid, her hearing, speech, and language should be checked.

How can I reduce the risk of middle ear fluid?

Children who live with smokers, attend group child care, or use pacifiers have more ear infections. Because some children who have middle ear infections later get middle ear fluid, you may want to

- Keep your child away from tobacco smoke.
- Keep your child away from children who are sick.
- Throw away pacifiers or limit to daytime use, *if your child is older than 1 year*.

Are there special tests to check for middle ear fluid?

Two tests that can check for middle ear fluid are *pneumatic otoscopy* and *tympanometry*. A pneumatic otoscope is the recommended test for middle ear fluid. With this tool, the doctor looks at the eardrum and uses air to see how well the eardrum moves. Tympanometry is another test for middle ear fluid that uses sound to see how well the eardrum moves. An eardrum with fluid behind it doesn't move as well as a normal eardrum. Your child must sit still for both tests; the tests are painless.

Because these tests don't check hearing level, a hearing test may be given, if needed. Hearing tests measure how well your child hears. Although hearing tests don't test for middle ear fluid, they can measure if the fluid is affecting your child's hearing level. The type of hearing test given depends on your child's age and ability to participate.

How can middle ear fluid be treated?

Middle ear fluid can be treated in several ways. Treatment options include observation and tube surgery or adenoid surgery. Because a treatment that works for one child may not work for another, your child's doctor can help you decide which treatment is best for your child and when you should see an ear, nose, and throat (ENT) specialist. If one treatment doesn't work, another treatment can be tried. Ask your child's doctor or ENT specialist about the costs, advantages, and disadvantages of each treatment.

When should middle ear fluid be treated?

Your child is more likely to need treatment for middle ear fluid if she has any of the following:

- Conditions placing her at risk for developmental delays (see "Can middle ear fluid affect my child's learning?")
- Fluid in both ears, especially if present more than 3 months
- Hearing loss or other significant symptoms (see "What are the symptoms of middle ear fluid?")

What treatments are not recommended?

A number of treatments are **not** recommended for young children with middle ear fluid.

- **Medicines** not recommended include antibiotics, decongestants, antihistamines, and steroids (by mouth or in nasal sprays). All of these have side effects and do not cure middle ear fluid.
- **Surgical treatments** not recommended include myringotomy (draining of fluid without placing a tube) and tonsillectomy (removal of the tonsils). If your child's doctor or ENT specialist suggests one of these surgeries, it may be for another medical reason. Ask your doctor why your child needs the surgery.

What about other treatment options?

There is no evidence that complementary and alternative medicine treatments or that treatment for allergies works to decrease middle ear fluid. Some of these treatments may be harmful and many are expensive.

From your doctor

American Academy of Pediatrics

DEDICATED TO THE HEALTH OF ALL CHILDREN™

The American Academy of Pediatrics is an organization of 66,000 primary care pediatricians, pediatric medical subspecialists, and pediatric surgical specialists dedicated to the health, safety, and well-being of infants, children, adolescents, and young adults.

American Academy of Pediatrics
Web site— www.HealthyChildren.org

Clinical Practice Guideline for the Diagnosis and Management of Acute Bacterial Sinusitis in Children Aged 1 to 18 Years

- *Clinical Practice Guideline*
  - *PPI: AAP Partnership for Policy Implementation*

See Appendix 1 for more information.

CLINICAL PRACTICE GUIDELINE

Clinical Practice Guideline for the Diagnosis and Management of Acute Bacterial Sinusitis in Children Aged 1 to 18 Years

abstract

FREE

OBJECTIVE: To update the American Academy of Pediatrics clinical practice guideline regarding the diagnosis and management of acute bacterial sinusitis in children and adolescents.

METHODS: Analysis of the medical literature published since the last version of the guideline (2001).

RESULTS: The diagnosis of acute bacterial sinusitis is made when a child with an acute upper respiratory tract infection (URI) presents with (1) persistent illness (nasal discharge [of any quality] or daytime cough or both lasting more than 10 days without improvement), (2) a worsening course (worsening or new onset of nasal discharge, daytime cough, or fever after initial improvement), or (3) severe onset (concurrent fever [temperature ≥39°C/102.2°F] and purulent nasal discharge for at least 3 consecutive days). Clinicians should not obtain imaging studies of any kind to distinguish acute bacterial sinusitis from viral URI, because they do not contribute to the diagnosis; however, a contrast-enhanced computed tomography scan of the paranasal sinuses should be obtained whenever a child is suspected of having orbital or central nervous system complications. The clinician should prescribe antibiotic therapy for acute bacterial sinusitis in children with severe onset or worsening course. The clinician should either prescribe antibiotic therapy or offer additional observation for 3 days to children with persistent illness. Amoxicillin with or without clavulanate is the first-line treatment of acute bacterial sinusitis. Clinicians should reassess initial management if there is either a caregiver report of worsening (progression of initial signs/symptoms or appearance of new signs/symptoms) or failure to improve within 72 hours of initial management. If the diagnosis of acute bacterial sinusitis is confirmed in a child with worsening symptoms or failure to improve, then clinicians may change the antibiotic therapy for the child initially managed with antibiotic or initiate antibiotic treatment of the child initially managed with observation.

CONCLUSIONS: Changes in this revision include the addition of a clinical presentation designated as "worsening course," an option to treat immediately or observe children with persistent symptoms for 3 days before treating, and a review of evidence indicating that imaging is not necessary in children with uncomplicated acute bacterial sinusitis. *Pediatrics* 2013;132:e262–e280

Ellen R. Wald, MD, FAAP, Kimberly E. Applegate, MD, MS, FAAP, Clay Bordley, MD, FAAP, David H. Darrow, MD, DDS, FAAP, Mary P. Glode, MD, FAAP, S. Michael Marcy, MD, FAAP, Carrie E. Nelson, MD, MS, Richard M. Rosenfeld, MD, FAAP, Nader Shaikh, MD, MPH, FAAP, Michael J. Smith, MD, MSCE, FAAP, Paul V. Williams, MD, FAAP, and Stuart T. Weinberg, MD, FAAP

KEY WORDS

acute bacterial sinusitis, sinusitis, antibiotics, imaging, sinus aspiration

ABBREVIATIONS

AAP—American Academy of Pediatrics
AOM—acute otitis media
CT—computed tomography
PCV-13—13-valent pneumococcal conjugate vaccine
RABS—recurrent acute bacterial sinusitis
RCT—randomized controlled trial
URI—upper respiratory tract infection

www.pediatrics.org/cgi/doi/10.1542/peds.2013-1071

doi:10.1542/peds.2013-1071

PEDIATRICS (ISSN Numbers: Print, 0031-4005; Online, 1098-4275).

INTRODUCTION

Acute bacterial sinusitis is a common complication of viral upper respiratory infection (URI) or allergic inflammation. Using stringent criteria to define acute sinusitis, it has been observed that between 6% and 7% of children seeking care for respiratory symptoms has an illness consistent with this definition.[1–4]

This clinical practice guideline is a revision of the clinical practice guideline published by the American Academy of Pediatrics (AAP) in 2001.[5] It has been developed by a subcommittee of the Steering Committee on Quality Improvement and Management that included physicians with expertise in the fields of primary care pediatrics, academic general pediatrics, family practice, allergy, epidemiology and informatics, pediatric infectious diseases, pediatric otolaryngology, radiology, and pediatric emergency medicine. None of the participants had financial conflicts of interest, and only money from the AAP was used to fund the development of the guideline. The guideline will be reviewed in 5 years unless new evidence emerges that warrants revision sooner.

The guideline is intended for use in a variety of clinical settings (eg, office, emergency department, hospital) by clinicians who treat pediatric patients. The data on which the recommendations are based are included in a companion technical report, published in the electronic pages.[6] The Partnership for Policy Implementation has developed a series of definitions using accepted health information technology standards to assist in the implementation of this guideline in computer systems and quality measurement efforts. This document is available at: http://www2.aap.org/informatics/PPI.html.

This revision focuses on the diagnosis and management of acute sinusitis in children between 1 and 18 years of age. It does not apply to children with subacute or chronic sinusitis. Similar to the previous guideline, this document does not consider neonates and children younger than 1 year or children with anatomic abnormalities of the sinuses, immunodeficiencies, cystic fibrosis, or primary ciliary dyskinesia. The most significant areas of change from the 2001 guideline are in the addition of a clinical presentation designated as "worsening course," inclusion of new data on the effectiveness of antibiotics in children with acute sinusitis,[4] and a review of evidence indicating that imaging is not necessary to identify those children who will benefit from antimicrobial therapy.

METHODS

The Subcommittee on Management of Sinusitis met in June 2009 to identify research questions relevant to guideline revision. The primary goal was to update the 2001 report by identifying and reviewing additional studies of pediatric acute sinusitis that have been performed over the past decade.

Searches of PubMed were performed by using the same search term as in the 2001 report. All searches were limited to English-language and human studies. Three separate searches were performed to maximize retrieval of the most recent and highest-quality evidence for pediatric sinusitis. The first limited results to all randomized controlled trials (RCTs) from 1966 to 2009, the second to all meta-analyses from 1966 to 2009, and the third to all pediatric studies (limited to ages <18 years) published since the last technical report (1999–2009). Additionally, the Web of Science was queried to identify studies that cited the original AAP guidelines. This literature search was replicated in July 2010

Evidence Quality	Preponderance of Benefit or Harm	Balance of Benefit and Harm
A. Well-designed RCTs or diagnostic studies on relevant population	Strong Recommendation	Option
B. RCTs or diagnostic studies with minor limitations;overwhelmingly consistent evidence from observational studies	Recommendation	
C. Observational studies (case-control and cohort design)		
D. Expert opinion, case reports, reasoning from first principles	Option	No Rec
X. Exceptional situations where validating studies cannot be performed and there is a clear preponderance of benefit or harm	Strong Recommendation / Recommendation	

FIGURE 1
Levels of recommendations. Rec, recommendation.

and November 2012 to capture recently published studies. The complete results of the literature review are published separately in the technical report.[6] In summary, 17 randomized studies of sinusitis in children were identified and reviewed. Only 3 trials met inclusion criteria. Because of significant heterogeneity among these studies, formal meta-analyses were not pursued.

The results from the literature review were used to guide development of the key action statements included in this document. These action statements were generated by using BRIDGE-Wiz (Building Recommendations in a Developers Guideline Editor, Yale School of Medicine, New Haven, CT), an interactive software tool that leads guideline development through a series of questions that are intended to create a more actionable set of key action statements.[7] BRIDGE-Wiz also incorporates the quality of available evidence into the final determination of the strength of each recommendation.

The AAP policy statement "Classifying Recommendations for Clinical Practice Guidelines" was followed in designating levels of recommendations (Fig 1).[8] Definitions of evidence-based statements are provided in Table 1. This guideline was reviewed by multiple groups in the AAP and 2 external organizations. Comments were compiled and reviewed by the subcommittee, and relevant changes were incorporated into the guideline.

KEY ACTION STATEMENTS

Key Action Statement 1

Clinicians should make a presumptive diagnosis of acute bacterial sinusitis when a child with an acute URI presents with the following:

- **Persistent illness, ie, nasal discharge (of any quality) or daytime cough or both lasting more than 10 days without improvement;**

OR

- **Worsening course, ie, worsening or new onset of nasal discharge, daytime cough, or fever after initial improvement;**

OR

- **Severe onset, ie, concurrent fever (temperature ≥39°C/102.2°F) and purulent nasal discharge for at least 3 consecutive days (Evidence Quality: B; Recommendation).**

KAS Profile 1

Aggregate evidence quality: B	
Benefit	Diagnosis allows decisions regarding management to be made. Children likely to benefit from antimicrobial therapy will be identified.
Harm	Inappropriate diagnosis may lead to unnecessary treatment. A missed diagnosis may lead to persistent infection or complications
Cost	Inappropriate diagnosis may lead to unnecessary cost of antibiotics. A missed diagnosis leads to cost of persistent illness (loss of time from school and work) or cost of caring for complications.
Benefits-harm assessment	Preponderance of benefit.
Value judgments	None.
Role of patient preference	Limited.
Intentional vagueness	None.
Exclusions	Children aged <1 year or older than 18 years and with underlying conditions.
Strength	Recommendation.

TABLE 1 Guideline Definitions for Evidence-Based Statements

Statement	Definition	Implication
Strong recommendation	A strong recommendation in favor of a particular action is made when the anticipated benefits of the recommended intervention clearly exceed the harms (as a strong recommendation against an action is made when the anticipated harms clearly exceed the benefits) and the quality of the supporting evidence is excellent. In some clearly identified circumstances, strong recommendations may be made when high-quality evidence is impossible to obtain and the anticipated benefits strongly outweigh the harms.	Clinicians should follow a strong recommendation unless a clear and compelling rationale for an alternative approach is present.
Recommendation	A recommendation in favor of a particular action is made when the anticipated benefits exceed the harms but the quality of evidence is not as strong. Again, in some clearly identified circumstances, recommendations may be made when high-quality evidence is impossible to obtain but the anticipated benefits outweigh the harms.	Clinicians would be prudent to follow a recommendation, but should remain alert to new information and sensitive to patient preferences.
Option	Options define courses that may be taken when either the quality of evidence is suspect or carefully performed studies have shown little clear advantage to one approach over another.	Clinicians should consider the option in their decision-making, and patient preference may have a substantial role.
No recommendation	No recommendation indicates that there is a lack of pertinent published evidence and that the anticipated balance of benefits and harms is presently unclear.	Clinicians should be alert to new published evidence that clarifies the balance of benefit versus harm.

The purpose of this action statement is to guide the practitioner in making a diagnosis of acute bacterial sinusitis on the basis of stringent clinical criteria. To develop criteria to be used in distinguishing episodes of acute bacterial sinusitis from other common respiratory infections, it is helpful to describe the features of an uncomplicated viral URI. Viral URIs are usually characterized by nasal symptoms (discharge and congestion/obstruction) or cough or both. Most often, the nasal discharge begins as clear and watery. Often, however, the quality of nasal discharge changes during the course of the illness. Typically, the nasal discharge becomes thicker and more mucoid and may become purulent (thick, colored, and opaque) for several days. Then the situation reverses, with the purulent discharge becoming mucoid and then clear again or simply resolving. The transition from clear to purulent to clear again occurs in uncomplicated viral URIs without the use of antimicrobial therapy.

Fever, when present in uncomplicated viral URI, tends to occur early in the illness, often in concert with other constitutional symptoms such as headache and myalgias. Typically, the fever and constitutional symptoms disappear in the first 24 to 48 hours, and the respiratory symptoms become more prominent (Fig 2).

The course of most uncomplicated viral URIs is 5 to 7 days.[9–12] As shown in Fig 2, respiratory symptoms usually peak in severity by days 3 to 6 and then begin to improve; however, resolving symptoms and signs may persist in some patients after day 10.[9,10]

Symptoms of acute bacterial sinusitis and uncomplicated viral URI overlap considerably, and therefore it is their persistence without improvement that suggests a diagnosis of acute sinusitis.[9,10,13] Such symptoms include nasal discharge (of any quality: thick or thin, serous, mucoid, or purulent) or daytime cough (which may be worse at night) or both. Bad breath, fatigue, headache, and decreased appetite, although common, are not specific indicators of acute sinusitis.[14] Physical examination findings are also not particularly helpful in distinguishing sinusitis from uncomplicated URIs. Erythema and swelling of the nasal turbinates are nonspecific findings.[14] Percussion of the sinuses is not useful. Transillumination of the sinuses is difficult to perform correctly in children and has been shown to be unreliable.[15,16] Nasopharyngeal cultures do not reliably predict the etiology of acute bacterial sinusitis.[14,16]

Only a minority (~6%–7%) of children presenting with symptoms of URI will meet criteria for persistence.[3,4,11] As a result, before diagnosing acute bacterial sinusitis, it is important for the practitioner to attempt to (1) differentiate between sequential episodes of uncomplicated viral URI (which may seem to coalesce in the mind of the patient or parent) from the onset of acute bacterial sinusitis with persistent symptoms and (2) establish whether the symptoms are clearly not improving.

A worsening course of signs and symptoms, termed "double sickening," in the context of a viral URI is another presentation of acute bacterial sinusitis.[13,17] Affected children experience substantial and acute worsening of respiratory symptoms (nasal discharge or nasal congestion or daytime cough) or a new fever, often on the sixth or seventh day of illness, after initial signs of recovery from an uncomplicated viral URI. Support for this definition comes from studies in children and adults, for whom antibiotic treatment of worsening symptoms after a period of apparent improvement was associated with better outcomes.[4]

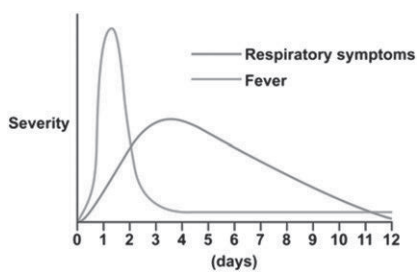


FIGURE 2
Uncomplicated viral URI.

Finally, some children with acute bacterial sinusitis may present with severe onset, ie, concurrent high fever (temperature >39°C) and purulent nasal discharge. These children usually are ill appearing and need to be distinguished from children with uncomplicated viral infections that are unusually severe. If fever is present in uncomplicated viral URIs, it tends to be present early in the illness, usually accompanied by other constitutional symptoms, such as headache and myalgia.[9,13,18] Generally, the constitutional symptoms resolve in the first 48 hours and then the respiratory symptoms become prominent. In most uncomplicated viral infections, including influenza, purulent nasal discharge does not appear for several days. Accordingly, it is the concurrent presentation of high fever and purulent nasal discharge for the first 3 to 4 days of an acute URI that helps to define the severe onset of acute bacterial sinusitis.[13,16,18] This presentation in children is the corollary to acute onset of headache, fever, and facial pain in adults with acute sinusitis.

Allergic and nonallergic rhinitis are predisposing causes of some cases of acute bacterial sinusitis in childhood. In addition, at their onset, these conditions may be mistaken for acute bacterial sinusitis. A family history of atopic conditions, seasonal occurrences, or occurrences with exposure to common allergens and other

allergic diatheses in the index patient (eczema, atopic dermatitis, asthma) may suggest the presence of noninfectious rhinitis. The patient may have complaints of pruritic eyes and nasal mucosa, which will provide a clue to the likely etiology of the condition. On physical examination, there may be a prominent nasal crease, allergic shiners, cobblestoning of the conjunctiva or pharyngeal wall, or pale nasal mucosa as other indicators of the diagnosis.

Key Action Statement 2A

Clinicians should not obtain imaging studies (plain films, contrast-enhanced computed tomography [CT], MRI, or ultrasonography) to distinguish acute bacterial sinusitis from viral URI (Evidence Quality: B; Strong Recommendation).

KAS Profile 2A

Aggregate evidence quality: B; overwhelmingly consistent evidence from observational studies.	
Benefit	Avoids exposure to radiation and costs of studies. Avoids unnecessary therapy for false-positive diagnoses.
Harm	None.
Cost	Avoids cost of imaging.
Benefits-harm assessment	Exclusive benefit.
Value judgments	Concern for unnecessary radiation and costs.
Role of patient preference	Limited. Parents may value a negative study and avoidance of antibiotics as worthy of radiation but panel disagrees.
Intentional vagueness	None.
Exclusions	Patients with complications of sinusitis.
Strength	Strong recommendation.

The purpose of this key action statement is to discourage the practitioner from obtaining imaging studies in children with uncomplicated acute bacterial sinusitis. As emphasized in Key Action Statement 1, acute bacterial sinusitis in children is a diagnosis that is made on the basis of stringent clinical criteria that describe signs, symptoms, and temporal patterns of a URI. Although historically imaging has been used as a confirmatory or diagnostic modality in children suspected to have acute bacterial sinusitis, it is no longer recommended.

The membranes that line the nose are continuous with the membranes (mucosa) that line the sinus cavities, the middle ear, the nasopharynx, and the oropharynx. When an individual experiences a viral URI, there is inflammation of the nasal mucosa and, often, the mucosa of the middle ear and paranasal sinuses as well. The continuity of the mucosa of the upper respiratory tract is responsible for the controversy regarding the usefulness of images of the paranasal sinuses in contributing to a diagnosis of acute bacterial sinusitis.

As early as the 1940s, observations were made regarding the frequency of abnormal sinus radiographs in healthy children without signs or symptoms of current respiratory disease.[19] In addition, several investigators in the 1970s and 1980s observed that children with uncomplicated viral URI had frequent abnormalities of the paranasal sinuses on plain radiographs.[20–22] These abnormalities were the same as those considered to be diagnostic of acute bacterial sinusitis (diffuse opacification, mucosal swelling of at least 4 mm, or an air-fluid level).[16]

As technology advanced and CT scanning of the central nervous system and skull became prevalent, several studies reported on incidental abnormalities of the paranasal sinuses that were observed in children.[23,24] Gwaltney et al[25] showed striking abnormalities (including air-fluid levels) in sinus CT scans of young adults with uncomplicated colds. Manning et al[26] evaluated children undergoing either CT or MRI of the head for indications other than respiratory complaints or suspected sinusitis. Each patient underwent rhinoscopy and otoscopy before imaging and each patient's parent was asked to fill out a questionnaire regarding recent symptoms of URI. Sixty-two percent of patients overall had physical findings or history consistent with an upper respiratory inflammatory process, and 55% of the total group showed some abnormalities on sinus imaging; 33% showed pronounced mucosal thickening or an air-fluid level. Gordts et al[27] made similar observations in children undergoing MRI. Finally, Kristo et al[28] performed MRI in children with URIs and confirmed the high frequency (68%) of major abnormalities seen in the paranasal sinuses.

In summary, when the paranasal sinuses are imaged, either with plain radiographs, contrast-enhanced CT, or MRI in children with uncomplicated URI, the majority of studies will be significantly abnormal with the same kind of findings that are associated with bacterial infection of the sinuses. Accordingly, although normal radiographs or CT or MRI results can ensure that a patient with respiratory symptoms does not have acute bacterial sinusitis, an abnormal image cannot confirm the diagnosis. Therefore, it is not necessary to perform imaging in children with uncomplicated episodes of clinical sinusitis. Similarly, the high likelihood of an abnormal imaging result in a child with an uncomplicated URI indicates that radiographic studies

not be performed in an attempt to eliminate the diagnosis of sinusitis.

Key Action Statement 2B

Clinicians should obtain a contrast-enhanced CT scan of the paranasal sinuses and/or an MRI with contrast whenever a child is suspected of having orbital or central nervous system complications of acute bacterial sinusitis (Evidence Quality: B; Strong Recommendation).

KAS Profile 2B

Aggregate evidence quality: B; overwhelmingly consistent evidence from observational studies.	
Benefit	Determine presence of abscesses, which may require surgical intervention; avoid sequelae because of appropriate aggressive management.
Harm	Exposure to ionizing radiation for CT scans; need for sedation for MRI.
Cost	Direct cost of studies.
Benefits-harm assessment	Preponderance of benefit.
Value judgments	Concern for significant complication that may be unrecognized and, therefore, not treated appropriately.
Role of patient preference	Limited.
Intentional vagueness	None.
Exclusions	None.
Strength	Strong recommendation.

The purpose of this key action statement is to have the clinician obtain contrast-enhanced CT images when children are suspected of having serious complications of acute bacterial sinusitis. The most common complication of acute sinusitis involves the orbit in children with ethmoid sinusitis who are younger than 5 years.[29–31] Orbital complications should be suspected when the child presents with a swollen eye, especially if accompanied by proptosis or impaired function of the extraocular muscles. Orbital complications of acute sinusitis have been divided into 5 categories: sympathetic effusion, subperiosteal abscess, orbital cellulitis, orbital abscess, and cavernous sinus thrombosis.[32] Although sympathetic effusion (inflammatory edema) is categorized as an orbital complication, the site of infection remains confined to the sinus cavities; eye swelling is attributable to the impedance of venous drainage secondary to congestion within the ethmoid sinuses. Alternative terms for sympathetic effusion (inflammatory edema) are preseptal or periorbital cellulitis. The remaining "true" orbital complications are best visualized by contrast-enhanced CT scanning.

Intracranial complications of acute sinusitis, which are substantially less common than orbital complications, are more serious, with higher morbidity and mortality than those involving the orbit. Intracranial complications should be suspected in the patient who presents with a very severe headache, photophobia, seizures, or other focal neurologic findings. Intracranial complications include subdural empyema, epidural empyema, venous thrombosis, brain abscess, and meningitis.[29] Typically, patients with intracranial complications of acute bacterial sinusitis are previously healthy adolescent males with frontal sinusitis.[33,34]

There have been no head-to-head comparisons of the diagnostic accuracy of contrast-enhanced CT scanning to MRI with contrast in the evaluation of orbital and intracranial complications of sinusitis in children. In general, the contrast-enhanced CT scan has been the preferred imaging study when complications of sinusitis are suspected.[35,36] However, there are documented cases in which a contrast-enhanced CT scan has not revealed the abnormality responsible for the clinical presentation and the MRI with contrast has, especially for intracranial complications and rarely for orbital complications.[37,38] Accordingly, the most recent appropriateness criteria from the American College of Radiology endorse both MRI with contrast and contrast-enhanced CT as complementary examinations when evaluating potential complications of sinusitis.[35] The availability and speed of obtaining the contrast-enhanced CT are desirable; however, there is increasing concern regarding exposure to radiation. The MRI, although very sensitive, takes longer than the contrast-enhanced CT and often requires sedation in young children (which carries its own risks). In older children and adolescents who may not require sedation, MRI with contrast, if available, may be preferred when intracranial complications are likely. Furthermore, MRI with contrast should be performed when there is persistent clinical concern or incomplete information has been provided by the contrast-enhanced CT scan.

Key Action Statement 3

Initial Management of Acute Bacterial Sinusitis

3A: "Severe onset and worsening course" acute bacterial sinusitis. The clinician should prescribe antibiotic therapy for acute bacterial sinusitis in children with severe onset or worsening course (signs, symptoms, or both) (Evidence Quality: B; Strong Recommendation).

KAS Profile 3A

Aggregate evidence quality: B; randomized controlled trials with limitations.	
Benefit	Increase clinical cures, shorten illness duration, and may prevent suppurative complications in a high-risk patient population.
Harm	Adverse effects of antibiotics.
Cost	Direct cost of therapy.
Benefits-harm assessment	Preponderance of benefit.
Value judgments	Concern for morbidity and possible complications if untreated.
Role of patient preference	Limited.
Intentional vagueness	None.
Exclusions	None.
Strength	Strong recommendation.

3B: "Persistent illness." The clinician should either prescribe antibiotic therapy OR offer additional outpatient observation for 3 days to children with persistent illness (nasal discharge of any quality or cough or both for at least 10 days without evidence of improvement) (Evidence Quality: B; Recommendation).

The purpose of this section is to offer guidance on initial management of persistent illness sinusitis by helping clinicians choose between the following 2 strategies:

1. Antibiotic therapy, defined as initial treatment of acute bacterial sinusitis with antibiotics, with the intent of starting antibiotic therapy as soon as possible after the encounter.
2. Additional outpatient observation, defined as initial management of acute bacterial sinusitis limited to continued observation for 3 days, with commencement of antibiotic therapy if either the child does not improve clinically within several days of diagnosis or if there is clinical worsening of the child's condition at any time.

KAS Profile 3B

Aggregate evidence quality: B; randomized controlled trials with limitations.	
Benefit	Antibiotics increase the chance of improvement or cure at 10 to 14 days (number needed to treat, 3–5); additional observation may avoid the use of antibiotics with attendant cost and adverse effects.
Harm	Antibiotics have adverse effects (number needed to harm, 3) and may increase bacterial resistance. Observation may prolong illness and delay start of needed antibiotic therapy.
Cost	Direct cost of antibiotics as well as cost of adverse reactions; indirect costs of delayed recovery when observation is used.
Benefits-harm assessment	Preponderance of benefit (because both antibiotic therapy and additional observation with rescue antibiotic, if needed, are appropriate management).
Value judgments	Role for additional brief observation period for selected children with persistent illness sinusitis, similar to what is recommended for acute otitis media, despite the lack of randomized trials specifically comparing additional observation with immediate antibiotic therapy and longer duration of illness before presentation.
Role of patient preference	Substantial role in shared decision-making that should incorporate illness severity, child's quality of life, and caregiver values and concerns.
Intentional vagueness	None.
Exclusions	Children who are excluded from randomized clinical trials of acute bacterial sinusitis, as defined in the text.
Strength	Recommendation.

In contrast to the 2001 AAP guideline,[5] which recommended antibiotic therapy for all children diagnosed with acute bacterial sinusitis, this guideline allows for additional observation of children presenting with persistent illness (nasal discharge of any quality or daytime cough or both for at least 10 days without evidence of improvement). In both guidelines, however, children presenting with severe or worsening illness (which was not defined explicitly in the 2001 guideline[5]) are to receive antibiotic therapy. The rationale for this approach (Table 2) is discussed below.

Antibiotic Therapy for Acute Bacterial Sinusitis

In the United States, antibiotics are prescribed for 82% of children with acute sinusitis.[39] The rationale for antibiotic therapy of acute bacterial sinusitis is based on the recovery of bacteria in high density ($\geq 10^4$ colony-forming units/mL) in 70% of maxillary sinus aspirates obtained from children with a clinical syndrome characterized by persistent nasal discharge, daytime cough, or both.[16,40] Children who present with severe-onset acute bacterial sinusitis are presumed to have bacterial infection, because a temperature of at least 39°C/102.2°F coexisting for at least 3 consecutive days with purulent nasal discharge is not consistent with the well-documented pattern of acute viral URI. Similarly, children with worsening-course acute bacterial sinusitis have a clinical course that is also not consistent with the steady improvement that characterizes an uncomplicated viral URI.[9,10]

Three RCTs have compared antibiotic therapy with placebo for the initial management of acute bacterial sinusitis in children. Two trials by Wald et al[4,41] found an increase in cure or improvement after antibiotic therapy compared with placebo with a number needed to treat of 3 to 5 children. Most children in these studies had persistent acute bacterial sinusitis, but children with severe or worsening illness were also included. Conversely, Garbutt et al,[42] who studied only children with persistent acute bacterial sinusitis, found no difference in outcomes for antibiotic versus placebo. Another RCT by Kristo et al,[43] often cited as showing no benefit from antibiotics for acute bacterial sinusitis, will not be considered further because of methodologic flaws, including weak entry criteria and inadequate dosing of antibiotic treatment.

The guideline recommends antibiotic therapy for severe or worsening acute bacterial sinusitis because of the benefits revealed in RCTs[4,41] and a theoretically higher risk of suppurative complications than for children who present with persistent symptoms. Orbital and intracranial complications of acute bacterial sinusitis have not been observed in RCTs, even when placebo was administered; however, sample sizes have inadequate power to preclude an increased risk. This risk, however, has caused some investigators to exclude children with severe acute bacterial sinusitis from trial entry.[42]

Additional Observation for Persistent Onset Acute Bacterial Sinusitis

The guideline recommends either antibiotic therapy or an additional brief period of observation as initial management strategies for children with persistent acute bacterial sinusitis because, although there are benefits to antibiotic therapy (number needed to treat, 3–5), some children improve on their own, and the risk of suppurative complications is low.[4,41] Symptoms of persistent acute bacterial sinusitis may be mild and have varying effects on a given child's quality of life, ranging from slight (mild cough, nasal discharge) to significant (sleep disturbance, behavioral changes, school or child care absenteeism). The benefits of antibiotic therapy in some trials[4,41] must also be balanced against an increased risk of adverse events (number need to harm, 3), most often self-limited diarrhea, but also including occasional rash.[4]

Choosing between antibiotic therapy or additional observation for initial management of persistent illness sinusitis presents an opportunity for shared decision-making with families (Table 2). Factors that might influence this decision include symptom severity, the child's quality of life, recent antibiotic use, previous experience or outcomes with acute bacterial sinusitis, cost of antibiotics, ease of administration, caregiver concerns about potential adverse effects of antibiotics, persistence of respiratory symptoms, or development of complications. Values and preferences expressed by the caregiver should be taken into consideration (Table 3).

Children with persistent acute bacterial sinusitis who received antibiotic therapy in the previous 4 weeks, those with concurrent bacterial infection (eg, pneumonia, suppurative cervical adenitis, group A streptococcal pharyngitis, or acute otitis media), those with actual or suspected complications of acute bacterial sinusitis, or those with underlying conditions should generally be managed with antibiotic therapy. The latter group includes children with asthma, cystic fibrosis, immunodeficiency, previous sinus surgery, or anatomic abnormalities of the upper respiratory tract.

Limiting antibiotic use in children with persistent acute bacterial sinusitis who may improve on their own reduces common antibiotic-related adverse events, such as diarrhea, diaper dermatitis, and skin rash. The most recent RCT of acute bacterial sinusitis in children[4] found adverse events of 44% with antibiotic and 14% with placebo.

Limiting antibiotics may also reduce the prevalence of resistant bacterial pathogens. Although this is always a desirable goal, no increase in resistant bacterial species was observed within the group of children treated with a single course of antimicrobial agents (compared with those receiving placebo) in 2 recent large studies of antibiotic versus placebo for children with acute otitis media.[44,45]

Key Action Statement 4

Clinicians should prescribe amoxicillin with or without clavulanate as first-line treatment when a decision has been made to initiate antibiotic treatment of acute bacterial sinusitis (Evidence Quality: B; Recommendation).

KAS Profile 4

Aggregate evidence quality: B; randomized controlled trials with limitations.

Benefit	Increase clinical cures with narrowest spectrum drug; stepwise increase in broadening spectrum as risk factors for resistance increase.
Harm	Adverse effects of antibiotics including development of hypersensitivity.
Cost	Direct cost of antibiotic therapy.
Benefits-harm assessment	Preponderance of benefit.
Value judgments	Concerns for not encouraging resistance if possible.
Role of patient preference	Potential for shared decision-making that should incorporate the caregiver's experiences and values.
Intentional vagueness	None.
Exclusions	May include allergy or intolerance.
Strength	Recommendation.

TABLE 2 Recommendations for Initial Use of Antibiotics for Acute Bacterial Sinusitis

Clinical Presentation	Severe Acute Bacterial Sinusitis[a]	Worsening Acute Bacterial Sinusitis[b]	Persistent Acute Bacterial Sinusitis[c]
Uncomplicated acute bacterial sinusitis without coexisting illness	Antibiotic therapy	Antibiotic therapy	Antibiotic therapy or additional observation for 3 days[d]
Acute bacterial sinusitis with orbital or intracranial complications	Antibiotic therapy	Antibiotic therapy	Antibiotic therapy
Acute bacterial sinusitis with coexisting acute otitis media, pneumonia, adenitis, or streptococcal pharyngitis	Antibiotic therapy	Antibiotic therapy	Antibiotic therapy

[a] Defined as temperature ≥39°C and purulent (thick, colored, and opaque) nasal discharge present concurrently for at least 3 consecutive days.
[b] Defined as nasal discharge or daytime cough with sudden worsening of symptoms (manifested by new-onset fever ≥38°C/100.4°F or substantial increase in nasal discharge or cough) after having experienced transient improvement of symptoms.
[c] Defined as nasal discharge (of any quality), daytime cough (which may be worse at night), or both, persisting for >10 days without improvement.
[d] Opportunity for shared decision-making with the child's family; if observation is offered, a mechanism must be in place to ensure follow-up and begin antibiotics if the child worsens at any time or fails to improve within 3 days of observation.

The purpose of this key action statement is to guide the selection of antimicrobial therapy once the diagnosis of acute bacterial sinusitis has been made. The microbiology of acute bacterial sinusitis was determined nearly 30 years ago through direct maxillary sinus aspiration in children with compatible signs and symptoms. The major bacterial pathogens recovered at that time were *Streptococcus pneumoniae* in approximately 30% of children and nontypeable *Haemophilus influenzae* and *Moraxella catarrhalis* in approximately 20% each.[16,40] Aspirates from the remaining 25% to 30% of children were sterile.

Maxillary sinus aspiration is rarely performed at the present time unless the course of the infection is unusually prolonged or severe. Although some authorities have recommended obtaining cultures from the middle meatus to determine the cause of a maxillary sinus infection, there are no data in children with acute bacterial sinusitis that have compared such cultures with cultures of a maxillary sinus aspirate. Furthermore, there are data indicating that the middle meatus in healthy children is commonly colonized with *S pneumoniae, H influenzae*, and *M catarrhalis*.[46]

Recent estimates of the microbiology of acute sinusitis have, of necessity, been based primarily on that of acute otitis media (AOM), a condition with relatively easy access to infective fluid through performance of tympanocentesis and one with a similar pathogenesis to acute bacterial sinusitis.[47,48] The 3 most common bacterial pathogens recovered from the middle ear fluid of children with AOM are the same as those that have been associated with acute bacterial sinusitis: *S pneumoniae*, nontypeable *H influenzae,* and *M catarrhalis*.[49] The proportion of each has varied from study to study depending on criteria used for diagnosis of AOM, patient characteristics, and bacteriologic techniques. Recommendations since the year 2000 for the routine use in infants of 7-valent and, more recently, 13-valent pneumococcal conjugate vaccine (PCV-13) have been associated with a decrease in recovery of *S pneumoniae* from ear fluid of children with AOM and a relative increase in the incidence of infections attributable to *H influenzae*.[50] Thus, on the basis of the proportions of bacteria found in middle ear infections, it is estimated that *S pneumoniae* and *H influenzae* are currently each responsible for approximately 30% of cases of acute bacterial sinusitis in children, and *M catarrhalis* is responsible for approximately 10%. These percentages are contingent on the assumption that approximately one-quarter of aspirates of maxillary sinusitis would still be sterile, as reported in earlier studies. *Staphylococcus aureus* is rarely isolated from sinus aspirates in children with acute bacterial sinusitis, and with the exception of acute maxillary sinusitis associated with infections of dental origin,[51] respiratory anaerobes are also rarely recovered.[40,52] Although *S aureus* is a very infrequent cause of acute bacterial sinusitis in children, it is a significant pathogen in the orbital and intracranial complications of sinusitis. The reasons for this discrepancy are unknown.

Antimicrobial susceptibility patterns for *S pneumoniae* vary considerably from community to community. Isolates obtained from surveillance centers nationwide indicate that, at the present time, 10% to 15% of upper respiratory tract isolates of *S pneumoniae* are nonsusceptible to penicillin[53,54]; however, values for penicillin nonsusceptibility as high as 50% to 60% have been reported in some areas.[55,56] Of the organisms that are resistant, approximately half are highly resistant to penicillin and the remaining half are intermediate in resistance. [53,54,56–59] Between 10% and 42% of *H influenzae*[56–59] and close to 100% of *M catarrhalis* are likely to be β-lactamase positive and nonsusceptible to amoxicillin. Because of dramatic geographic variability in the prevalence of β-lactamase–positive *H influenzae*, it is extremely desirable for the practitioner to be familiar with local patterns of susceptibility. Risk factors for the presence of organisms

likely to be resistant to amoxicillin include attendance at child care, receipt of antimicrobial treatment within the previous 30 days, and age younger than 2 years.[50,55,60]

Amoxicillin remains the antimicrobial agent of choice for first-line treatment of uncomplicated acute bacterial sinusitis in situations in which antimicrobial resistance is not suspected. This recommendation is based on amoxicillin's effectiveness, safety, acceptable taste, low cost, and relatively narrow microbiologic spectrum. For children aged 2 years or older with uncomplicated acute bacterial sinusitis that is mild to moderate in degree of severity who do not attend child care and who have not been treated with an antimicrobial agent within the last 4 weeks, amoxicillin is recommended at a standard dose of 45 mg/kg per day in 2 divided doses. In communities with a high prevalence of nonsusceptible *S pneumoniae* (>10%, including intermediate- and high-level resistance), treatment may be initiated at 80 to 90 mg/kg per day in 2 divided doses, with a maximum of 2 g per dose.[55] This high-dose amoxicillin therapy is likely to achieve sinus fluid concentrations that are adequate to overcome the resistance of *S pneumoniae,* which is attributable to alteration in penicillin-binding proteins on the basis of data derived from patients with AOM.[61] If, within the next several years after licensure of PCV-13, a continuing decrease in isolates of *S pneumoniae* (including a decrease in isolates of nonsusceptible *S pneumoniae)* and an increase in β-lactamase–producing *H influenzae* are observed, standard-dose amoxicillin-clavulanate (45 mg/kg per day) may be most appropriate.

Patients presenting with moderate to severe illness as well as those younger than 2 years, attending child care, or who have recently been treated with an antimicrobial may receive high-dose amoxicillin-clavulanate (80–90 mg/kg per day of the amoxicillin component with 6.4 mg/kg per day of clavulanate in 2 divided doses with a maximum of 2 g per dose). The potassium clavulanate levels are adequate to inhibit all β-lactamase–producing *H influenzae* and *M catarrhalis*.[56,59]

A single 50-mg/kg dose of ceftriaxone, given either intravenously or intramuscularly, can be used for children who are vomiting, unable to tolerate oral medication, or unlikely to be adherent to the initial doses of antibiotic.[62–64] The 3 major bacterial pathogens involved in acute bacterial sinusitis are susceptible to ceftriaxone in 95% to 100% of cases.[56,58,59] If clinical improvement is observed at 24 hours, an oral antibiotic can be substituted to complete the course of therapy. Children who are still significantly febrile or symptomatic at 24 hours may require additional parenteral doses before switching to oral therapy.

The treatment of patients with presumed allergy to penicillin has been controversial. However, recent publications indicate that the risk of a serious allergic reaction to second- and third-generation cephalosporins in patients with penicillin or amoxicillin allergy appears to be almost nil and no greater than the risk among patients without such allergy.[65–67] Thus, patients allergic to amoxicillin with a non–type 1 (late or delayed, >72 hours) hypersensitivity reaction can safely be treated with cefdinir, cefuroxime, or cefpodoxime.[66–68] Patients with a history of a serious type 1 immediate or accelerated (anaphylactoid) reaction to amoxicillin can also safely be treated with cefdinir, cefuroxime, or cefpodoxime. In both circumstances, clinicians may wish to determine individual tolerance by referral to an allergist for penicillin and/or cephalosporin skin-testing before initiation of therapy.[66–68] The susceptibility of *S pneumoniae* to cefdinir, cefpodoxime, and cefuroxime varies from 60% to 75%,[56–59] and the susceptibility of *H influenzae* to these agents varies from 85% to 100%.[56,58] In young children (<2 years) with a serious type 1 hypersensitivity to penicillin and moderate or more severe sinusitis, it may be prudent to use a combination of clindamycin (or linezolid) and cefixime to achieve the most comprehensive coverage against both resistant *S pneumoniae* and *H influenzae*. Linezolid has excellent activity against all *S pneumoniae*, including penicillin-resistant strains, but lacks activity against *H influenzae* and *M catarrhalis*. Alternatively, a quinolone, such as levofloxacin, which has a high level of activity against both *S pneumoniae* and *H influenzae*, may be prescribed.[57,58] Although the use of quinolones is usually restricted because of concerns for toxicity, cost, and emerging resistance, their use in this circumstance can be justified.

Pneumococcal and *H influenzae* surveillance studies have indicated that resistance of these organisms to trimethoprim-sulfamethoxazole and azithromycin is sufficient to preclude their use for treatment of acute bacterial sinusitis in patients with penicillin hypersensitivity.[56,58,59,69]

The optimal duration of antimicrobial therapy for patients with acute bacterial sinusitis has not received systematic study. Recommendations based on clinical observations have varied widely, from 10 to 28 days of treatment. An alternative suggestion has been made that antibiotic therapy be continued for 7 days after the patient becomes free of signs and symptoms.[5] This strategy has the advantage of individualizing the treatment of each patient, results in a minimum course of 10 days, and

avoids prolonged antimicrobial therapy in patients who are asymptomatic and therefore unlikely to adhere to the full course of treatment.[5]

Patients who are acutely ill and appear toxic when first seen (see below) can be managed with 1 of 2 options. Consultation can be requested from an otolaryngologist for consideration of maxillary sinus aspiration (with appropriate analgesia/anesthesia) to obtain a sample of sinus secretions for Gram stain, culture, and susceptibility testing so that antimicrobial therapy can be adjusted precisely. Alternatively, inpatient therapy can be initiated with intravenous cefotaxime or ceftriaxone, with referral to an otolaryngologist if the patient's condition worsens or fails to show improvement within 48 hours. If a complication is suspected, management will differ depending on the site and severity.

A recent guideline was published by the Infectious Diseases Society of America for acute bacterial rhinosinusitis in children and adults.[70] Their recommendation for initial empirical antimicrobial therapy for acute bacterial sinusitis in children was amoxicillin-clavulanate based on the concern that there is an increasing prevalence of *H influenzae* as a cause of sinusitis since introduction of the pneumococcal conjugate vaccines and an increasing prevalence of β-lactamase production among these strains. In contrast, this guideline from the AAP allows either amoxicillin or amoxicillin-clavulanate as first-line empirical therapy and is therefore inclusive of the Infectious Diseases Society of America's recommendation. Unfortunately, there are scant data available regarding the precise microbiology of acute bacterial sinusitis in the post–PCV-13 era. Prospective surveillance of nasopharyngeal cultures may be helpful in completely aligning these recommendations in the future.

Key Action Statement 5A

Clinicians should reassess initial management if there is either a caregiver report of worsening (progression of initial signs/symptoms or appearance of new signs/symptoms) OR failure to improve (lack of reduction in all presenting signs/symptoms) within 72 hours of initial management (Evidence Quality: C; Recommendation).

KAS Profile 5A

Aggregate evidence quality: C; observational studies	
Benefits	Identification of patients who may have been misdiagnosed, those at risk of complications, and those who require a change in management.
Harm	Delay of up to 72 hours in changing therapy if patient fails to improve.
Cost	Additional provider and caregiver time and resources.
Benefits-harm assessment	Preponderance of benefit.
Value judgments	Use of 72 hours to assess progress may result in excessive classification as treatment failures if premature; emphasis on importance of worsening illness in defining treatment failures.
Role of patient preferences	Caregivers determine whether the severity of the patient's illness justifies the report to clinician of the patient's worsening or failure to improve.
Intentional vagueness	None.
Exclusions	Patients with severe illness, poor general health, complicated sinusitis, immune deficiency, previous sinus surgery, or coexisting bacterial illness.
Strength	Recommendation.

The purpose of this key action statement is to ensure that patients with acute bacterial sinusitis who fail to improve symptomatically after initial management are reassessed to be certain that they have been correctly diagnosed and to consider initiation of alternate therapy to hasten resolution of symptoms and avoid complications. "Worsening" is defined as progression of presenting signs or symptoms of acute bacterial sinusitis or onset of new signs or symptoms. "Failure to improve" is lack of reduction in presenting signs or symptoms of acute bacterial sinusitis by 72 hours after diagnosis and initial management; patients with persistent but improving symptoms do not meet this definition.

The rationale for using 72 hours as the time to assess treatment failure for acute bacterial sinusitis is based on clinical outcomes in RCTs. Wald et al[41] found that 18 of 35 patients (51%) receiving placebo demonstrated symptomatic improvement within 3 days of initiation of treatment; only an additional 3 patients receiving placebo (9%) improved between days 3 and 10. In the same study, 48 of 58 patients (83%) receiving antibiotics were cured or improved within 3 days; at 10 days, the overall rate of improvement was 79%, suggesting that no additional patients improved between days 3 and 10. In a more recent study, 17 of 19 children who ultimately failed initial therapy with either antibiotic or placebo demonstrated failure to improve within 72 hours.[4] Although Garbutt et al[42] did not report the percentage of patients who improved by day 3, they did demonstrate that the majority of improvement in symptoms occurred within

the first 3 days of study entry whether they received active treatment or placebo.

Reporting of either worsening or failure to improve implies a shared responsibility between clinician and caregiver. Although the clinician should educate the caregiver regarding the anticipated reduction in symptoms within 3 days, it is incumbent on the caregiver to appropriately notify the clinician of concerns regarding worsening or failure to improve. Clinicians should emphasize the importance of reassessing those children whose symptoms are worsening whether or not antibiotic therapy was prescribed. Reassessment may be indicated before the 72-hour process by which such reporting occurs should be discussed at the time the initial management strategy is determined.

Key Action Statement 5B

If the diagnosis of acute bacterial sinusitis is confirmed in a child with worsening symptoms or failure to improve in 72 hours, then clinicians may change the antibiotic therapy for the child initially managed with antibiotic OR initiate antibiotic treatment of the child initially managed with observation (Evidence Quality: D; Option based on expert opinion, case reports, and reasoning from first principles).

KAS Profile 5B

Aggregate evidence quality: D; expert opinion and reasoning from first principles.	
Benefit	Prevention of complications, administration of effective therapy.
Harm	Adverse effects of secondary antibiotic therapy.
Cost	Direct cost of medications, often substantial for second-line agents.
Benefits-harm assessment	Preponderance of benefit.
Value judgments	Clinician must determine whether cost and adverse effects associated with change in antibiotic is justified given the severity of illness.
Role of patient preferences	Limited in patients whose symptoms are severe or worsening, but caregivers of mildly affected children who are failing to improve may reasonably defer change in antibiotic.
Intentional vagueness	None.
Exclusions	None.
Strength	Option.

mark if the patient is substantially worse, because it may indicate the development of complications or a need for parenteral therapy. Conversely, in some cases, caregivers may think that symptoms are not severe enough to justify a change to an antibiotic with a less desirable safety profile or even the time, effort, and resources required for reassessment. Accordingly, the circumstances under which caregivers report back to the clinician and the corresponds to the patient's pattern of illness, as defined in Key Action Statement 1. If caregivers report worsening of symptoms at any time in a patient for whom observation was the initial intervention, the clinician should begin treatment as discussed in Key Action Statement 4. For patients whose symptoms are mild and who have failed to improve but have not worsened, initiation of antimicrobial agents or continued observation (for up to 3 days) is reasonable.

The purpose of this key action statement is to ensure optimal antimicrobial treatment of children with acute bacterial sinusitis whose symptoms worsen or fail to respond to the initial intervention to prevent complications and reduce symptom severity and duration (see Table 4).

Clinicians who are notified by a caregiver that a child's symptoms are worsening or failing to improve should confirm that the clinical diagnosis of acute bacterial sinusitis

If caregivers report worsening of symptoms after 3 days in a patient initially treated with antimicrobial agents, current signs and symptoms should be reviewed to determine whether acute bacterial sinusitis is still the best diagnosis. If sinusitis is still the best diagnosis, infection with drug-resistant bacteria is probable, and an alternate antimicrobial agent may be administered. Face-to-face reevaluation of the patient is desirable. Once the decision is made to change medications, the clinician should consider the limitations of the initial antibiotic coverage, the anticipated susceptibility of residual bacterial pathogens, and the ability of antibiotics to adequately penetrate the site of infection. Cultures of sinus or nasopharyngeal secretions in patients with initial antibiotic failure have identified a large percentage of bacteria with resistance to the original antibiotic.[71,72] Furthermore, multidrug-resistant *S pneumoniae* and β-lactamase–positive *H influenzae* and *M catarrhalis* are more commonly isolated after previous antibiotic exposure.[73–78] Unfortunately, there are no studies in children that have investigated the microbiology of treatment failure in acute bacterial sinusitis or cure rates using second-line antimicrobial agents. As a result, the likelihood of adequate antibiotic coverage for resistant organisms must be

addressed by extrapolations from studies of acute otitis media in children and sinusitis in adults and by using the results of data generated in vitro. A general guide to management of the child who worsens in 72 hours is shown in Table 4.

NO RECOMMENDATION

Adjuvant Therapy

Potential adjuvant therapy for acute sinusitis might include intranasal corticosteroids, saline nasal irrigation or lavage, topical or oral decongestants, mucolytics, and topical or oral antihistamines. A recent Cochrane review on decongestants, antihistamines, and nasal irrigation for acute sinusitis in children found no appropriately designed studies to determine the effectiveness of these interventions.[79]

Intranasal Steroids

The rationale for the use of intranasal corticosteroids in acute bacterial sinusitis is that an antiinflammatory agent may reduce the swelling around the sinus ostia and encourage drainage, thereby hastening recovery. However, there are limited data on how much inflammation is present, whether the inflammation is responsive to steroids, and whether there are differences in responsivity according to age. Nonetheless, there are several RCTs in adolescents and adults, most of which do show significant differences compared with placebo or active comparator that favor intranasal steroids in the reduction of symptoms and the patient's global assessment of overall improvement.[80–85] Several studies in adults with acute bacterial sinusitis provide data supporting the use of intranasal steroids as either monotherapy or adjuvant therapy to antibiotics.[81,86] Only one study did not show efficacy.[85]

There have been 2 trials of intranasal steroids performed exclusively in children: one comparing intranasal corticosteroids versus an oral decongestant[87] and the other comparing intranasal corticosteroids with placebo.[88] These studies showed a greater rate of complete resolution[87] or greater reduction in symptoms in patients receiving the steroid preparation, although the effects were modest.[88] It is important to note that nearly all of these studies (both those reported in children and adults) suffered from substantial methodologic problems. Examples of these methodologic problems are as follows: (1) variable inclusion criteria for sinusitis, (2) mixed populations of allergic and nonallergic subjects, and (3) different outcome criteria. All of these factors make deriving a clear conclusion difficult. Furthermore, the lack of stringent criteria in selecting the subject population increases the chance that the subjects had viral URIs or even persistent allergies rather than acute bacterial sinusitis.

The intranasal steroids studied to date include budesonide, flunisolide, fluticasone, and mometasone. There is no reason to believe that one steroid would be more effective than another, provided equivalent doses are used.

Potential harm in using nasal steroids in children with acute sinusitis includes the increased cost of therapy, difficulty in effectively administering nasal sprays in young children, nasal irritation and epistaxis, and potential systemic adverse effects of steroid use. Fortunately, no clinically significant steroid adverse effects have been discovered in studies in children.[89–96]

Saline Irrigation

Saline nasal irrigation or lavage (not saline nasal spray) has been used to remove debris from the nasal cavity and temporarily reduce tissue edema (hypertonic saline) to promote drainage from the sinuses. There have been very few RCTs using saline nasal irrigation or lavage in acute sinusitis, and these have had mixed results.[97,98] The 1 study in children showed greater improvement in nasal airflow and quality of life as well as a better rate of improvement in total symptom score when compared with placebo in patients treated with antibiotics and decongestants.[98] There are 2 Cochrane reviews published on the use of saline nasal irrigation in acute sinusitis in adults that showed variable results. One review published in 2007[99] concluded that it is a beneficial adjunct, but the other, published in 2010,[100] concluded that most trials were too small or contained too high a risk of bias to be confident about benefits.

Nasal Decongestants, Mucolytics, and Antihistamines

Data are insufficient to make any recommendations about the use of oral or topical nasal decongestants, mucolytics, or oral or nasal spray antihistamines as adjuvant therapy for acute bacterial sinusitis in children.[79] It is the opinion of the expert panel that antihistamines should not be used for the primary indication of acute bacterial sinusitis in any child, although such therapy might be helpful in reducing typical allergic symptoms in patients with atopy who also have acute sinusitis.

OTHER RELATED CONDITIONS

Recurrence of Acute Bacterial Sinusitis

Recurrent acute bacterial sinusitis (RABS) is an uncommon occurrence in healthy children and must be distinguished from recurrent URIs, exacerbations of allergic rhinitis, and chronic sinusitis. The former is defined by episodes of bacterial infection of the paranasal sinuses lasting fewer than 30 days and separated by intervals of

TABLE 3 Parent Information Regarding Initial Management of Acute Bacterial Sinusitis

How common are sinus infections in children?	Thick, colored, or cloudy mucus from your child's nose frequently occurs with a common cold or viral infection and does not by itself mean your child has sinusitis. In fact, fewer than 1 in 15 children get a true bacterial sinus infection during or after a common cold.
How can I tell if my child has bacterial sinusitis or simply a common cold?	Most colds have a runny nose with mucus that typically starts out clear, becomes cloudy or colored, and improves by about 10 d. Some colds will also include fever (temperature >38°C [100.4°F]) for 1 to 2 days. In contrast, acute bacterial sinusitis is likely when the pattern of illness is persistent, severe, or worsening. 1. *Persistent* sinusitis is the most common type, defined as runny nose (of any quality), daytime cough (which may be worse at night), or both for at least 10 days without improvement. 2. *Severe* sinusitis is present when fever (temperature ≥39°C [102.2°F]) lasts for at least 3 days in a row and is accompanied by nasal mucus that is thick, colored, or cloudy. 3. *Worsening* sinusitis starts with a viral cold, which begins to improve but then worsens when bacteria take over and cause new-onset fever (temperature ≥38°C [100.4°F]) or a substantial increase in daytime cough or runny nose.
If my child has sinusitis, should he or she take an antibiotic?	Children with *persistent* sinusitis may be managed with either an antibiotic or with an additional brief period of observation, allowing the child up to another 3 days to fight the infection and improve on his or her own. The choice to treat or observe should be discussed with your doctor and may be based on your child's quality of life and how much of a problem the sinusitis is causing. In contrast, all children diagnosed with *severe* or *worsening* sinusitis should start antibiotic treatment to help them recover faster and more often.
Why not give all children with acute bacterial sinusitis an immediate antibiotic?	Some episodes of *persistent* sinusitis include relatively mild symptoms that may improve on their own in a few days. In addition, antibiotics can have adverse effects, which may include vomiting, diarrhea, upset stomach, skin rash, allergic reactions, yeast infections, and development of resistant bacteria (that make future infections more difficult to treat).

at least 10 days during which the patient is asymptomatic. Some experts require at least 4 episodes in a calendar year to fulfill the criteria for this condition. Chronic sinusitis is manifest as 90 or more uninterrupted days of respiratory symptoms, such as cough, nasal discharge, or nasal obstruction.

Children with RABS should be evaluated for underlying allergies, particularly allergic rhinitis; quantitative and functional immunologic defect(s), chiefly immunoglobulin A and immunoglobulin G deficiency; cystic fibrosis; gastroesophageal reflux disease; or dysmotile cilia syndrome.[101] Anatomic abnormalities obstructing one or more sinus ostia may be present. These include septal deviation, nasal polyps, or concha bullosa (pneumatization of the middle turbinate); atypical ethmoid cells with compromised drainage; a lateralized middle turbinate; and intrinsic ostiomeatal anomalies.[102] Contrast-enhanced CT, MRI, or endoscopy or all 3 should be performed for detection of obstructive conditions, particularly in children with genetic or acquired craniofacial abnormalities.

The microbiology of RABS is similar to that of isolated episodes of acute bacterial sinusitis and warrants the same treatment.[72] It should be recognized that closely spaced sequential courses of antimicrobial therapy may foster the emergence of antibiotic-resistant bacterial species as the causative agent in recurrent episodes. There are no systematically evaluated options for prevention of RABS in children. In general, the use of prolonged prophylactic antimicrobial therapy should be avoided and is not usually recommended for children with recurrent acute otitis media. However, when there are no recognizable predisposing conditions to remedy in children with RABS, prophylactic antimicrobial agents may be used for several months during the respiratory season. Enthusiasm for this strategy is tempered by concerns regarding the encouragement of bacterial resistance. Accordingly, prophylaxis should only be considered in carefully selected children whose infections have been thoroughly documented.

Influenza vaccine should be administered annually, and PCV-13 should be administered at the recommended ages for all children, including those with RABS. Intranasal steroids and nonsedating antihistamines can be helpful for children with allergic rhinitis, as can antireflux medications for those with gastroesophageal reflux disease. Children with anatomic abnormalities may require endoscopic surgery for removal of or reduction in ostiomeatal obstruction.

The pathogenesis of chronic sinusitis is poorly understood and appears to be multifactorial; however, many of the conditions associated with RABS

TABLE 4 Management of Worsening or Lack of Improvement at 72 Hours

Initial Management	Worse in 72 Hours	Lack of Improvement in 72 Hours
Observation	Initiate amoxicillin with or without clavulanate	Additional observation or initiate antibiotic based on shared decision-making
Amoxicillin	High-dose amoxicillin-clavulanate	Additional observation or high-dose amoxicillin-clavulanate based on shared decision-making
High-dose amoxicillin-clavulanate	Clindamycin[a] and cefixime OR linezolid and cefixime OR levofloxacin	Continued high-dose amoxicillin-clavulanate OR clindamycin[a] and cefixime OR linezolid and cefixime OR levofloxacin

[a] Clindamycin is recommended to cover penicillin-resistant *S pneumoniae*. Some communities have high levels of clindamycin-resistant *S pneumoniae*. In these communities, linezolid is preferred.

have also been implicated in chronic sinusitis, and it is clear that there is an overlap between the 2 syndromes.[101,102] In some cases, there may be episodes of acute bacterial sinusitis superimposed on a chronic sinusitis, warranting antimicrobial therapy to hasten resolution of the acute infection.

Complications of Acute Bacterial Sinusitis

Complications of acute bacterial sinusitis should be diagnosed when the patient develops signs or symptoms of orbital and/or central nervous system (intracranial) involvement. Rarely, complicated acute bacterial sinusitis can result in permanent blindness, other neurologic sequelae, or death if not treated promptly and appropriately. Orbital complications have been classified by Chandler et al.[32] Intracranial complications include epidural or subdural abscess, brain abscess, venous thrombosis, and meningitis.

Periorbital and intraorbital inflammation and infection are the most common complications of acute sinusitis and most often are secondary to acute ethmoiditis in otherwise healthy young children. These disorders are commonly classified in relation to the orbital septum; periorbital or preseptal inflammation involves only the eyelid, whereas postseptal (intraorbital) inflammation involves structures of the orbit. Mild cases of preseptal cellulitis (eyelid <50% closed) may be treated on an outpatient basis with appropriate oral antibiotic therapy (high-dose amoxicillin-clavulanate for comprehensive coverage) for acute bacterial sinusitis and daily follow-up until definite improvement is noted. If the patient does not improve within 24 to 48 hours or if the infection is progressive, it is appropriate to admit the patient to the hospital for antimicrobial therapy. Similarly, if proptosis, impaired visual acuity, or impaired and/or painful extraocular mobility is present on examination, the patient should be hospitalized, and a contrast-enhanced CT should be performed. Consultation with an otolaryngologist, an ophthalmologist, and an infectious disease expert is appropriate for guidance regarding the need for surgical intervention and the selection of antimicrobial agents.

Intracranial complications are most frequently encountered in previously healthy adolescent males with frontal sinusitis.[33,34] In patients with altered mental status, severe headache, or Pott's puffy tumor (osteomyelitis of the frontal bone), neurosurgical consultation should be obtained. A contrast-enhanced CT scan (preferably coronal thin cut) of the head, orbits, and sinuses is essential to confirm intracranial or intraorbital suppurative complications; in such cases, intravenous antibiotics should be started immediately. Alternatively, an MRI may also be desirable in some cases of intracranial abnormality. Appropriate antimicrobial therapy for intraorbital complications include vancomycin (to cover possible methicillin-resistant *S aureus* or penicillin-resistant *S pneumoniae*) and either ceftriaxone, ampicillin-sulbactam, or piperacillin-tazobactam.[103] Given the polymicrobial nature of sinogenic abscesses, coverage for anaerobes (ie, metronidazole) should also be considered for intraorbital complications and should be started in all cases of intracranial complications if ceftriaxone is prescribed.

Patients with small orbital, subperiosteal, or epidural abscesses and minimal ocular and neurologic abnormalities may be managed with intravenous antibiotic treatment for 24 to 48 hours while performing frequent visual and mental status checks.[104] In patients who develop progressive signs and symptoms, such as impaired visual acuity, ophthalmoplegia, elevated intraocular pressure (>20 mm), severe proptosis (>5 mm), altered mental status, headache, or vomiting, as well as those who fail to improve within 24 to 48 hours while receiving antibiotics, prompt surgical intervention and drainage of the abscess should be undertaken.[104] Antibiotics can be tailored to the results of culture and sensitivity studies when they become available.

AREAS FOR FUTURE RESEARCH

Since the publication of the original guideline in 2001, only a small number of high-quality studies of the diagnosis and treatment of acute bacterial sinusitis in children have been published.[5] Ironically, the number of published guidelines on the topic (5) exceeds the number of prospective,

placebo-controlled clinical trials of either antibiotics or ancillary treatments of acute bacterial sinusitis. Thus, as was the case in 2001, there are scant data on which to base recommendations. Accordingly, areas for future research include the following:

Etiology

1. Reexamine the microbiology of acute sinusitis in children in the postpneumococcal conjugate vaccine era and determine the value of using newer polymerase chain reaction–based respiratory testing to document viral, bacterial, and polymicrobial disease.
2. Correlate cultures obtained from the middle meatus of the maxillary sinus of infected children with cultures obtained from the maxillary sinus by puncture of the antrum.
3. Conduct more and larger studies to more clearly define and correlate the clinical findings with the various available diagnostic criteria of acute bacterial sinusitis (eg, sinus aspiration and treatment outcome).
4. Develop noninvasive strategies to accurately diagnose acute bacterial sinusitis in children.
5. Develop imaging technology that differentiates bacterial infection from viral infection or allergic inflammation, preferably without radiation.

Treatment

1. Determine the optimal duration of antimicrobial therapy for children with acute bacterial sinusitis.
2. Evaluate a "wait-and-see prescription" strategy for children with persistent symptom presentation of acute sinusitis.
3. Determine the optimal antimicrobial agent for children with acute bacterial sinusitis, balancing the incentives of choosing narrow-spectrum agents against the known microbiology of the disease and resistance patterns of likely pathogens.
4. Determine the causes and treatment of subacute, recurrent acute, and chronic bacterial sinusitis.
5. Determine the efficacy of prophylaxis with antimicrobial agents to prevent RABS.
6. Determine the effects of bacterial resistance among *S pneumoniae*, *H influenzae*, and *M catarrhalis* on outcome of treatment with antibiotics by the performance of randomized, double-blind, placebo-controlled studies in well-defined populations of patients.
7. Determine the role of adjuvant therapies (antihistamines, nasal corticosteroids, mucolytics, decongestants, nasal irrigation, etc) in patients with acute bacterial sinusitis by the performance of prospective, randomized clinical trials.
8. Determine whether early treatment of acute bacterial sinusitis prevents orbital or central nervous system complications.
9. Determine the role of complementary and alternative medicine strategies in patients with acute bacterial sinusitis by performing systematic, prospective, randomized clinical trials.
10. Develop new bacterial and viral vaccines to reduce the incidence of acute bacterial sinusitis.

SUBCOMMITTEE ON ACUTE SINUSITIS

Ellen R. Wald, MD, FAAP (Chair, Pediatric Infectious Disease Physician: no financial conflicts; published research related to sinusitis)
Kimberly E. Applegate, MD, MS, FAAP (Radiologist, AAP Section on Radiology: no conflicts)
Clay Bordley, MD, MPH, FAAP (Pediatric Emergency and Hospitalist Medicine physician: no conflicts)
David H. Darrow, MD, FAAP (Otolaryngologist, AAP Section on Otolaryngology–Head and Neck Surgery: no conflicts)
Mary P. Glode, MD, FAAP (Pediatric Infectious Disease Physician, AAP Committee on Infectious Disease: no conflicts)
S. Michael Marcy, MD, FAAP (General Pediatrician with Infectious Disease Expertise, AAP Section on Infectious Diseases: no conflicts)
Nader Shaikh, MD, FAAP (General Academic Pediatrician: no financial conflicts; published research related to sinusitis)
Michael J. Smith, MD, MSCE, FAAP (Epidemiologist, Pediatric Infectious Disease Physician: research funding for vaccine clinical trials from Sanofi Pasteur and Novartis)
Paul V. Williams, MD, FAAP (Allergist, AAP Section on Allergy, Asthma, and Immunology: no conflicts)
Stuart T. Weinberg, MD, FAAP (PPI Informatician, General Academic Pediatrician: no conflicts)
Carrie E. Nelson, MD, MS (Family Physician, American Academy of Family Physicians: employed by McKesson Health Solutions)
Richard M. Rosenfeld, MD, MPH, FAAP (Otolaryngologist, AAP Section on Otolaryngology–Head and Neck Surgery, American Academy of Otolaryngology–Head and Neck Surgery: no financial conflicts; published research related to sinusitis)

CONSULTANT

Richard N. Shiffman, MD, FAAP (Informatician, Guideline Methodologist, General Academic Pediatrician: no conflicts)

STAFF

Caryn Davidson, MA

REFERENCES

1. Aitken M, Taylor JA. Prevalence of clinical sinusitis in young children followed up by primary care pediatricians. *Arch Pediatr Adolesc Med.* 1998;152(3):244–248
2. Kakish KS, Mahafza T, Batieha A, Ekteish F, Daoud A. Clinical sinusitis in children attending primary care centers. *Pediatr Infect Dis J.* 2000;19(11):1071–1074
3. Ueda D, Yoto Y. The ten-day mark as a practical diagnostic approach for acute paranasal sinusitis in children. *Pediatr Infect Dis J.* 1996;15(7):576–579

4. Wald ER, Nash D, Eickhoff J. Effectiveness of amoxicillin/clavulanate potassium in the treatment of acute bacterial sinusitis in children. *Pediatrics*. 2009;124(1):9–15
5. American Academy of Pediatrics, Subcommittee on Management of Sinusitis and Committee on Quality Improvement. Clinical practice guideline: management of sinusitis. *Pediatrics*. 2001;108(3):798–808
6. Smith MJ. AAP technical report: evidence for the diagnosis and treatment of acute uncomplicated sinusitis in children: a systematic review. 2013, In press.
7. Shiffman RN, Michel G, Rosenfeld RM, Davidson C. Building better guidelines with BRIDGE-Wiz: development and evaluation of a software assistant to promote clarity, transparency, and implementability. *J Am Med Inform Assoc*. 2012;19 (1):94–101
8. American Academy of Pediatrics, Steering Committee on Quality Improvement and Management. Classifying recommendations for clinical practice guidelines. *Pediatrics*. 2004;114(3):874–877
9. Gwaltney JM, Jr, Hendley JO, Simon G, Jordan WS Jr. Rhinovirus infections in an industrial population. II. Characteristics of illness and antibody response. *JAMA*. 1967;202(6):494–500
10. Pappas DE, Hendley JO, Hayden FG, Winther B. Symptom profile of common colds in school-aged children. *Pediatr Infect Dis J*. 2008;27(1):8–11
11. Wald ER, Guerra N, Byers C. Frequency and severity of infections in day care: three-year follow-up. *J Pediatr*. 1991;118(4 pt 1): 509–514
12. Wald ER, Guerra N, Byers C. Upper respiratory tract infections in young children: duration of and frequency of complications. *Pediatrics*. 1991;87(2):129–133
13. Meltzer EO, Hamilos DL, Hadley JA, et al. Rhinosinusitis: establishing definitions for clinical research and patient care. *J Allergy Clin Immunol*. 2004;114(6 suppl): 155–212
14. Shaikh N, Wald ER. Signs and symptoms of acute sinusitis in children. *Pediatr Infect Dis J*. 2013; in press
15. Wald ER. The diagnosis and management of sinusitis in children: diagnostic considerations. *Pediatr Infect Dis*. 1985;4(6 suppl):S61–S64
16. Wald ER, Milmoe GJ, Bowen A, Ledesma-Medina J, Salamon N, Bluestone CD. Acute maxillary sinusitis in children. *N Engl J Med*. 1981;304(13):749–754
17. Lindbaek M, Hjortdahl P, Johnsen UL. Use of symptoms, signs, and blood tests to diagnose acute sinus infections in primary care: comparison with computed tomography. *Fam Med*. 1996;28(3):183–188
18. Wald ER. Beginning antibiotics for acute rhinosinusitis and choosing the right treatment. *Clin Rev Allergy Immunol*. 2006; 30(3):143–152
19. Maresh MM, Washburn AH. Paranasal sinuses from birth to late adolescence. II. Clinical and roentgenographic evidence of infection. *Am J Dis Child*. 1940;60:841–861
20. Glasier CM, Mallory GB, Jr, Steele RW. Significance of opacification of the maxillary and ethmoid sinuses in infants. *J Pediatr*. 1989;114(1):45–50
21. Kovatch AL, Wald ER, Ledesma-Medina J, Chiponis DM, Bedingfield B. Maxillary sinus radiographs in children with nonrespiratory complaints. *Pediatrics*. 1984; 73(3):306–308
22. Shopfner CE, Rossi JO. Roentgen evaluation of the paranasal sinuses in children. *Am J Roentgenol Radium Ther Nucl Med*. 1973;118(1):176–186
23. Diament MJ, Senac MO, Jr, Gilsanz V, Baker S, Gillespie T, Larsson S. Prevalence of incidental paranasal sinuses opacification in pediatric patients: a CT study. *J Comput Assist Tomogr*. 1987;11(3):426–431
24. Glasier CM, Ascher DP, Williams KD. Incidental paranasal sinus abnormalities on CT of children: clinical correlation. *AJNR Am J Neuroradiol*. 1986;7(5):861–864
25. Gwaltney JM, Jr, Phillips CD, Miller RD, Riker DK. Computed tomographic study of the common cold. *N Engl J Med*. 1994;330 (1):25–30
26. Manning SC, Biavati MJ, Phillips DL. Correlation of clinical sinusitis signs and symptoms to imaging findings in pediatric patients. *Int J Pediatr Otorhinolaryngol*. 1996;37(1):65–74
27. Gordts F, Clement PA, Destryker A, Desprechins B, Kaufman L. Prevalence of sinusitis signs on MRI in a non-ENT paediatric population. *Rhinology*. 1997;35(4): 154–157
28. Kristo A, Uhari M, Luotonen J, et al. Paranasal sinus findings in children during respiratory infection evaluated with magnetic resonance imaging. *Pediatrics*. 2003;111(5 pt 1):e586–e589
29. Brook I. Microbiology and antimicrobial treatment of orbital and intracranial complications of sinusitis in children and their management. *Int J Pediatr Otorhinolaryngol*. 2009;73(9):1183–1186
30. Sultesz M, Csakanyi Z, Majoros T, Farkas Z, Katona G. Acute bacterial rhinosinusitis and its complications in our pediatric otolaryngological department between 1997 and 2006. *Int J Pediatr Otorhinolaryngol*. 2009;73(11):1507–1512
31. Wald ER. Periorbital and orbital infections. *Infect Dis Clin North Am*. 2007;21(2):393–408
32. Chandler JR, Langenbrunner DJ, Stevens ER. The pathogenesis of orbital complications in acute sinusitis. *Laryngoscope*. 1970;80(9):1414–1428
33. Kombogiorgas D, Seth R, Modha J, Singh J. Suppurative intracranial complications of sinusitis in adolescence. Single institute experience and review of the literature. *Br J Neurosurg*. 2007;21(6):603–609
34. Rosenfeld EA, Rowley AH. Infectious intracranial complications of sinusitis, other than meningitis in children: 12 year review. *Clin Infect Dis*. 1994;18(5):750–754
35. American College of Radiology. Appropriateness criteria for sinonasal disease. 2009. Available at: www.acr.org/~/media/8172B4DE503149248E64856857674BB5.pdf. Accessed November 6, 2012
36. Triulzi F, Zirpoli S. Imaging techniques in the diagnosis and management of rhinosinusitis in children. *Pediatr Allergy Immunol*. 2007;18(suppl 18):46–49
37. McIntosh D, Mahadevan M. Failure of contrast enhanced computed tomography scans to identify an orbital abscess. The benefit of magnetic resonance imaging. *J Laryngol Otol*. 2008;122(6):639–640
38. Younis RT, Anand VK, Davidson B. The role of computed tomography and magnetic resonance imaging in patients with sinusitis with complications. *Laryngoscope*. 2002;112(2):224–229
39. Shapiro DJ, Gonzales R, Cabana MD, Hersh AL. National trends in visit rates and antibiotic prescribing for children with acute sinusitis. *Pediatrics*. 2011;127(1): 28–34
40. Wald ER, Reilly JS, Casselbrant M, et al. Treatment of acute maxillary sinusitis in childhood: a comparative study of amoxicillin and cefaclor. *J Pediatr*. 1984;104(2): 297–302
41. Wald ER, Chiponis D, Ledesma-Medina J. Comparative effectiveness of amoxicillin and amoxicillin-clavulanate potassium in acute paranasal sinus infections in children: a double-blind, placebo-controlled trial. *Pediatrics*. 1986;77(6):795–800
42. Garbutt JM, Goldstein M, Gellman E, Shannon W, Littenberg B. A randomized, placebo-controlled trial of antimicrobial treatment for children with clinically diagnosed acute sinusitis. *Pediatrics*. 2001; 107(4):619–625

43. Kristo A, Uhari M, Luotonen J, Ilkko E, Koivunen P, Alho OP. Cefuroxime axetil versus placebo for children with acute respiratory infection and imaging evidence of sinusitis: a randomized, controlled trial. *Acta Paediatr*. 2005;94(9): 1208–1213
44. Hoberman A, Paradise JL, Rockette HE, et al. Treatment of acute otitis media in children under 2 years of age. *N Engl J Med*. 2011;364(2):105–115
45. Tahtinen PA, Laine MK, Huovinen P, Jalava J, Ruuskanen O, Ruohola A. A placebo-controlled trial of antimicrobial treatment for acute otitis media. *N Engl J Med*. 2011;364(2):116–126
46. Gordts F, Abu Nasser I, Clement PA, Pierard D, Kaufman L. Bacteriology of the middle meatus in children. *Int J Pediatr Otorhinolaryngol*. 1999;48(2):163–167
47. Parsons DS, Wald ER. Otitis media and sinusitis: similar diseases. *Otolaryngol Clin North Am*. 1996;29(1):11–25
48. Revai K, Dobbs LA, Nair S, Patel JA, Grady JJ, Chonmaitree T. Incidence of acute otitis media and sinusitis complicating upper respiratory tract infection: the effect of age. *Pediatrics*. 2007;119(6). Available at: www.pediatrics.org/cgi/content/full/119/6/e1408
49. Klein JO, Bluestone CD. *Textbook of Pediatric Infectious Diseases*. 6th ed. Philadelphia, PA: Saunders; 2009
50. Casey JR, Adlowitz DG, Pichichero ME. New patterns in the otopathogens causing acute otitis media six to eight years after introduction of pneumococcal conjugate vaccine. *Pediatr Infect Dis J*. 2010;29(4): 304–309
51. Brook I, Gober AE. Frequency of recovery of pathogens from the nasopharynx of children with acute maxillary sinusitis before and after the introduction of vaccination with the 7-valent pneumococcal vaccine. *Int J Pediatr Otorhinolaryngol*. 2007;71(4):575–579
52. Wald ER. Microbiology of acute and chronic sinusitis in children. *J Allergy Clin Immunol*. 1992;90(3 pt 2):452–456
53. Centers for Disease Control and Prevention. Effects of new penicillin susceptibility breakpoints for *Streptococcus pneumoniae*—United States, 2006-2007. *MMWR Morb Mortal Wkly Rep*. 2008;57 (50):1353–1355
54. Centers for Disease Control and Prevention. Active Bacterial Core Surveillance (ABCs): Emerging Infections Program Network. 2011. Available at: www.cdc.gov/abcs/reports-findings/survreports/spneu09.html. Accessed November 6, 2012
55. Garbutt J, St Geme JW, III, May A, Storch GA, Shackelford PG. Developing community-specific recommendations for first-line treatment of acute otitis media: is high-dose amoxicillin necessary? *Pediatrics*. 2004;114(2):342–347
56. Harrison CJ, Woods C, Stout G, Martin B, Selvarangan R. Susceptibilities of *Haemophilus influenzae, Streptococcus pneumoniae*, including serotype 19A, and *Moraxella catarrhalis* paediatric isolates from 2005 to 2007 to commonly used antibiotics. *J Antimicrob Chemother*. 2009; 63(3):511–519
57. Critchley IA, Jacobs MR, Brown SD, Traczewski MM, Tillotson GS, Janjic N. Prevalence of serotype 19A Streptococcus pneumoniae among isolates from U.S. children in 2005-2006 and activity of faropenem. *Antimicrob Agents Chemother*. 2008;52(7):2639–2643
58. Jacobs MR, Good CE, Windau AR, et al. Activity of ceftaroline against recent emerging serotypes of *Streptococcus pneumoniae* in the United States. *Antimicrob Agents Chemother*. 2010;54(6):2716–2719
59. Tristram S, Jacobs MR, Appelbaum PC. Antimicrobial resistance in *Haemophilus influenzae*. *Clin Microbiol Rev*. 2007;20(2): 368–389
60. Levine OS, Farley M, Harrison LH, Lefkowitz L, McGeer A, Schwartz B. Risk factors for invasive pneumococcal disease in children: a population-based case-control study in North America. *Pediatrics*. 1999; 103(3). Available at: www.pediatrics.org/cgi/content/full/103/3/e28
61. Seikel K, Shelton S, McCracken GH Jr. Middle ear fluid concentrations of amoxicillin after large dosages in children with acute otitis media. *Pediatr Infect Dis J*. 1997;16(7):710–711
62. Cohen R, Navel M, Grunberg J, et al. One dose ceftriaxone vs. ten days of amoxicillin/clavulanate therapy for acute otitis media: clinical efficacy and change in nasopharyngeal flora. *Pediatr Infect Dis J*. 1999;18(5):403–409
63. Green SM, Rothrock SG. Single-dose intramuscular ceftriaxone for acute otitis media in children. *Pediatrics*. 1993;91(1): 23–30
64. Leibovitz E, Piglansky L, Raiz S, Press J, Leiberman A, Dagan R. Bacteriologic and clinical efficacy of one day vs. three day intramuscular ceftriaxone for treatment of nonresponsive acute otitis media in children. *Pediatr Infect Dis J*. 2000;19(11): 1040–1045
65. DePestel DD, Benninger MS, Danziger L, et al. Cephalosporin use in treatment of patients with penicillin allergies. *J Am Pharm Assoc*. 2008;48(4):530–540
66. Pichichero ME. A review of evidence supporting the American Academy of Pediatrics recommendation for prescribing cephalosporin antibiotics for penicillin-allergic patients. *Pediatrics*. 2005;115(4): 1048–1057
67. Pichichero ME, Casey JR. Safe use of selected cephalosporins in penicillin-allergic patients: a meta-analysis. *Otolaryngol Head Neck Surg*. 2007;136(3): 340–347
68. Park MA, Koch CA, Klemawesch P, Joshi A, Li JT. Increased adverse drug reactions to cephalosporins in penicillin allergy patients with positive penicillin skin test. *Int Arch Allergy Immunol*. 2010;153(3): 268–273
69. Jacobs MR. Antimicrobial-resistant Streptococcus pneumoniae: trends and management. *Expert Rev Anti Infect Ther*. 2008; 6(5):619–635
70. Chow AW, Benninger MS, Brook I, et al; Infectious Diseases Society of America. IDSA clinical practice guideline for acute bacterial rhinosinusitis in children and adults. *Clin Infect Dis*. 2012;54(8):e72–e112
71. Brook I, Gober AE. Resistance to antimicrobials used for therapy of otitis media and sinusitis: effect of previous antimicrobial therapy and smoking. *Ann Otol Rhinol Laryngol*. 1999;108(7 pt 1):645–647
72. Brook I, Gober AE. Antimicrobial resistance in the nasopharyngeal flora of children with acute maxillary sinusitis and maxillary sinusitis recurring after amoxicillin therapy. *J Antimicrob Chemother*. 2004;53(2):399–402
73. Dohar J, Canton R, Cohen R, Farrell DJ, Felmingham D. Activity of telithromycin and comparators against bacterial pathogens isolated from 1,336 patients with clinically diagnosed acute sinusitis. *Ann Clin Microbiol Antimicrob*. 2004;3(3): 15–21
74. Jacobs MR, Bajaksouzian S, Zilles A, Lin G, Pankuch GA, Appelbaum PC. Susceptibilities of *Streptococcus pneumoniae* and *Haemophilus influenzae* to 10 oral antimicrobial agents based on pharmacodynamic parameters: 1997 U.S. surveillance study. *Antimicrob Agents Chemother*. 1999;43(8):1901–1908
75. Jacobs MR, Felmingham D, Appelbaum PC, Gruneberg RN. The Alexander Project 1998-2000: susceptibility of pathogens isolated from community-acquired respiratory tract infection to commonly used antimicrobial agents. *J Antimicrob Chemother*. 2003;52(2):229–246

76. Lynch JP, III, Zhanel GG. *Streptococcus pneumoniae*: epidemiology and risk factors, evolution of antimicrobial resistance, and impact of vaccines. *Curr Opin Pulm Med.* 2010;16(3):217–225
77. Sahm DF, Jones ME, Hickey ML, Diakun DR, Mani SV, Thornsberry C. Resistance surveillance of *Streptococcus pneumoniae, Haemophilus influenzae* and *Moraxella catarrhalis* isolated in Asia and Europe, 1997-1998. *J Antimicrob Chemother.* 2000; 45(4):457–466
78. Sokol W. Epidemiology of sinusitis in the primary care setting: results from the 1999-2000 respiratory surveillance program. *Am J Med.* 2001;111(suppl 9A):19S–24S
79. Shaikh N, Wald ER, Pi M. Decongestants, antihistamines and nasal irrigation for acute sinusitis in children. *Cochrane Database Syst Rev.* 2010;(12):CD007909
80. Dolor RJ, Witsell DL, Hellkamp AS, Williams JW, Jr, Califf RM, Simel DL. Comparison of cefuroxime with or without intranasal fluticasone for the treatment of rhinosinusitis. The CAFFS Trial: a randomized controlled trial. *JAMA.* 2001;286(24):3097–3105
81. Meltzer EO, Bachert C, Staudinger H. Treating acute rhinosinusitis: comparing efficacy and safety of mometasone furoate nasal spray, amoxicillin, and placebo. *J Allergy Clin Immunol.* 2005;116(6):1289–1295
82. Meltzer EO, Charous BL, Busse WW, Zinreich SJ, Lorber RR, Danzig MR. Added relief in the treatment of acute recurrent sinusitis with adjunctive mometasone furoate nasal spray. The Nasonex Sinusitis Group. *J Allergy Clin Immunol.* 2000;106 (4):630–637
83. Meltzer EO, Orgel HA, Backhaus JW, et al. Intranasal flunisolide spray as an adjunct to oral antibiotic therapy for sinusitis. *J Allergy Clin Immunol.* 1993;92(6):812–823
84. Nayak AS, Settipane GA, Pedinoff A, et al. Effective dose range of mometasone furoate nasal spray in the treatment of acute rhinosinusitis. *Ann Allergy Asthma Immunol.* 2002;89(3):271–278
85. Williamson IG, Rumsby K, Benge S, et al. Antibiotics and topical nasal steroid for treatment of acute maxillary sinusitis: a randomized controlled trial. *JAMA.* 2007; 298(21):2487–2496
86. Zalmanovici A, Yaphe J. Intranasal steroids for acute sinusitis. *Cochrane Database Syst Rev.* 2009;(4):CD005149
87. Yilmaz G, Varan B, Yilmaz T, Gurakan B. Intranasal budesonide spray as an adjunct to oral antibiotic therapy for acute sinusitis in children. *Eur Arch Otorhinolaryngol.* 2000;257(5):256–259
88. Barlan IB, Erkan E, Bakir M, Berrak S, Basaran MM. Intranasal budesonide spray as an adjunct to oral antibiotic therapy for acute sinusitis in children. *Ann Allergy Asthma Immunol.* 1997;78(6):598–601
89. Bruni FM, De Luca G, Venturoli V, Boner AL. Intranasal corticosteroids and adrenal suppression. *Neuroimmunomodulation.* 2009;16 (5):353–362
90. Kim KT, Rabinovitch N, Uryniak T, Simpson B, O'Dowd L, Casty F. Effect of budesonide aqueous nasal spray on hypothalamic-pituitary-adrenal axis function in children with allergic rhinitis. *Ann Allergy Asthma Immunol.* 2004;93(1):61–67
91. Meltzer EO, Tripathy I, Maspero JF, Wu W, Philpot E. Safety and tolerability of fluticasone furoate nasal spray once daily in paediatric patients aged 6-11 years with allergic rhinitis: subanalysis of three randomized, double-blind, placebo-controlled, multicentre studies. *Clin Drug Investig.* 2009;29(2):79–86
92. Murphy K, Uryniak T, Simpson B, O'Dowd L. Growth velocity in children with perennial allergic rhinitis treated with budesonide aqueous nasal spray. *Ann Allergy Asthma Immunol.* 2006;96(5):723–730
93. Ratner PH, Meltzer EO, Teper A. Mometasone furoate nasal spray is safe and effective for 1-year treatment of children with perennial allergic rhinitis. *Int J Pediatr Otorhinolaryngol.* 2009;73(5):651–657
94. Skoner DP, Gentile DA, Doyle WJ. Effect on growth of long-term treatment with intranasal triamcinolone acetonide aqueous in children with allergic rhinitis. *Ann Allergy Asthma Immunol.* 2008;101(4): 431–436
95. Weinstein S, Qaqundah P, Georges G, Nayak A. Efficacy and safety of triamcinolone acetonide aqueous nasal spray in children aged 2 to 5 years with perennial allergic rhinitis: a randomized, double-blind, placebo-controlled study with an open-label extension. *Ann Allergy Asthma Immunol.* 2009;102(4):339–347
96. Zitt M, Kosoglou T, Hubbell J. Mometasone furoate nasal spray: a review of safety and systemic effects. *Drug Saf.* 2007;30(4): 317–326
97. Adam P, Stiffman M, Blake RL Jr. A clinical trial of hypertonic saline nasal spray in subjects with the common cold or rhinosinusitis. *Arch Fam Med.* 1998;7(1):39–43
98. Wang YH, Yang CP, Ku MS, Sun HL, Lue KH. Efficacy of nasal irrigation in the treatment of acute sinusitis in children. *Int J Pediatr Otorhinolaryngol.* 2009;73(12): 1696–1701
99. Harvey R, Hannan SA, Badia L, Scadding G. Nasal saline irrigations for the symptoms of chronic rhinosinusitis. *Cochrane Database Syst Rev.* 2007;(3):CD006394
100. Kassel JC, King D, Spurling GK. Saline nasal irrigation for acute upper respiratory tract infections. *Cochrane Database Syst Rev.* 2010;(3):CD006821
101. Shapiro GG, Virant FS, Furukawa CT, Pierson WE, Bierman CW. Immunologic defects in patients with refractory sinusitis. *Pediatrics.* 1991;87(3):311–316
102. Wood AJ, Douglas RG. Pathogenesis and treatment of chronic rhinosinusitis. *Postgrad Med J.* 2010;86(1016):359–364
103. Liao S, Durand ML, Cunningham MJ. Sinogenic orbital and subperiosteal abscesses: microbiology and methicillin-resistant Staphylococcus aureus incidence. *Otolaryngol Head Neck Surg.* 2010;143(3):392–396
104. Oxford LE, McClay J. Medical and surgical management of subperiosteal orbital abscess secondary to acute sinusitis in children. *Int J Pediatr Otorhinolaryngol.* 2006;70(11):1853–1861

Sinusitis Clinical Practice Guideline Quick Reference Tools

- Action Statement Summary
  — Clinical Practice Guideline for the Diagnosis and Management of Acute Bacterial Sinusitis in Children Aged 1 to 18 Years
- *ICD-10-CM* Coding Quick Reference for Sinusitis
- AAP Patient Education Handout
  — *Sinusitis and Your Child*

Action Statement Summary

Clinical Practice Guideline for the Diagnosis and Management of Acute Bacterial Sinusitis in Children Aged 1 to 18 Years

Key Action Statement 1

Clinicians should make a presumptive diagnosis of acute bacterial sinusitis when a child with an acute URI presents with the following:

- Persistent illness, ie, nasal discharge (of any quality) or daytime cough or both lasting more than 10 days without improvement;

OR

- Worsening course, ie, worsening or new onset of nasal discharge, daytime cough, or fever after initial improvement;

OR

- Severe onset, ie, concurrent fever (temperature ≥39°C/102.2°F) and purulent nasal discharge for at least 3 consecutive days (Evidence Quality: B; Recommendation).

Key Action Statement 2A

Clinicians should not obtain imaging studies (plain films, contrast-enhanced computed tomography [CT], MRI, or ultrasonography) to distinguish acute bacterial sinusitis from viral URI (Evidence Quality: B; Strong Recommendation).

Key Action Statement 2B

Clinicians should obtain a contrast-enhanced CT scan of the paranasal sinuses and/or an MRI with contrast whenever a child is suspected of having orbital or central nervous system complications of acute bacterial sinusitis (Evidence Quality: B; Strong Recommendation).

Key Action Statement 3

Initial Management of Acute Bacterial Sinusitis

3A: "Severe onset and worsening course" acute bacterial sinusitis. The clinician should prescribe antibiotic therapy for acute bacterial sinusitis in children with severe onset or worsening course (signs, symptoms, or both) (Evidence Quality: B; Strong Recommendation).

3B: "Persistent illness." The clinician should either prescribe antibiotic therapy OR offer additional outpatient observation for 3 days to children with persistent illness (nasal discharge of any quality or cough or both for at least 10 days without evidence of improvement) (Evidence Quality: B; Recommendation).

Key Action Statement 4

Clinicians should prescribe amoxicillin with or without clavulanate as first-line treatment when a decision has been made to initiate antibiotic treatment of acute bacterial sinusitis (Evidence Quality: B; Recommendation).

Key Action Statement 5A

Clinicians should reassess initial management if there is either a caregiver report of worsening (progression of initial signs/symptoms or appearance of new signs/symptoms) OR failure to improve (lack of reduction in all presenting signs/symptoms) within 72 hours of initial management (Evidence Quality: C; Recommendation).

Key Action Statement 5B

If the diagnosis of acute bacterial sinusitis is confirmed in a child with worsening symptoms or failure to improve in 72 hours, then clinicians may change the antibiotic therapy for the child initially managed with antibiotic OR initiate antibiotic treatment of the child initially managed with observation (Evidence Quality: D; Option based on expert opinion, case reports, and reasoning from first principles).

Coding Quick Reference for Sinusitis
ICD-10-CM
J01.00 Acute maxillary sinusitis, unspecified
J01.01 Acute recurrent maxillary sinusitis
J01.10 Acute frontal sinusitis, unspecified
J01.11 Acute recurrent frontal sinusitis
J01.21 Acute recurrent ethmoidal sinusitis
J01.30 Acute sphenoidal sinusitis, unspecified
J01.31 Acute recurrent sphenoidal sinusitis
J01.40 Acute pansinusitis, unspecified
J01.41 Acute recurrent pansinusitis
J01.80 Other acute sinusitis
J01.81 Other acute recurrent sinusitis
J01.90 Acute sinusitis, unspecified
J01.91 Acute recurrent sinusitis, unspecified
J32.9 Sinusitis NOS

Sinusitis and Your Child

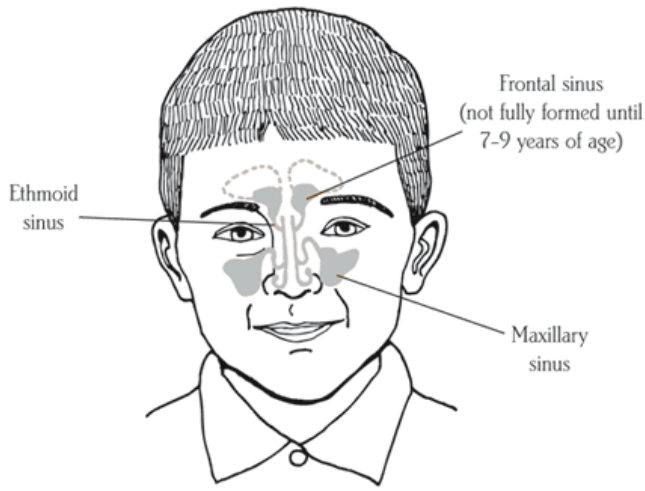
Sinusitis is an inflammation of the lining of the nose and sinuses. It is a very common infection in children.

Viral sinusitis usually accompanies a cold. Allergic sinusitis may accompany allergies such as hay fever. Bacterial sinusitis is a secondary infection caused by the trapping of bacteria in the sinuses during the course of a cold or allergy.

Fluid inside the sinuses

When your child has a viral cold or hay fever, the linings of the nose and sinus cavities swell up and produce more fluid than usual. This is why the nose gets congested and is "runny" during a cold.

Most of the time the swelling disappears by itself as the cold or allergy goes away. However, if the swelling does not go away, the openings that normally allow the sinuses to drain into the back of the nose get blocked and the sinuses fill with fluid. Because the sinuses are blocked and cannot drain properly, bacteria are trapped inside and grow there, causing a secondary infection. Although nose blowing and sniffing may be natural responses to this blockage, when excessive they can make the situation worse by pushing bacteria from the back of the nose into the sinuses.



The linings of the sinuses and the nose always produce some fluid (secretions). This fluid keeps the nose and sinus cavities from becoming too dry and adds moisture to the air that you breathe.

Is it a cold or bacterial sinusitis?

It is often difficult to tell if an illness is just a viral cold or if it is complicated by a bacterial infection of the sinuses.

Generally viral colds have the following characteristics:

- Colds usually last only 5 to 10 days.
- Colds typically start with clear, watery nasal discharge. After a day or 2, it is normal for the nasal discharge to become thicker and white, yellow, or green. After several days, the discharge becomes clear again and dries.
- Colds include a daytime cough that often gets worse at night.
- If a fever is present, it is usually at the beginning of the cold and is generally low grade, lasting for 1 or 2 days.
- Cold symptoms usually peak in severity at 3 or 5 days, then improve and disappear over the next 7 to 10 days.

Signs and symptoms that your child may have bacterial sinusitis include:

- Cold symptoms (nasal discharge, daytime cough, or both) lasting more than 10 days *without improving*
- Thick yellow nasal discharge *and* a fever for at least 3 or 4 days in a row
- A severe headache behind or around the eyes that gets worse when bending over
- Swelling and dark circles around the eyes, especially in the morning
- Persistent bad breath along with cold symptoms (However, this also could be from a sore throat or a sign that your child is not brushing his teeth!)

In very rare cases, a bacterial sinus infection may spread to the eye or the central nervous system (the brain). If your child has the following symptoms, call your pediatrician immediately:

- Swelling and/or redness around the eyes, not just in the morning but all day
- Severe headache and/or pain in the back of the neck
- Persistent vomiting
- Sensitivity to light
- Increasing irritability

Diagnosing bacterial sinusitis

It may be difficult to tell a sinus infection from an uncomplicated cold, especially in the first few days of the illness. Your pediatrician will most likely be able to tell if your child has bacterial sinusitis after examining your child and hearing about the progression of symptoms. In older children, when the diagnosis is uncertain, your pediatrician may order computed tomographic (CT) scans to confirm the diagnosis.

Treating bacterial sinusitis

If your child has bacterial sinusitis, your pediatrician may prescribe an antibiotic for at least 10 days. Once your child is on the medication, symptoms should start to go away over the next 2 to 3 days—the nasal discharge will clear and the cough will improve. *Even though your child may seem better, continue to give the antibiotics for the prescribed length of time. Ending the medications too early could cause the infection to return.*

When a diagnosis of sinusitis is made in children with cold symptoms lasting more than 10 days without improving, some doctors may choose to continue observation for another few days. If your child's symptoms worsen during this time or do not improve after 3 days, antibiotics should be started.

If your child's symptoms show no improvement 2 to 3 days after starting the antibiotics, talk with your pediatrician. Your child might need a different medication or need to be re-examined.

Treating related symptoms of bacterial sinusitis

Headache or sinus pain. To treat headache or sinus pain, try placing a warm washcloth on your child's face for a few minutes at a time. Pain medications such as acetaminophen or ibuprofen may also help. (However, do not give your child aspirin. It has been associated with a rare but potentially fatal disease called Reye syndrome.)

Nasal congestion. If the secretions in your child's nose are especially thick, your pediatrician may recommend that you help drain them with saline nose drops. These are available without a prescription or can be made at home by adding 1/4 teaspoon of table salt to an 8-ounce cup of water. Unless advised by your pediatrician, do not use nose drops that contain medications because they can be absorbed in amounts that can cause side effects.

Placing a cool-mist humidifier in your child's room may help keep your child more comfortable. Clean and dry the humidifier daily to prevent bacteria or mold from growing in it (follow the instructions that came with the humidifier). Hot water vaporizers are not recommended because they can cause scalds or burns.

Remember

If your child has symptoms of a bacterial sinus infection, see your pediatrician. Your pediatrician can properly diagnose and treat the infection and recommend ways to help alleviate the discomfort from some of the symptoms.

From your doctor

American Academy of Pediatrics

DEDICATED TO THE HEALTH OF ALL CHILDREN™

The American Academy of Pediatrics is an organization of 60,000 primary care pediatricians, pediatric medical subspecialists, and pediatric surgical specialists dedicated to the health, safety, and well-being of infants, children, adolescents, and young adults.

American Academy of Pediatrics
Web site — www.HealthyChildren.org

Diagnosis and Management of Childhood Obstructive Sleep Apnea Syndrome

- *Clinical Practice Guideline*

CLINICAL PRACTICE GUIDELINE

Diagnosis and Management of Childhood Obstructive Sleep Apnea Syndrome

abstract

FREE

OBJECTIVES: This revised clinical practice guideline, intended for use by primary care clinicians, provides recommendations for the diagnosis and management of the obstructive sleep apnea syndrome (OSAS) in children and adolescents. This practice guideline focuses on uncomplicated childhood OSAS, that is, OSAS associated with adenotonsillar hypertrophy and/or obesity in an otherwise healthy child who is being treated in the primary care setting.

METHODS: Of 3166 articles from 1999–2010, 350 provided relevant data. Most articles were level II–IV. The resulting evidence report was used to formulate recommendations.

RESULTS AND CONCLUSIONS: The following recommendations are made. (1) All children/adolescents should be screened for snoring. (2) Polysomnography should be performed in children/adolescents with snoring and symptoms/signs of OSAS; if polysomnography is not available, then alternative diagnostic tests or referral to a specialist for more extensive evaluation may be considered. (3) Adenotonsillectomy is recommended as the first-line treatment of patients with adenotonsillar hypertrophy. (4) High-risk patients should be monitored as inpatients postoperatively. (5) Patients should be reevaluated postoperatively to determine whether further treatment is required. Objective testing should be performed in patients who are high risk or have persistent symptoms/signs of OSAS after therapy. (6) Continuous positive airway pressure is recommended as treatment if adenotonsillectomy is not performed or if OSAS persists postoperatively. (7) Weight loss is recommended in addition to other therapy in patients who are overweight or obese. (8) Intranasal corticosteroids are an option for children with mild OSAS in whom adenotonsillectomy is contraindicated or for mild postoperative OSAS. *Pediatrics* 2012;130:576–584

Carole L. Marcus, MBBCh, Lee Jay Brooks, MD, Kari A. Draper, MD, David Gozal, MD, Ann Carol Halbower, MD, Jacqueline Jones, MD, Michael S. Schechter, MD, MPH, Stephen Howard Sheldon, DO, Karen Spruyt, PhD, Sally Davidson Ward, MD, Christopher Lehmann, MD, Richard N. Shiffman, MD

KEY WORDS

snoring, sleep-disordered breathing, adenotonsillectomy, continuous positive airway pressure

ABBREVIATIONS

AAP—American Academy of Pediatrics
AHI—apnea hypopnea index
CPAP—continuous positive airway pressure
OSAS—obstructive sleep apnea syndrome

INTRODUCTION

Obstructive sleep apnea syndrome (OSAS) is a common condition in childhood and can result in severe complications if left untreated. In 2002, the American Academy of Pediatrics (AAP) published a practice guideline for the diagnosis and management of childhood OSAS.[1] Since that time, there has been a considerable increase in publications and research on the topic; thus, the guidelines have been revised.

www.pediatrics.org/cgi/doi/10.1542/peds.2012-1671

doi:10.1542/peds.2012-1671

PEDIATRICS (ISSN Numbers: Print, 0031-4005; Online, 1098-4275).

The purposes of this revised clinical practice guideline are to (1) increase the recognition of OSAS by primary care clinicians to minimize delay in diagnosis and avoid serious sequelae of OSAS; (2) evaluate diagnostic techniques; (3) describe treatment options; (4) provide guidelines for follow-up; and (5) discuss areas requiring further research. The recommendations in this statement do not indicate an exclusive course of treatment. Variations, taking into account individual circumstances, may be appropriate.

This practice guideline focuses on uncomplicated childhood OSAS—that is, the OSAS associated with adenotonsillar hypertrophy and/or obesity in an otherwise healthy child who is being treated in the primary care setting. This guideline specifically excludes infants younger than 1 year of age, patients with central apnea or hypoventilation syndromes, and patients with OSAS associated with other medical disorders, including but not limited to Down syndrome, craniofacial anomalies, neuromuscular disease (including cerebral palsy), chronic lung disease, sickle cell disease, metabolic disease, or laryngomalacia. These important patient populations are too complex to discuss within the scope of this article and require consultation with a pediatric subspecialist.

Additional information providing justification for the key action statements and a detailed review of the literature are provided in the accompanying technical report available online.[2]

METHODS OF GUIDELINE DEVELOPMENT

Details of the methods of guideline development are included in the accompanying technical report.[2] The AAP selected a subcommittee composed of pediatricians and other experts in the fields of sleep medicine, pulmonology, and otolaryngology, as well as experts from epidemiology and pediatric practice to develop an evidence base of literature on this topic. The committee included liaison members from the AAP Section on Otolaryngology-Head and Neck Surgery, American Thoracic Society, American Academy of Sleep Medicine, American College of Chest Physicians, and the National Sleep Foundation. Committee members signed forms disclosing conflicts of interest.

An automated search of the literature on childhood OSAS from 1999 to 2008 was performed by using 5 scientific literature search engines.[2] The medical subject heading terms that were used in all fields were snoring, apnea, sleep-disordered breathing, sleep-related breathing disorders, upper airway resistance, polysomnography, sleep study, adenoidectomy, tonsillectomy, continuous positive airway pressure, obesity, adiposity, hypopnea, hypoventilation, cognition, behavior, and neuropsychology. Reviews, case reports, letters to the editor, and abstracts were not included. Non–English-language articles, animal studies, and studies relating to infants younger than 1 year and to special populations (eg, children with craniofacial anomalies or sickle cell disease) were excluded. In several steps, a total of 3166 hits was reduced to 350 articles, which underwent detailed review.[2] Committee members selectively updated this literature search for articles published from 2008 to 2011 specific to guideline categories. Details of the literature grading system are available in the accompanying technical report.

Since publication of the previous guidelines, there has been an improvement in the quality of OSAS studies in the literature; however, there remain few randomized, blinded, controlled studies. Most studies were questionnaire or polysomnography based. Many studies used standard definitions for pediatric polysomnography scoring, but the interpretation of polysomnography (eg, the apnea hypopnea index [AHI] criterion used for diagnosis or to determine treatment) varied widely. The guideline notes the quality of evidence for each key action statement. Additional details are available in the technical report.

The evidence-based approach to guideline development requires that the evidence in support of each key action statement be identified, appraised, and summarized and that an explicit link between evidence and recommendations be defined. Evidence-based recommendations reflect the quality of evidence and the balance of benefit and harm that is anticipated when the recommendation is followed. The AAP policy statement, "Classifying Recommendations for Clinical Practice Guidelines,"[3] was followed in designating levels of recommendation (see Fig 1 and Table 1).

DEFINITION

This guideline defines OSAS in children as a "disorder of breathing during sleep characterized by prolonged partial upper airway obstruction and/or intermittent complete obstruction (obstructive apnea) that disrupts normal ventilation during sleep and normal sleep patterns,"[4] accompanied by symptoms or signs, as listed in Table 2. Prevalence rates based on level I and II studies range from 1.2% to 5.7%.[5–7] Symptoms include habitual snoring (often with intermittent pauses, snorts, or gasps), disturbed sleep, and daytime neurobehavioral problems. Daytime sleepiness may occur, but is uncommon in young children. OSAS is associated with neurocognitive impairment, behavioral problems, failure to thrive, hypertension, cardiac dysfunction, and systemic inflammation. Risk factors include adenotonsillar hypertrophy, obesity, craniofacial anomalies, and neuromuscular disorders. Only the first 2 risk factors are

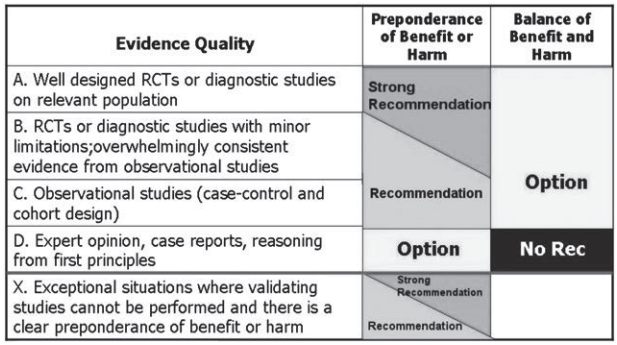


FIGURE 1

Evidence quality. Integrating evidence quality appraisal with an assessment of the anticipated balance between benefits and harms if a policy is carried out leads to designation of a policy as a strong recommendation, recommendation, option, or no recommendation. RCT, randomized controlled trial; Rec, recommendation.

discussed in this guideline. In this guideline, obesity is defined as a BMI >95th percentile for age and gender.[8]

KEY ACTION STATEMENTS

Key Action Statement 1: Screening for OSAS

As part of routine health maintenance visits, clinicians should inquire whether the child or adolescent snores. If the answer is affirmative or if a child or adolescent presents with signs or symptoms of OSAS (Table 2), clinicians should perform a more focused evaluation. (Evidence Quality: Grade B, Recommendation Strength: Recommendation.)

Evidence Profile KAS 1

- Aggregate evidence quality: B
- Benefit: Early identification of OSAS is desirable, because it is a high-prevalence condition, and identification and treatment can result in alleviation of current symptoms, improved quality of life, prevention of sequelae, education of parents, and decreased health care utilization.
- Harm: Provider time, patient and parent time.
- Benefits-harms assessment: Preponderance of benefit over harm.
- Value judgments: Panelists believe that identification of a serious medical condition outweighs the time expenditure necessary for screening.
- Role of patient preferences: None.
- Exclusions: None.
- Intentional vagueness: None.
- Strength: Recommendation.

Almost all children with OSAS snore,[9–11] although caregivers frequently do not volunteer this information at medical visits.[12] Thus, asking about snoring at each health maintenance visit (as well as at other appropriate times, such as when evaluating for tonsillitis) is a sensitive, albeit nonspecific, screening measure that is quick and easy to perform. Snoring is common in children and adolescents; however, OSAS is less common. Therefore, an affirmative answer should be followed by a detailed history and examination to determine whether further evaluation for OSAS is needed (Table 2); this clinical evaluation alone

TABLE 1 Definitions and Recommendation Implications

Statement	Definition	Implication
Strong recommendation	A strong recommendation in favor of a particular action is made when the anticipated benefits of the recommended intervention clearly exceed the harms (as a strong recommendation against an action is made when the anticipated harms clearly exceed the benefits) and the quality of the supporting evidence is excellent. In some clearly identified circumstances, strong recommendations may be made when high-quality evidence is impossible to obtain and the anticipated benefits strongly outweigh the harms.	Clinicians should follow a strong recommendation unless a clear and compelling rationale for an alternative approach is present.
Recommendation	A recommendation in favor of a particular action is made when the anticipated benefits exceed the harms but the quality of evidence is not as strong. Again, in some clearly identified circumstances, recommendations may be made when high-quality evidence is impossible to obtain but the anticipated benefits outweigh the harms.	It would be prudent for clinicians to follow a recommendation, but they should remain alert to new information and sensitive to patient preferences.
Option	Options define courses that may be taken when either the quality of evidence is suspect or carefully performed studies have shown little clear advantage to one approach over another.	Clinicians should consider the option in their decision-making, and patient preference may have a substantial role.
No recommendation	No recommendation indicates that there is a lack of pertinent published evidence and that the anticipated balance of benefits and harms is presently unclear.	Clinicians should be alert to new published evidence that clarifies the balance of benefit versus harm.

TABLE 2 Symptoms and Signs of OSAS

History
Frequent snoring (≥3 nights/wk)
Labored breathing during sleep
Gasps/snorting noises/observed episodes of apnea
Sleep enuresis (especially secondary enuresis)[a]
Sleeping in a seated position or with the neck hyperextended
Cyanosis
Headaches on awakening
Daytime sleepiness
Attention-deficit/hyperactivity disorder
Learning problems
Physical examination
Underweight or overweight
Tonsillar hypertrophy
Adenoidal facies
Micrognathia/retrognathia
High-arched palate
Failure to thrive
Hypertension

[a] Enuresis after at least 6 mo of continence.

does not establish the diagnosis (see technical report). Occasional snoring, for example, with an upper respiratory tract infection, is less of a concern than snoring that occurs at least 3 times a week and is associated with any of the symptoms or signs listed in Table 2.

Key Action Statement 2A: Polysomnography

If a child or adolescent snores on a regular basis and has any of the complaints or findings shown in Table 2, clinicians should either (1) obtain a polysomnogram (Evidence Quality A, Key Action strength: Recommendation) OR (2) refer the patient to a sleep specialist or otolaryngologist for a more extensive evaluation (Evidence quality D, Key Action strength: Option). (Evidence Quality: Grade A for polysomnography; Grade D for specialist referral, Recommendation Strength: Recommendation.)

Evidence Profile KAS 2A: Polysomnography

- Aggregate evidence quality: A
- Benefits: Establish diagnosis and determine severity of OSAS.
- Harm: Expense, time, anxiety/discomfort.
- Benefits-harms assessment: Preponderance of benefit over harm.
- Value judgments: Panelists weighed the value of establishing a diagnosis as more important than the minor potential harms listed.
- Role of patient preferences: Small because of preponderance of evidence that polysomnography is the most accurate way to make a diagnosis.
- Exclusions: See Key Action Statement 2B regarding lack of availability.
- Intentional vagueness: None.
- Strength: Recommendation.

Evidence Profile KAS 2A: Referral

- Aggregate evidence quality: D
- Benefits: Subspecialist may be better able to establish diagnosis and determine severity of OSAS.
- Harm: Expense, time, anxiety/discomfort.
- Benefits-harms assessment: Preponderance of benefit over harm.
- Value judgments: Panelists weighed the value of establishing a diagnosis as more important than the minor potential harms listed.
- Role of patient preferences: Large.
- Exclusions: None.
- Intentional vagueness: None.
- Strength: Option.

Although history and physical examination are useful to screen patients and determine which patients need further investigation for OSAS, the sensitivity and specificity of the history and physical examination are poor (see accompanying technical report). Physical examination when the child is awake may be normal, and the size of the tonsils cannot be used to predict the presence of OSAS in an individual child. Thus, objective testing is required. The gold standard test is overnight, attended, in-laboratory polysomnography (sleep study). This is a noninvasive test involving the measurement of a number of physiologic functions overnight, typically including EEG; pulse oximetry; oronasal airflow, abdominal and chest wall movements, partial pressure of carbon dioxide (P_{CO_2}); and video recording.[13] Specific pediatric measuring and scoring criteria should be used.[13] Polysomnography will demonstrate the presence or absence of OSAS. Polysomnography also demonstrates the severity of OSAS, which is helpful in planning treatment and in postoperative short- and long-term management.

Key Action Statement 2B: Alternative Testing

If polysomnography is not available, then clinicians may order alternative diagnostic tests, such as nocturnal video recording, nocturnal oximetry, daytime nap polysomnography, or ambulatory polysomnography. (Evidence Quality: Grade C, Recommendation Strength: Option.)

Evidence Profile KAS 2B

- Aggregate evidence quality: C
- Benefit: Varying positive and negative predictive values for establishing diagnosis.
- Harm: False-negative and false-positive results may underestimate or overestimate severity, expense, time, anxiety/discomfort.
- Benefits-harms assessment: Equilibrium of benefits and harms.
- Value judgments: Opinion of the panel that some objective testing is better than none. Pragmatic decision based on current shortage of pediatric polysomnography facilities (this may change over time).
- Role of patient preferences: Small, if choices are limited by availability;

families may choose to travel to centers where more extensive facilities are available.

- Exclusions: None.
- Intentional vagueness: None.
- Strength: Option.

Although polysomnography is the gold standard for diagnosis of OSAS, there is a shortage of sleep laboratories with pediatric expertise. Hence, polysomnography may not be readily available in certain regions of the country. Alternative diagnostic tests have been shown to have weaker positive and negative predictive values than polysomnography, but nevertheless, objective testing is preferable to clinical evaluation alone. If an alternative test fails to demonstrate OSAS in a patient with a high pretest probability, full polysomnography should be sought.

Key Action Statement 3: Adenotonsillectomy

If a child is determined to have OSAS, has a clinical examination consistent with adenotonsillar hypertrophy, and does not have a contraindication to surgery (see Table 3), the clinician should recommend adenotonsillectomy as the first line of treatment. If the child has OSAS but does not have adenotonsillar hypertrophy, other treatment should be considered (see Key Action Statement 6). Clinical judgment is required to determine the benefits of adenotonsillectomy compared with other treatments in obese children with varying degrees of adenotonsillar hypertrophy. (Evidence Quality: Grade B, Recommendation Strength: Recommendation.)

Evidence Profile KAS 3

- Aggregate evidence quality: B
- Benefit: Improve OSAS and accompanying symptoms and sequelae.
- Harm: Pain, anxiety, dehydration, anesthetic complications, hemorrhage, infection, postoperative respiratory difficulties, velopharyngeal incompetence, nasopharyngeal stenosis, death.
- Benefits-harms assessment: Preponderance of benefit over harm.
- Value judgments: The panel sees the benefits of treating OSAS as more beneficial than the low risk of serious consequences.
- Role of patient preferences: Low; continuous positive airway pressure (CPAP) is an option but involves prolonged, long-term treatment as compared with a single, relatively low-risk surgical procedure.
- Exclusions: See Table 3.
- Intentional vagueness: None.
- Strength: Recommendation.

Adenotonsillectomy is very effective in treating OSAS. Adenoidectomy or tonsillectomy alone may not be sufficient, because residual lymphoid tissue may contribute to persistent obstruction. In otherwise healthy children with adenotonsillar hypertrophy, adenotonsillectomy is associated with improvements in symptoms and sequelae of OSAS. Postoperative polysomnography typically shows a major decrease in the number of obstructive events, although some obstructions may still be present. Although obese children may have less satisfactory results, many will be adequately treated with adenotonsillectomy; however, further research is needed to determine which obese children are most likely to benefit from surgery. In this population, the benefits of a 1-time surgical procedure, with a small but real risk of complications, need to be weighed against long-term treatment with CPAP, which is associated with discomfort, disruption of family lifestyle, and risks of poor adherence. Potential complications of adenotonsillectomy are shown in Table 4. Although serious complications (including death) may occur, the rate of these complications is low, and the risks of complications need to be weighed against the consequences of untreated OSAS. In general, a 1-time only procedure with a relatively low morbidity is preferable to lifelong treatment with CPAP; furthermore, the efficacy of CPAP is limited by generally suboptimal adherence. Other treatment options, such as anti-inflammatory medications, weight loss, or tracheostomy, are less effective, are difficult to achieve, or have higher morbidity, respectively.

TABLE 3 Contraindications for Adenotonsillectomy

Absolute contraindications
No adenotonsillar tissue (tissue has been surgically removed)
Relative contraindications
Very small tonsils/adenoid
Morbid obesity and small tonsils/adenoid
Bleeding disorder refractory to treatment
Submucus cleft palate
Other medical conditions making patient medically unstable for surgery

Key Action Statement 4: High-Risk Patients Undergoing Adenotonsillectomy

Clinicians should monitor high-risk patients (Table 5) undergoing adenotonsillectomy as inpatients postoperatively. (Evidence Quality: Grade B, Recommendation Strength: Recommendation.)

TABLE 4 Risks of Adenotonsillectomy

Minor
Pain
Dehydration attributable to postoperative nausea/vomiting and poor oral intake
Major
Anesthetic complications
Acute upper airway obstruction during induction or emergence from anesthesia
Postoperative respiratory compromise
Hemorrhage
Velopharyngeal incompetence
Nasopharyngeal stenosis
Death

TABLE 5 Risk Factors for Postoperative Respiratory Complications in Children With OSAS Undergoing Adenotonsillectomy

Younger than 3 y of age
Severe OSAS on polysomnography[a]
Cardiac complications of OSAS
Failure to thrive
Obesity
Craniofacial anomalies[b]
Neuromuscular disorders[b]
Current respiratory infection

[a] It is difficult to provide exact polysomnographic criteria for severity, because these criteria will vary depending on the age of the child; additional comorbidities, such as obesity, asthma, or cardiac complications of OSAS; and other polysomnographic criteria that have not been evaluated in the literature, such as the level of hypercapnia and the frequency of desaturation (as compared with lowest oxygen saturation). Nevertheless, on the basis of published studies (primarily Level III, see Technical Report), it is recommended that all patients with a lowest oxygen saturation <80% (either on preoperative polysomnography or during observation in the recovery room postoperatively) or an AHI ≥24/h be observed as inpatients postoperatively as they are at increased risk for postoperative respiratory compromise. Additionally, on the basis of expert consensus, it is recommended that patients with significant hypercapnia on polysomnography (peak P_{CO_2} ≥60 mm Hg) be admitted postoperatively. The committee noted that that most published studies were retrospective and not comprehensive, and therefore these recommendations may change if higher-level studies are published. Clinicians may decide to admit patients with less severe polysomnographic abnormalities based on a constellation of risk factors (age, comorbidities, and additional polysomnographic factors) for a particular individual.

[b] Not discussed in these guidelines.

Evidence Profile KAS 4

- Aggregate evidence quality: B
- Benefit: Effectively manage severe respiratory compromise and avoid death.
- Harm: Expense, time, anxiety.
- Benefits-harms assessment: Preponderance of benefit over harm.
- Value judgments: The panel believes that early recognition of any serious adverse events is critically important.
- Role of patient preferences: Minimal; this is an important safety issue.
- Exclusions: None.
- Intentional vagueness: None.
- Strength: Recommendation.

Patients with OSAS may develop respiratory complications, such as worsening of OSAS or pulmonary edema, in the immediate postoperative period. Death attributable to respiratory complications in the immediate postoperative period has been reported in patients with severe OSAS. Identified risk factors are shown in Table 5. High-risk patients should undergo surgery in a center capable of treating complex pediatric patients. They should be hospitalized overnight for close monitoring postoperatively. Children with an acute respiratory infection on the day of surgery, as documented by fever, cough, and/or wheezing, are at increased risk of postoperative complications and, therefore, should be rescheduled or monitored closely postoperatively. Clinicians should decide on an individual basis whether these patients should be rescheduled, taking into consideration the severity of OSAS in the particular patient and keeping in mind that many children with adenotonsillar hypertrophy have chronic rhinorrhea and nasal congestion, even in the absence of viral infections.

Key Action Statement 5: Reevaluation

Clinicians should clinically reassess all patients with OSAS for persisting signs and symptoms after therapy to determine whether further treatment is required. (Evidence Quality: Grade B, Recommendation Strength: Recommendation.)

Evidence Profile KAS 5A

- Aggregate evidence quality: B
- Benefit: Determine effects of treatment.
- Harm: Expense, time.
- Benefits-harms assessment: Preponderance of benefit over harm.
- Value judgments: Data show that a significant proportion of children continue to have abnormalities postoperatively; therefore, the panel determined that the benefits of follow-up outweigh the minor inconveniences.
- Role of patient preferences: Minimal; follow-up is good clinical practice.
- Exclusions: None.
- Intentional vagueness: None.
- Strength: Recommendation.

Clinicians should reassess OSAS-related symptoms and signs (Table 2) after 6 to 8 weeks of therapy to determine whether further evaluation and treatment are indicated. Objective data regarding the timing of the postoperative evaluation are not available. Most clinicians recommend reevaluation 6 to 8 weeks after treatment to allow for healing of the operative site and to allow time for upper airway, cardiac, and central nervous system recovery. Patients who remain symptomatic should undergo objective testing (see Key Action Statement 2) or be referred to a sleep specialist for further evaluation.

Key Action Statement 5B: Reevaluation of High-Risk Patients

Clinicians should reevaluate high-risk patients for persistent OSAS after adenotonsillectomy, including those who had a significantly abnormal baseline polysomnogram, have sequelae of OSAS, are obese, or remain symptomatic after treatment, with an objective test (see Key Action Statement 2) or refer such patients to a sleep specialist. (Evidence Quality: Grade B, Recommendation Strength: Recommendation.)

Evidence Profile KAS 5B

- Aggregate evidence quality: B
- Benefit: Determine effects of treatment.
- Harm: Expense, time, anxiety/discomfort.
- Benefits-harms assessment: Preponderance of benefit over harm.

- Value judgments: Given the panel's concerns about the consequences of OSAS and the frequency of postoperative persistence in high-risk groups, the panel believes that the follow-up costs are outweighed by benefits of recognition of persistent OSAS. A minority of panelists believed that all children with OSAS should have follow-up polysomnography because of the high prevalence of persistent postoperative abnormalities on polysomnography, but most panelists believed that persistent polysomnographic abnormalities in uncomplicated children with mild OSAS were usually mild in patients who were asymptomatic after surgery.
- Role of patient preferences: Minimal. Further evaluation is needed to determine the need for further treatment.
- Exclusions: None.
- Intentional vagueness: None.
- Strength: Recommendation.

Numerous studies have shown that a large proportion of children at high risk continue to have some degree of OSAS postoperatively[10,13,14]; thus, objective evidence is required to determine whether further treatment is necessary.

Key Action Statement 6: CPAP

Clinicians should refer patients for CPAP management if symptoms/signs (Table 2) or objective evidence of OSAS persists after adenotonsillectomy or if adenotonsillectomy is not performed. (Evidence Quality: Grade B, Recommendation Strength: Recommendation.)

Evidence Profile KAS 6

- Aggregate evidence quality: B
- Benefit: Improve OSAS and accompanying symptoms and sequelae.
- Harm: Expense, time, anxiety; parental sleep disruption; nasal and skin adverse effects; possible midface remodeling; extremely rare serious pressure-related complications, such as pneumothorax; poor adherence.
- Benefits-harms assessment: Preponderance of benefit over harm.
- Value judgments: Panelists believe that CPAP is the most effective treatment of OSAS that persists postoperatively and that the benefits of treatment outweigh the adverse effects. Other treatments (eg, rapid maxillary expansion) may be effective in specially selected patients.
- Role of patient preferences: Other treatments may be effective in specially selected patients.
- Exclusions: Rare patients at increased risk of severe pressure complications.
- Intentional vagueness: None.
- Policy level: Recommendation.

CPAP therapy is delivered by using an electronic device that delivers air at positive pressure via a nasal mask, leading to mechanical stenting of the airway and improved functional residual capacity in the lungs. There is no clear advantage of using bilevel pressure over CPAP.[15] CPAP should be managed by an experienced and skilled clinician with expertise in its use in children. CPAP pressure requirements vary among individuals and change over time; thus, CPAP must be titrated in the sleep laboratory before prescribing the device and periodically readjusted thereafter. Behavioral modification therapy may be required, especially for young children or those with developmental delays. Objective monitoring of adherence, by using the equipment software, is important. If adherence is suboptimal, the clinician should institute measures to improve adherence (such as behavioral modification, or treating side effects of CPAP) and institute alternative treatments if these measures are ineffective.

Key Action Statement 7: Weight Loss

Clinicians should recommend weight loss in addition to other therapy if a child/adolescent with OSAS is overweight or obese. (Evidence Quality: Grade C, Recommendation Strength: Recommendation.)

Evidence Profile KAS 7

- Aggregate evidence quality: C
- Benefit: Improve OSAS and accompanying symptoms and sequelae; non–OSAS-related benefits of weight loss.
- Harm: Hard to achieve and maintain weight loss.
- Benefits-harms assessment: Preponderance of benefit over harm.
- Value judgments: The panel agreed that weight loss is beneficial for both OSAS and other health issues, but clinical experience suggests that weight loss is difficult to achieve and maintain, and even effective weight loss regimens take time; therefore, additional treatment is required in the interim.
- Role of patient preferences: Strong role for patient and family preference regarding nutrition and exercise.
- Exclusions: None.
- Intentional vagueness: None.
- Strength: Recommendation.

Weight loss has been shown to improve OSAS,[16,17] although the degree of weight loss required has not been determined. Because weight loss is a slow and unreliable process, other treatment modalities (such as adenotonsillectomy or CPAP therapy) should be instituted until sufficient weight loss has been achieved and maintained.

Key Action Statement 8: Intranasal Corticosteroids

Clinicians may prescribe topical intranasal corticosteroids for children with mild OSAS in whom adenotonsillectomy is contraindicated or for children with mild postoperative OSAS. (Evidence Quality: Grade B, Recommendation Strength: Option.)

Evidence Profile KAS 8

- Aggregate evidence quality: B
- Benefit: Improves mild OSAS and accompanying symptoms and sequelae.
- Harm: Some subjects may not have an adequate response. It is not known whether therapeutic effect persists long-term; therefore, long-term observation is required. Low risk of steroid-related adverse effects.
- Benefits-harms assessment: Preponderance of benefit over harm.
- Value judgments: The panel agreed that intranasal steroids provide a less invasive treatment than surgery or CPAP and, therefore, may be preferred in some cases despite lower efficacy and lack of data on long-term efficacy.
- Role of patient preferences: Moderate role for patient and family preference if OSAS is mild.
- Exclusions: None.
- Intentional vagueness: None.
- Strength: Option.

Mild OSAS is defined, for this indication, as an AHI <5 per hour, on the basis of studies on intranasal corticosteroids described in the accompanying technical report.[2] Several studies have shown that the use of intranasal steroids decreases the degree of OSAS; however, although OSAS improves, residual OSAS may remain. Furthermore, there is individual variability in response to treatment, and long-term studies have not been performed to determine the duration of improvement. Therefore, nasal steroids are not recommended as a first-line therapy. The response to treatment should be measured objectively after a course of treatment of approximately 6 weeks. Because the long-term effect of this treatment is unknown, the clinician should continue to observe the patient for symptoms of recurrence and adverse effects of corticosteroids.

AREAS FOR FUTURE RESEARCH

A detailed list of research recommendations is provided in the accompanying technical report.[2] There is a great need for further research into the prevalence of OSAS, sequelae of OSAS, best treatment methods, and the role of obesity. In particular, well-controlled, blinded studies, including randomized controlled trials of treatment, are needed to determine the best care for children and adolescents with OSAS.

SUBCOMMITTEE ON OBSTRUCTIVE SLEEP APNEA SYNDROME*

Carole L. Marcus, MBBCh, Chairperson (Sleep Medicine, Pediatric Pulmonologist; Liaison, American Academy of Sleep Medicine; Research Support from Philips Respironics; Affiliated with an academic sleep center; Published research related to OSAS)

Lee J. Brooks, MD (Sleep Medicine, Pediatric Pulmonologist; Liaison, American College of Chest Physicians; No financial conflicts; Affiliated with an academic sleep center; Published research related to OSAS)

Sally Davidson Ward, MD (Sleep Medicine, Pediatric Pulmonologist; No financial conflicts; Affiliated with an academic sleep center; Published research related to OSAS)

Kari A. Draper, MD (General Pediatrician; No conflicts)

David Gozal, MD (Sleep Medicine, Pediatric Pulmonologist; Research support from AstraZeneca; Speaker for Merck Company; Affiliated with an academic sleep center; Published research related to OSAS)

Ann C. Halbower, MD (Sleep Medicine, Pediatric Pulmonologist; Liaison, American Thoracic Society; Research Funding from Resmed; Affiliated with an academic sleep center; Published research related to OSAS)

Jacqueline Jones, MD (Pediatric Otolaryngologist; AAP Section on Otolaryngology-Head and Neck Surgery; Liaison, American Academy of Otolaryngology-Head and Neck Surgery; No financial conflicts; Affiliated with an academic otolaryngologic practice)

Christopher Lehman, MD (Neonatologist, Informatician; No conflicts)

Michael S. Schechter, MD, MPH (Pediatric Pulmonologist; AAP Section on Pediatric Pulmonology; Consultant to Genentech, Inc and Gilead, Inc, not related to Obstructive Sleep Apnea; Research Support from Mpex Pharmaceuticals, Inc, Vertex Pharmaceuticals Incorporated, PTC Therapeutics, Bayer Healthcare, not related to Obstructive Sleep Apnea)

Stephen Sheldon, MD (Sleep Medicine, General Pediatrician; Liaison, National Sleep Foundation; No financial conflicts; Affiliated with an academic sleep center; Published research related to OSAS)

Richard N. Shiffman, MD, MCIS (General pediatrics, Informatician; No conflicts)

Karen Spruyt, PhD (Clinical Psychologist, Child Neuropsychologist, and Biostatistician/Epidemiologist; No financial conflicts; Affiliated with an academic sleep center)

Oversight from the Steering Committee on Quality Improvement and Management, 2009–2012

STAFF

Caryn Davidson, MA

*Areas of expertise are shown in parentheses after each name.

ACKNOWLEDGMENTS

The committee thanks Jason Caboot, June Chan, Mary Currie, Fiona Healy, Maureen Josephson, Sofia Konstantinopoulou, H. Madan Kumar, Roberta Leu, Darius Loghmanee, Rajeev Bhatia, Argyri Petrocheilou, Harsha Vardhan, and Colleen Walsh for assisting with evidence extraction.

REFERENCES

1. Section on Pediatric Pulmonology, Subcommittee on Obstructive Sleep Apnea Syndrome. American Academy of Pediatrics. Clinical practice guideline: diagnosis and management of childhood obstructive sleep apnea syndrome. *Pediatrics*. 2002;109(4):704–712
2. Marcus CL, Brooks LJ, Davidson C, et al; American Academy of Pediatrics, Subcommittee on Obstructive Sleep Apnea

Syndrome. Technical report: diagnosis and management of childhood obstructive sleep apnea syndrome. *Pediatrics*. 2012; 130(3):In press

3. American Academy of Pediatrics Steering Committee on Quality Improvement and Management. Classifying recommendations for clinical practice guidelines. *Pediatrics*. 2004;114(3):874–877
4. American Thoracic Society. Standards and indications for cardiopulmonary sleep studies in children. *Am J Respir Crit Care Med*. 1996;153(2):866–878
5. Bixler EO, Vgontzas AN, Lin HM, et al. Sleep disordered breathing in children in a general population sample: prevalence and risk factors. *Sleep*. 2009;32(6):731–736
6. Li AM, So HK, Au CT, et al. Epidemiology of obstructive sleep apnoea syndrome in Chinese children: a two-phase community study. *Thorax*. 2010;65(11):991–997
7. O'Brien LM, Holbrook CR, Mervis CB, et al. Sleep and neurobehavioral characteristics of 5- to 7-year-old children with parentally reported symptoms of attention-deficit/hyperactivity disorder. *Pediatrics*. 2003; 111(3):554–563
8. Himes JH, Dietz WH; The Expert Committee on Clinical Guidelines for Overweight in Adolescent Preventive Services. Guidelines for overweight in adolescent preventive services: recommendations from an expert committee. *Am J Clin Nutr*. 1994;59(2):307–316
9. Mitchell RB. Adenotonsillectomy for obstructive sleep apnea in children: outcome evaluated by pre- and postoperative polysomnography. *Laryngoscope*. 2007;117(10):1844–1854
10. Suen JS, Arnold JE, Brooks LJ. Adenotonsillectomy for treatment of obstructive sleep apnea in children. *Arch Otolaryngol Head Neck Surg*. 1995;121(5):525–530
11. Nieminen P, Tolonen U, Löppönen H. Snoring and obstructive sleep apnea in children: a 6-month follow-up study. *Arch Otolaryngol Head Neck Surg*. 2000;126(4):481–486
12. Blunden S, Lushington K, Lorenzen B, Wong J, Balendran R, Kennedy D. Symptoms of sleep breathing disorders in children are underreported by parents at general practice visits. *Sleep Breath*. 2003;7(4):167–176
13. Apostolidou MT, Alexopoulos EI, Chaidas K, et al. Obesity and persisting sleep apnea after adenotonsillectomy in Greek children. *Chest*. 2008;134(6):1149–1155
14. Mitchell RB, Kelly J. Outcome of adenotonsillectomy for severe obstructive sleep apnea in children. *Int J Pediatr Otorhinolaryngol*. 2004;68(11):1375–1379
15. Marcus CL, Rosen G, Ward SL, et al. Adherence to and effectiveness of positive airway pressure therapy in children with obstructive sleep apnea. *Pediatrics*. 2006; 117(3). Available at: www.pediatrics.org/cgi/content/full/117/3/e442
16. Verhulst SL, Franckx H, Van Gaal L, De Backer W, Desager K. The effect of weight loss on sleep-disordered breathing in obese teenagers. *Obesity (Silver Spring)*. 2009;17(6):1178–1183
17. Kalra M, Inge T. Effect of bariatric surgery on obstructive sleep apnoea in adolescents. *Paediatr Respir Rev*. 2006;7(4):260–267

Sleep Apnea Clinical Practice Guideline Quick Reference Tools

- Action Statement Summary
  — Diagnosis and Management of Childhood Obstructive Sleep Apnea Syndrome
- *ICD-10-CM* Coding Quick Reference for Sleep Apnea
- AAP Patient Education Handout
  — *Sleep Apnea and Your Child*

Action Statement Summary

Diagnosis and Management of Childhood Obstructive Sleep Apnea Syndrome

Key Action Statement 1: Screening for OSAS

As part of routine health maintenance visits, clinicians should inquire whether the child or adolescent snores. If the answer is affirmative or if a child or adolescent presents with signs or symptoms of OSAS (Table 2), clinicians should perform a more focused evaluation. (Evidence Quality: Grade B, Recommendation Strength: Recommendation.)

Key Action Statement 2A: Polysomnography

If a child or adolescent snores on a regular basis and has any of the complaints or findings shown in Table 2, clinicians should either (1) obtain a polysomnogram (Evidence Quality A, Key Action strength: Recommendation) OR (2) refer the patient to a sleep specialist or otolaryngologist for a more extensive evaluation (Evidence quality D, Key Action strength: Option). (Evidence Quality: Grade A for polysomnography; Grade D for specialist referral, Recommendation Strength: Recommendation.)

Key Action Statement 2B: Alternative Testing

If polysomnography is not available, then clinicians may order alternative diagnostic tests, such as nocturnal video recording, nocturnal oximetry, daytime nap polysomnography, or ambulatory polysomnography. (Evidence Quality: Grade C, Recommendation Strength: Option.)

Key Action Statement 3: Adenotonsillectomy

If a child is determined to have OSAS, has a clinical examination consistent with adenotonsillar hypertrophy, and does not have a contraindication to surgery (see Table 3), the clinician should recommend adenotonsillectomy as the first line of treatment. If the child has OSAS but does not have adenotonsillar hypertrophy, other treatment should be considered (see Key Action Statement 6). Clinical judgment is required to determine the benefits of adenotonsillectomy compared with other treatments in obese children with varying degrees of adenotonsillar hypertrophy. (Evidence Quality: Grade B, Recommendation Strength: Recommendation.)

Key Action Statement 4: High-Risk Patients Undergoing Adenotonsillectomy

Clinicians should monitor high-risk patients (Table 5) undergoing adenotonsillectomy as inpatients postoperatively. (Evidence Quality: Grade B, Recommendation Strength: Recommendation.)

Key Action Statement 5: Reevaluation

Clinicians should clinically reassess all patients with OSAS for persisting signs and symptoms after therapy to determine whether further treatment is required. (Evidence Quality: Grade B, Recommendation Strength: Recommendation.)

Key Action Statement 5B: Reevaluation of High-Risk Patients

Clinicians should reevaluate high-risk patients for persistent OSAS after adenotonsillectomy, including those who had a significantly abnormal baseline polysomnogram, have sequelae of OSAS, are obese, or remain symptomatic after treatment, with an objective test (see Key Action Statement 2) or refer such patients to a sleep specialist. (Evidence Quality: Grade B, Recommendation Strength: Recommendation.)

Key Action Statement 6: CPAP

Clinicians should refer patients for CPAP management if symptoms/signs (Table 2) or objective evidence of OSAS persists after adenotonsillectomy or if adenotonsillectomy is not performed. (Evidence Quality: Grade B, Recommendation Strength: Recommendation.)

Key Action Statement 7: Weight Loss

Clinicians should recommend weight loss in addition to other therapy if a child/adolescent with OSAS is overweight or obese. (Evidence Quality: Grade C, Recommendation Strength: Recommendation.)

Key Action Statement 8: Intranasal Corticosteroids

Clinicians may prescribe topical intranasal corticosteroids for children with mild OSAS in whom adenotonsillectomy is contraindicated or for children with mild postoperative OSAS. (Evidence Quality: Grade B, Recommendation Strength: Option.)

Coding Quick Reference for Sleep Apnea	
ICD-10-CM	
G47.30	Sleep apnea, unspecified
G47.31	Primary central sleep apnea
G47.33	Obstructive sleep apnea (adult) (pediatric) _____(Code additional underlying conditions.)
J35.3	Hypertrophy of tonsils with hypertrophy of adenoids
E66.01	Morbid (severe) obesity due to excess calories
E66.09	Other obesity due to excess calories
E66.3	Overweight
E66.8	Other obesity
E66.9	Obesity, unspecified
P28.3	Primary sleep apnea of newborn
P28.4	Other apnea of newborn

Sleep Apnea and Your Child

Does your child snore a lot? Does he sleep restlessly? Does he have difficulty breathing, or does he gasp or choke, while he sleeps?

If your child has these symptoms, he may have a condition known as sleep apnea.

Sleep apnea is a common problem that affects an estimated 2% of all children, including many who are undiagnosed.

If not treated, sleep apnea can lead to a variety of problems. These include heart, behavior, learning, and growth problems.

How do I know if my child has sleep apnea?

Symptoms of sleep apnea include

- Frequent snoring
- Problems breathing during the night
- Sleepiness during the day
- Difficulty paying attention
- Behavior problems

If you notice any of these symptoms, let your pediatrician know as soon as possible. Your pediatrician may recommend an overnight sleep study called a *polysomnogram.* Overnight polysomnograms are conducted at hospitals and major medical centers. During the study, medical staff will watch your child sleep. Several sensors will be attached to your child to monitor breathing, oxygenation, and brain waves. An electroencephalogram (EEG) is a test that measures brain waves.

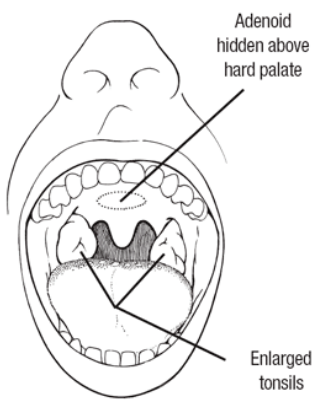
The results of the study will show whether your child suffers from sleep apnea. Other specialists, such as pediatric pulmonologists, otolaryngologists, neurologists, and pediatricians with specialty training in sleep disorders, may help your pediatrician make the diagnosis.

What causes sleep apnea?

Many children with sleep apnea have larger tonsils and adenoids.

Tonsils are the round, reddish masses on each side of your child's throat. They help fight infections in the body. You can only see the adenoid with an x-ray or special mirror. It lies in the space between the nose and throat.

Large tonsils and adenoid may block a child's airway while she sleeps. This causes her to snore and wake up often during the night. However, not every child with large tonsils and adenoid has sleep apnea. A sleep study can tell your doctor whether your child has sleep apnea or if she is simply snoring.



Children born with other medical conditions, such as Down syndrome, cerebral palsy, or craniofacial (skull and face) abnormalities, are at higher risk for sleep apnea. Overweight children are also more likely to suffer from sleep apnea.

How is sleep apnea treated?

The most common way to treat sleep apnea is to remove your child's tonsils and adenoid. This surgery is called a tonsillectomy and adenoidectomy. It is highly effective in treating sleep apnea.

Another effective treatment is nasal continuous positive airway pressure (CPAP), which requires the child to wear a mask while he sleeps. The mask delivers steady air pressure through the child's nose, allowing him to breathe comfortably. Continuous positive airway pressure is usually used in children who do not improve after tonsillectomy and adenoidectomy, or who are not candidates for tonsillectomy and adenoidectomy.

Children who may need additional treatment include children who are overweight or suffering from another complicating condition. Overweight children will improve if they lose weight, but may need to use CPAP until the weight is lost.

Remember

A good night's sleep is important to good health. If your child suffers from the symptoms of sleep apnea, talk with your pediatrician. A proper diagnosis and treatment can mean restful nights and restful days for your child and your family.

From your doctor

American Academy of Pediatrics

DEDICATED TO THE HEALTH OF ALL CHILDREN™

The American Academy of Pediatrics is an organization of 60,000 primary care pediatricians, pediatric medical subspecialists, and pediatric surgical specialists dedicated to the health, safety, and well-being of infants, children, adolescents, and young adults.

American Academy of Pediatrics
Web site — www.HealthyChildren.org

Evaluation and Management of Well-Appearing Febrile Infants 8 to 60 Days Old

- *Clinical Practice Guideline*
  - *PPI: AAP Partnership for Policy Implementation*
    See Appendix 1 for more information.

CLINICAL PRACTICE GUIDELINE

American Academy of Pediatrics
DEDICATED TO THE HEALTH OF ALL CHILDREN™

Clinical Practice Guideline: Evaluation and Management of Well-Appearing Febrile Infants 8 to 60 Days Old

Robert H. Pantell, MD, FAAP,[a] Kenneth B. Roberts, MD, FAAP,[b] William G. Adams, MD, FAAP,[c] Benard P. Dreyer, MD, FAAP,[d] Nathan Kuppermann, MD, MPH, FAAP, FACEP,[e] Sean T. O'Leary, MD, MPH, FAAP,[f] Kymika Okechukwu, MPA,[g] Charles R. Woods Jr, MD, MS, FAAP[h] SUBCOMMITTEE ON FEBRILE INFANTS

This guideline addresses the evaluation and management of well-appearing, term infants, 8 to 60 days of age, with fever ≥38.0°C. Exclusions are noted. After a commissioned evidence-based review by the Agency for Healthcare Research and Quality, an additional extensive and ongoing review of the literature, and supplemental data from published, peer-reviewed studies provided by active investigators, 21 key action statements were derived. For each key action statement, the quality of evidence and benefit-harm relationship were assessed and graded to determine the strength of recommendations. When appropriate, parents' values and preferences should be incorporated as part of shared decision-making. For diagnostic testing, the committee has attempted to develop numbers needed to test, and for antimicrobial administration, the committee provided numbers needed to treat. Three algorithms summarize the recommendations for infants 8 to 21 days of age, 22 to 28 days of age, and 29 to 60 days of age. The recommendations in this guideline do not indicate an exclusive course of treatment or serve as a standard of medical care. Variations, taking into account individual circumstances, may be appropriate.

BACKGROUND

Efforts to develop an evidence-based approach to the evaluation and management of young febrile infants have spanned more than 4 decades.[1] In the 1970s, concerns arose about the emergence and rapid progression of group B *Streptococcus* (GBS) infection in neonates, whose clinical appearance and preliminary laboratory evaluations did not always reflect the presence of serious disease.[2] Such concerns led to extensive evaluations, hospitalizations, and antimicrobial treatment of all febrile infants younger than 60 days,[3] with many institutions extending complete sepsis workups to 90 days. However, the seminal

abstract

[a]*Department of Pediatrics, School of Medicine, University of California San Francisco, San Francisco, California;* [b]*Department of Pediatrics, School of Medicine, University of North Carolina at Chapel Hill, Chapel Hill, North Carolina;* [c]*Boston Medical Center/Boston University School of Medicine, Deparment of Pediatrics, Boston, Massachusetts;* [d]*Department of Pediatrics, NYU Grossman School of Medicine, New York, New York;* [e]*Departments of Emergency Medicine and Pediatrics, School of Medicine, University of California, Davis School of Medicine, Sacramento, California;* [f]*Department of Pediatrics, University of Colorado Anschutz Medical Campus, Aurora, Colorado;* [g]*American Academy of Pediatrics, Itasca, Illinois; and* [h]*Department of Pediatrics, Children's Hospital at Erlanger and College of Medicine, The University of Tennessee at Chattanooga, Chattanooga, Tennessee*

The recommendations in this guideline do not indicate an exclusive course of treatment or serve as a standard of medical care. Variations, taking into account individual circumstances, may be appropriate.

All clinical practice guidelines from the American Academy of Pediatrics automatically expire 5 years after publication unless reaffirmed, revised, or retired at or before that time.

DOI: https://doi.org/10.1542/peds.2021-052228

Address correspondence to Robert H. Pantell, MD. E-mail: Robert.Pantell@UCSF.edu

PEDIATRICS (ISSN Numbers: Print, 0031-4005; Online, 1098-4275).

To cite: Pantell RH, Roberts KB, Adams WG, et al. Clinical Practice Guideline: Evaluation and Management of Well-Appearing Febrile Infants 8 to 60 Days Old. *Pediatrics.* 2021;148(2):e2021052228

1983 study by De Angelis et al[4] highlighted the iatrogenic complications that accompany hospitalizing young, febrile infants and provided an impetus for developing clinical strategies that would be more selective for hospitalizations. Today, the consequences of medical errors during hospitalizations are well known.[5–7]

In the 1980s and 1990s, there were numerous efforts to develop and validate clinical prediction models for detecting serious bacterial illness (SBI).[8–15] Efforts were hampered by the heterogeneity of the definition of SBI. Some studies included clinically obvious infections such as cellulitis. Others included pneumonia, which may be viral or bacterial; many included bacterial gastroenteritis in infants with diarrhea. All included urinary tract infection (UTI), bacteremia, and bacterial meningitis, but UTI is so much more common than the other infections that it distorts models attempting to identify all causes.

These prediction models involved a combination of clinical and laboratory test parameters that were based on a priori criteria and were not derived from the primary data. Each variable was defined arbitrarily, such as age groupings in weeks or months and integers ending in zero, for which there is no real physiologic or biological basis. For example, the variable that defined an abnormal white blood cell (WBC) count as <5000 per mm^3 or $>15\,000$ per mm^3 was not statistically derived but established in advance as an indicator and tested in combination with other predictor variables.

Recommendations emerged that generally relied on clinical appearance, age, urinalysis, WBC count (and/or absolute neutrophil count [ANC], band count, and/or immature to total neutrophil ratio), and cerebrospinal fluid (CSF) analysis (except for the Rochester criteria, which did not require CSF).[10] All had somewhat similar sensitivities and specificities as well as predictive values. The models were promulgated because of moderately high sensitivities (90% to 95%) and high negative predictive values (NPVs) (97%–99%). The high NPVs were expected because of the uncommon occurrence of the most serious infections, which, along with modest specificities (20% to 40%), also explained the relatively low positive predictive values.

A major shift occurred in the mid-1980s when Powell et al in Rochester accepted the inability to predict who was at high risk and attempted instead to predict who was at low risk, even in the first month of life.[10,14] A pattern emerged in which it was recommended that all infants in the youngest group (<29 days of age) should receive extensive evaluations, hospitalization, and empirical antimicrobial treatment, and infants 29 to 90 days of age could be managed with presumptive intramuscular ceftriaxone as outpatients with pending blood, urine, and CSF culture results.[15]

In time, other groups used techniques to develop clinical prediction rules that rely on gathered data to derive and define the best, most precise, and parsimonious set of variables that predict a defined outcome that can be translated into recommendations.[16–18] Still another approach was the sequential approach of established clinical and laboratory criteria.[19,20] Despite these substantial efforts, there has been ongoing evidence that community and emergency physicians do not routinely follow these recommendations in real-world settings.[17,21–27] Clinical outcomes have not been shown to suffer despite nonadherence to contemporaneous standards of care.

Differing approaches to the management of very young febrile infants indicated the need for a guideline that is current, evidence-based, and developed by a national professional society or organization with broad representation. This led the American Academy of Pediatrics (AAP) to embark on developing this guideline with the assistance of an evidence review commissioned by the Agency for Healthcare Research and Quality (AHRQ).[26]

Attention has been given to the following present-day considerations:

1. Changing Bacteriology

Since the 1980s, the epidemiology of bacterial infections in neonates and infants has changed as a result of many factors, including prenatal GBS screening and incorporation of immunization against *Streptococcus pneumoniae.* Furthermore, improvements in food safety may have resulted in a decrease in the incidence of disease caused by *Listeria monocytogenes* in this age group. Recent studies demonstrate that *Esherichia coli* is now the most common organism to cause bacteremia, while GBS remains the most common cause of meningitis in most studies.[25,27–31] Infections with *L monocytogenes* are now rare in the United States.[32,33] The shift from Gram-positive to Gram-negative predominance has implications for the choice of tests, interpretation of values for decision-making, and the selection of antimicrobial drugs. Using the decision models of the 1980s today can lead to misclassification of bacterial meningitis in 23.3% to 32.1% of cases.[34]

2. Cost of Unnecessary Care

Studies indicate significant variation in care and consequently considerable differences in costs.[17,22–24] Differential access, delays, language barriers, and fragmented care can also be costly to infants, families, and the health care system. A substantial basis for practice variability among clinicians is attributable to differences in infants' clinical presentations and severities of illness. However, more than 50% of the variability has been unexplained.[35] Beyond unnecessary hospitalizations, and financial and social costs, there are also potential harms from hospital-acquired infections and iatrogenesis in prolonged hospitalizations.

Costs are justified on the basis of the magnitude of the benefit and/or reduction of potential harms. In studies of prediction models, instances of missed invasive bacterial infections (IBI) in well-appearing low-risk infants are uncommon. For infants not managed according to existing clinical prediction models, there are also uncommon misses reported in the literature. These factors suggested there is an opportunity to "safely do less."[36]

3. Advances in Testing

Inflammatory Markers

The WBC, ANC, and band count, combined with clinical appearance and urinalysis, have been the foundation of earlier clinical prediction models. With *E coli* replacing GBS as the most common bacterial pathogen in this age group, these markers are no longer as useful. C-reactive protein (CRP), an inflammatory marker (IM) produced by the liver in response to infections and numerous other conditions, is now available for point-of-care testing.[37] Procalcitonin, expressed mainly by thyroid C cells, is produced rapidly in response to infection and other tissue injuries. It is more specific for bacterial infections than other IMs and rises more quickly to abnormal values. Procalcitonin has emerged as the most accurate IM for risk stratification available, although not currently available at many sites in the United States with timely results on a 24/7 basis.[38,39] (See additional discussion in KAS 10)

Pathogen Identification

There have been improvements allowing more accurate screening for invasive infections and more rapid and precise identification of bacterial, viral, and fungal pathogens. Automated blood culture systems can now identify most bacterial pathogens in <24 hours. Most recently, nested multiplex polymerase chain reaction (PCR) testing of positive blood cultures can identify bacterial pathogens and antimicrobial resistance genes in approximately 1 hour.[40–42] Similarly, multiplex meningoencephalitis panels can provide results on CSF for 14 potential CSF pathogens in 1 hour.[43]

Viral Testing

The development of rapid viral PCR and multiplex respiratory viral testing has led to identifying emerging agents, such as parechovirus, and prompted analyses of their effect on risk stratification of young febrile infants.[44–53] Although the presence of documented respiratory viral infections decreases the risk of IBIs in febrile infants (see Inclusion Criteria 5, Positive viral test), it remains unclear how a positive viral test result should influence further laboratory evaluation and management, especially in the first month of life. In addition, it is unclear whether a positive viral test result will either obviate or shorten hospitalization. Researchers in a study analyzing data before the widespread availability of multiplex viral testing (2000–2012) did not find a difference in length of stay between febrile infants with or without positive viral test results.[54] More work is needed, and this is included as an important question in Future Research.

Emerging Technologies

The area of genomic diagnostics for IBIs is still in its relative infancy, including both genomic identification of viral and bacterial genetic material as well as identifying host genomic responses to viral or bacterial infections. Both need further work to see how these technologies compare in accuracy and timing to routine diagnostic techniques. But progress is being made for RNA transcriptional profiling[55] and next-generation sequencing of microbial cell-free DNA.[56]

4. Opportunities to Improve the Care of Hospitalized Infants

Advances in testing and clinical strategies can speed discharge. Data indicate that including evidence-based strategies in care process models can improve infant outcomes.[57] Hospital environments can be stressful for parents but can be restructured to support maternal/child bonding and breastfeeding.[58] See further discussion in KAS 6.

5. Evolving Research Strategies

Although early studies largely emanated from single-site inner-city emergency departments (EDs), recent investigations conducted by large, geographically widespread research networks and integrated regional health care systems have developed more generalizable evidence.[17–20,22,25,57] Advances in data storage and analysis as well as adoption of statistical procedures[59] for developing clinical prediction rules offer

advantages compared with earlier efforts. Collaborative efforts of primary care practices, EDs, hospitals, and integrated health systems are creating larger and more refined data sets. With personalized medicine, enabled by these large data sets and evolving modeling techniques capable of analyzing infants on dozens of variables, the committee anticipates that in the future we will see "one child, one guideline."

This guideline, grounded in continually expanding evidence and including new technologies, should, for today's clinicians, form the foundation on which a more nuanced and precise approach can be used to develop an optimal strategy for evaluating and managing each febrile infant. The committee encourages use of the 3 age-based algorithms in Figs 1–3 as a guide to arriving at the best approach. Approaches may differ somewhat depending on many perinatal or neonatal factors, clinician's experience, parents' abilities and values, nature of relationship with the infant's family, characteristics of the clinical setting, and ability to obtain timely laboratory results, among others.

EVIDENCE FOR AGE-BASED RISK STRATIFICATION

Ongoing research has challenged classifying all infants younger than

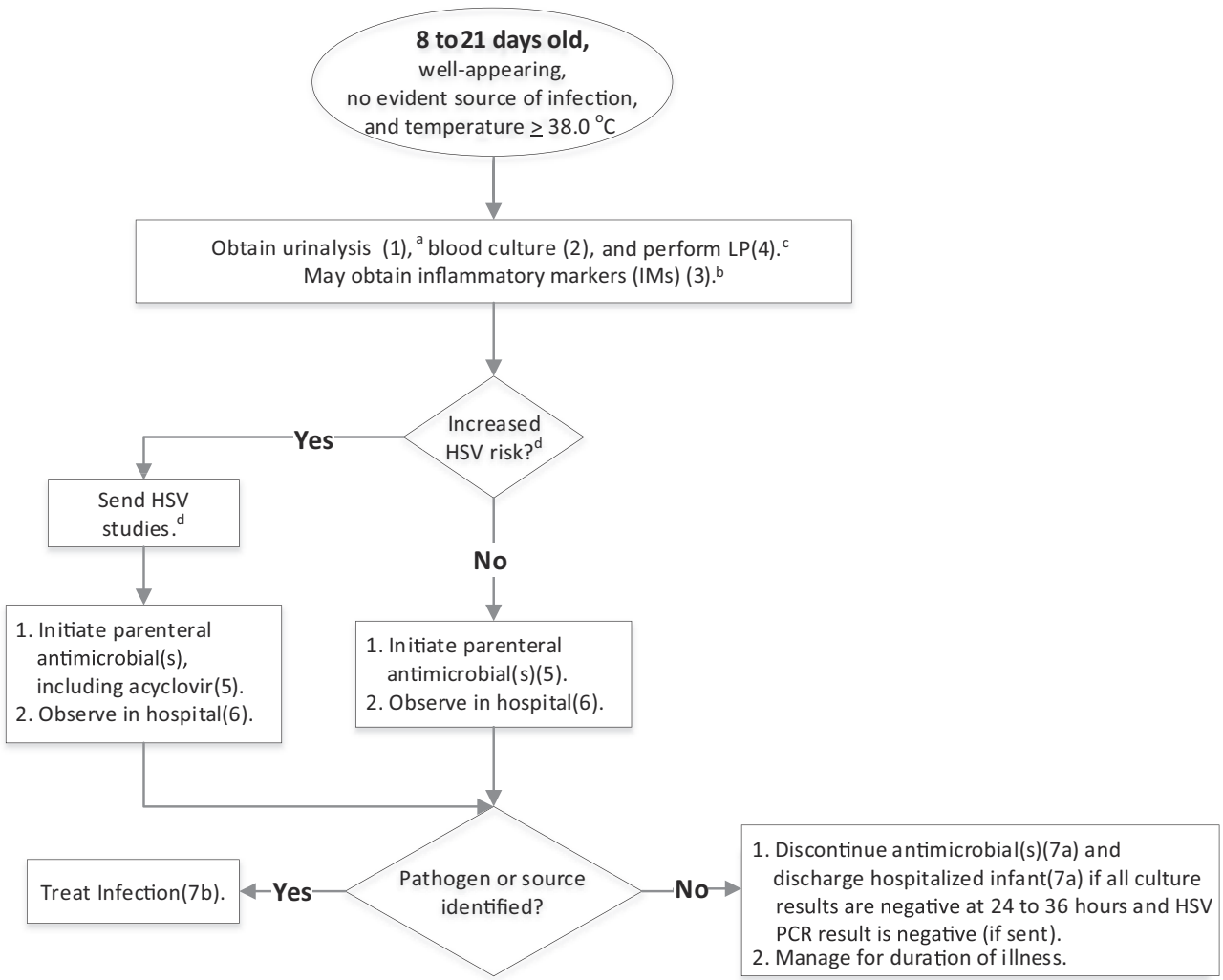


FIGURE 1 Algorithm for 8- to 21-day-old infants. [a] KAS references are shown in parentheses. [b] Laboratory values of inflammation are considered elevated at the following levels: (1) procalcitonin >0.5 ng/mL, (2) CRP >20 mg/L, and (3) ANC >4000, >5200 per mm^3 (see text). Although we recommend all infants in this age group have a complete sepsis workup, receive parenteral antimicrobial agents, and be monitored in a hospital, knowing IM results can potentially guide ongoing clinical decisions. [c] Send CSF for cell count, Gram stain, glucose, protein, bacterial culture, and enterovirus PCR (if available) if pleocytosis is present and during periods of increased local enterovirus prevalence. [d] HSV should be considered when there is a maternal history of genital HSV lesions or fevers from 48 hours before to 48 hours after delivery and in infants with vesicles, seizures, hypothermia, mucous membrane ulcers, CSF pleocytosis in the absence of a positive Gram stain result, leukopenia, thrombocytopenia, or elevated alanine aminotransferase levels. For further discussion, see the current *Red Book*. Recommended HSV studies are CSF PCR; HSV surface swabs of the mouth, nasopharynx, conjunctivae, and anus for an HSV culture (if available) or PCR assay; alanine aminotransferase; and blood PCR.

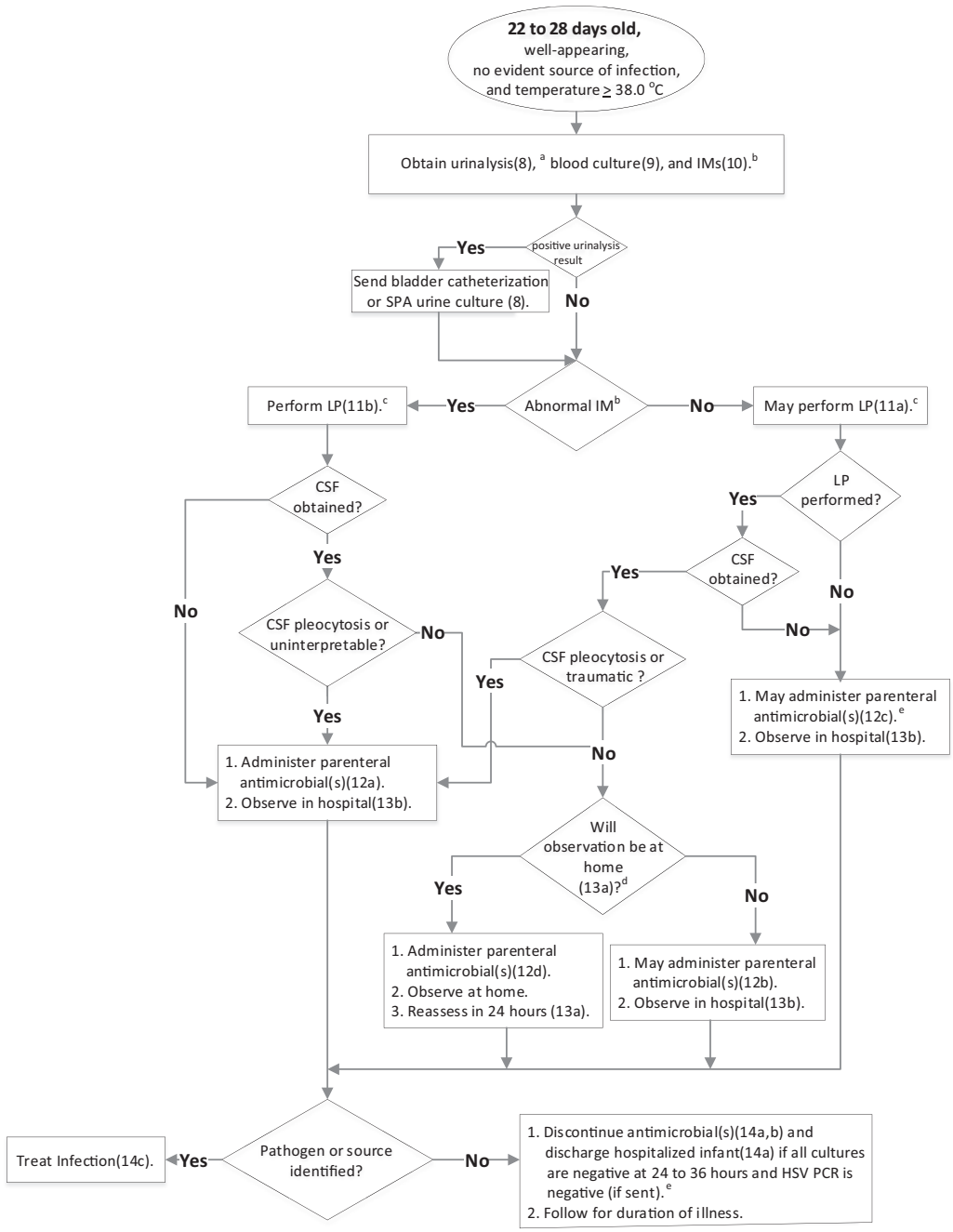


FIGURE 2 Algorithm for 22- to 28-day-old infants. [a] KAS references are shown in parentheses. [b] If available, procalcitonin should be obtained along with ANC or CRP. If procalcitonin is unavailable, both ANC and CRP should be obtained, and a temperature >38.5°C is considered abnormal. IMs are considered abnormal at the following levels: (1) temperature >38.5°C, (2) procalcitonin >0.5 ng/mL, (3) CRP >20 mg/L, and (4) ANC >4000, >5200 per mm^3 (see text). [c] LP is recommended before administration of antimicrobial agents because interpreting CSF after the administration of antimicrobial agents is difficult. However, the risk of meningitis in 22- to 28-day-old infants is lower than that in infants <22 days old in several studies. Therefore, in some circumstances, clinicians may elect to defer an LP and initiate antimicrobial agents, recognizing the potential risk of partially treated meningitis. Send CSF for cell count, Gram stain, glucose, protein, bacterial culture, and enterovirus PCR (if available) if pleocytosis is present and during periods of increased enterovirus prevalence. HSV can occur in this age group. HSV should be considered in infants with vesicles, seizures, hypothermia, mucous membrane ulcers, CSF pleocytosis in the absence of a positive Gram stain result, leukopenia, thrombocytopenia, or elevated alanine aminotransferase levels. For further discussion, see the current *Red Book*. Recommended HSV studies: CSF PCR; HSV surface swabs of mouth, nasopharynx, conjunctivae, and anus for HSV culture (if available) or PCR assay; alanine aminotransferase; and blood PCR. [d] Infant may be managed at home if parent and clinician agree that the following are present: reliable phone and transportation, parent willingness to observe and communicate changes in condition, and agreement to the infant being reevaluated in 24 hours. [e] If CSF is positive for enterovirus, clinicians may withhold or discontinue antimicrobial agents and discharge at 24 hours, provided they meet other criteria for observation at home.

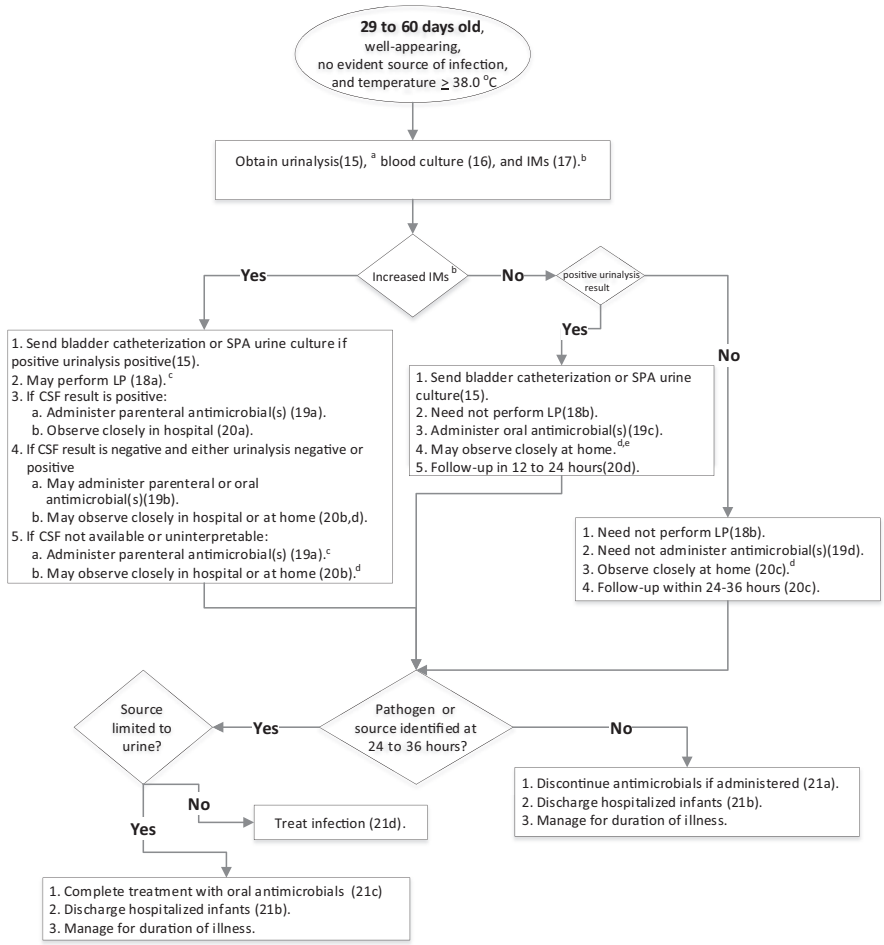


FIGURE 3 Algorithm for 29- to 60-day-old infants. [a] KAS references are shown in parentheses. [b] If available, procalcitonin should be obtained along with ANC or CRP. If procalcitonin is unavailable, both ANC and CRP should be obtained, and a temperature >38.5°C is considered abnormal. IMs are considered abnormal at the following levels: (1) temperature >38.5°C, (2) procalcitonin >0.5 ng/mL, (3) CRP >20 mg/L, (4) ANC >4000, >5200 per mm^3 (see text). [c] Send CSF for cell count, Gram stain, glucose, protein, bacterial culture, and enterovirus PCR (if available) if CSF pleocytosis is present and during periods of increased local enterovirus prevalence. Although uncommon in this age group, HSV should be considered when there is a maternal history of genital HSV lesions and in infants with vesicles, seizures, hypothermia, mucous membrane ulcers, CSF pleocytosis in the absence of a positive Gram stain result, leukopenia, thrombocytopenia, or elevated alanine aminotransferase levels. For further discussion, see the current *Red Book*. Recommended HSV studies are CSF PCR; HSV surface swabs of mouth, nasopharynx, conjunctivae, and anus for HSV culture (if available) or PCR assay; alanine aminotransferase; and blood PCR. If CSF is unobtainable or uninterpretable, there are insufficient data to make a specific recommendation. Options include the following: observe without treatment for a period of time and, depending on infant clinical condition, repeat LP and/or laboratory markers; begin empirical antimicrobial agents and reassess in 24 hours on the basis of infant response and results of blood culture; if CSF is bloody or antimicrobial agents have previously been started, analysis by multiplex PCR can add additional information; consult with local a pediatric infectious disease specialist. [d] Infant may be managed at home if parent and clinician agree that the following are present: reliable phone and transportation, parent willingness to observe and communicate changes in condition, and agreement to the infant being reevaluated in 24 hours. [e] Most 29- to 60-day-old infants with negative IM and urinalysis results may be observed at home. However, hospital observation is an option for infants when there are barriers to follow-up.

29 days as high risk. The Pediatric Research in Office Settings (PROS) study indicated that when combined with other variables, infants >25 days of age were at low risk for IBIs, 0.4%.[17] Subsequently, the European Collaborative Group developed and validated the step-by-step approach with a combination of clinical and laboratory variables that included 22- to 28-day-old infants, capable of identifying infants at low risk for IBIs, ranging from 0.2% to 0.7%.[19,20] A recent scoring system methodologically derived by Aronson et al identified age >21 days to be useful in identifying low-risk infants.[60] In a prospective study of 4778 infants from the Pediatric Emergency Care Applied Research Network (PECARN), there was a significantly lower rate of bacteremia in the fourth week (1.6%) compared with weeks 2 (5.3%) and 3 (3.3%) and no difference from weeks 5 and 6

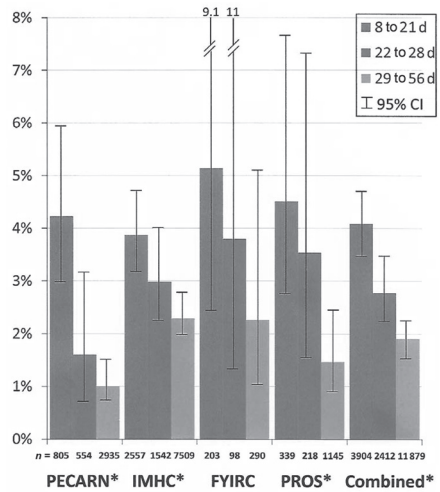


FIGURE 4 Rate of bacteremia by age groupings. * χ^2 for trend: $P < .001$. Note that the 95% CIs in the combined group do not overlap. Data were adapted from reference 61; from reference 94, with detail provided by C.L.B. (personal communication, 2020); from reference 24, with detail provided by Paul Aronson (personal communication, 2020); and from reference 17, with detail provided by Matthew Pantell (personal communication, 2020). FYIRC, Febrile Young Infants Research Collaborative; IMHC, University of Utah/Intermountain Healthcare.

($P = .76$).[61] A prospective national surveillance study in England analyzed 22 075 episodes of IBI from 2010–2017.[62] This population-based analysis documented a dramatic decrease in IBI after the first week of life, followed by a continuous stepwise decrease in population incidence over the next 8 weeks. The decline in bacteremia prevalence by age for regional and national studies is portrayed in Fig 4.

Because risk of IBI has extensively been documented to steadily decline over the first few months, any day or week cutoff is arbitrary and subject to interpretation depending on a clinician's or a parent's risk aversion or tolerance. These data form the basis for the committee developing a separate algorithm for infants 22 to 28 days of age.

CHALLENGES

A number of unique challenges confronted the development of an evidence-based approach to the febrile infant.

1. The initial challenge was to decide whether to include infants in the first week of life. The committee decided early on that infants in the first week of life are sufficiently different in rates and types of illness, including early-onset bacterial infection, that they should be excluded from this guideline.
2. Many published studies used SBI as an outcome measure. Because SBI is not a single clinical entity, analyses fell short of identifying the risks for specific infections. UTI is so much more common than the other bacterial infections that it can distort the accuracy of a prediction model to detect bacteremia or bacterial meningitis. This guideline addresses evidence for bacterial meningitis and bacteremia separately from UTIs; the committee strongly discourages further use of the term "SBI."
3. Meningitis, the most serious bacterial infection responsible for infants' fevers, is uncommon. Accumulating a large enough sample size to be able to accurately predict infrequent infections is a major research challenge; an even larger sample size is required to address the morbidity and long-term consequences accompanying meningitis.
4. As the epidemiology of bacterial species responsible for infections is continually changing, a prediction model or rule developed today will not necessarily be valid in the future. Species types and resistance patterns also vary geographically.
5. Existing clinical prediction models as well as prediction rules often rely on "clinical appearance," well versus ill, a subjective assessment.[8–17,19,20] Despite an elegant process of development, the Yale Observational Score,[8] a formal scoring system for illness appearance, has not proven to be useful in this age group.[63,64] The accuracy of clinician assessment is likely related to experience. Unfortunately, there is no measure or adequate definition for what constitutes "experienced," or of "well appearing." Researchers in large studies have often treated clinical appearance as binary: well appearing or not, or ill appearing or not. When offered 3 categories, however, both senior residents[65] and experienced pediatricians[17] classified a quarter of the young febrile infants they encountered in an intermediate category, acknowledgment that the distinction between "well" and "ill" is not always clear-cut. The distinction is likely to be most difficult before the emergence of the social smile, which enables the infant to "respond to social overtures," a key element in the Yale Observational Score.[8] Clinicians differ in a variety of ways including knowledge, clinical experience with febrile infants, and in the time available to evaluate and monitor infants. The committee acknowledges that some clinicians may have different levels of experience and

confidence in determining well appearance compared with experienced pediatricians.
6. Clinicians work in different settings with a range of familiarity with their patients and families, access to medical records, and abilities to follow-up with patients in a timely fashion.
7. Clinicians have variable access to newer diagnostic tests and timely results, particularly procalcitonin.
8. Families possess a spectrum of knowledge and skills to continuously observe and assess infants discharged from the hospital. Multiple factors may affect a timely return visit. There has been considerable interest focused on shared decision-making for young febrile infants,[66–70] including a recent mobile device app to help clinicians communicate with parents.[71]

For purposes of this guideline, the committee believes that at a minimum, families should be provided with information about the risks and benefits of all procedures, including invasive procedures such as a lumbar puncture (LP) and a bladder catheterization. An opportunity for questions and dialogue between the family and care team should be provided. Families' decisions about their infant will be made in the context of their previous experiences with the health system, their personal beliefs and values, and knowledge and understanding of their child's condition and diagnostic and treatment options and outcomes.

The decision to actively monitor an infant at home or in the hospital requires a collaborative discussion between the family and the care team. The discussion should be centered on the best interest of the child, taking into account the family's and the care team's assessment of the multiple factors of risk and risk tolerance, experience and comfort of monitoring an ill infant, and ease and accessibility of transportation. Academic medical centers and children's hospitals generally provide high-quality observation for ill infants, as do many community hospitals with dedicated pediatrics units. Many hospitals do not have nurses and staff with experience and skills caring for young infants, however. In the current health care system, insurance status and coverage may further affect the family's and care team's decision on location of monitoring.

RISK TOLERANCE: A NUMBER IS NOT A DECISION

Even with the availability of valid and reliable data, thoughtful investigators and clinicians will have different thresholds for recommending diagnostic tests and therapeutic interventions. The committee believes understanding risk tolerance is of fundamental importance to guideline interpretation. In a straightforward case of a febrile infant having CSF pleocytosis with a predominance of polymorphonuclear leukocytes and a positive Gram stain result, the committee would expect clinicians to unanimously agree the infant be hospitalized and receive immediate antimicrobial treatment. Similarly, on the basis of prevalences cited in KAS 1, 8, and 15, a risk for UTI can be estimated at 10%, which translates to a recommendation to perform 10 urinalyses to detect a single UTI, or a number needed to test of 10. This is an example in which agreement to perform a urinalysis is expected. However, challenges frequently occur. For example, if clinical and laboratory evaluations suggest the likelihood of bacteremia is 1:100 (number needed to treat = 100) or a risk of bacterial meningitis at 1:1000 (number needed to test = 1000), is it worth 100 doses of antibiotics to treat a single case of bacteremia while awaiting blood culture results? Should the committee recommend performing the number of LPs required to obtain 1000 samples of interpretable CSF to prevent a delay in recognizing and treating a single case of bacterial meningitis? Responses to these questions depend on how much risk is considered tolerable. The challenge in guideline development was succinctly stated as, "Thus, evidence alone never speaks for itself or conveys the truth because it always requires interpretation."[72] In the committee's discussions, responses to the above questions and similar issues varied among and within the specialty groups constituting the committee and reviewers.

Differences in risk tolerance also exist between parents and physicians and may exist among family members. A clinician may estimate that an infant's risk of meningitis is 1% and an LP is indicated, whereas a parent may have a higher threshold for consenting to the procedure. These differences, along with other parent beliefs and values, provide further challenges in an effort to share decision-making in an acute setting.

CONSENSUS RECOMMENDATIONS

The recommendations in this guideline reflect universal agreement or a strong consensus among committee members. In the one situation when there was majority but not consensus agreement, additional committee members were appointed and added; subsequently, consensus was achieved. The major reason for disagreement was varying levels of risk tolerance among committee members. For these recommendations, a more detailed

explanation of the uncertainties involved and attempts to derive numbers needed to test and numbers needed to treat are provided in the specific Key Action Statements.

METHODOLOGY

The working group consisted of representatives from epidemiology; general pediatrics; pediatric subspecialties, including emergency medicine, infectious diseases, and hospital medicine; and family medicine. Individuals with expertise in guideline development, algorithm creation, and quality improvement were also included. During the development of this guideline, all members had access to the AHRQ evidence review,[26] the additional analyses by the committee epidemiologist (C.R.W. Jr.) as well as others, copies of all published literature cited in these reports, and the opportunity to participate in 4 meetings convened at the AAP and on conference calls. The authoring group relied on data and analyses from the following: (1) a formal analysis and systematic review of published articles from the United States and selected international countries that was conducted by an Evidence-Based Practice Center under contract to AHRQ; (2) a supplemental review and analyses were performed by the epidemiologist assigned to the committee; (3) consistent with a previous AAP guideline[73] if literature gaps existed, data were solicited and received from authors of previously published, peer-reviewed articles who performed additional analyses from their investigations: Kaiser Permanente Northern California; Intermountain Healthcare; the AAP PROS network; the Febrile Young Infant Research Collaborative (FYIRC); Boston Children's Hospital; The European Collaborative Group; Cruces University Hospital, Barakaldo,

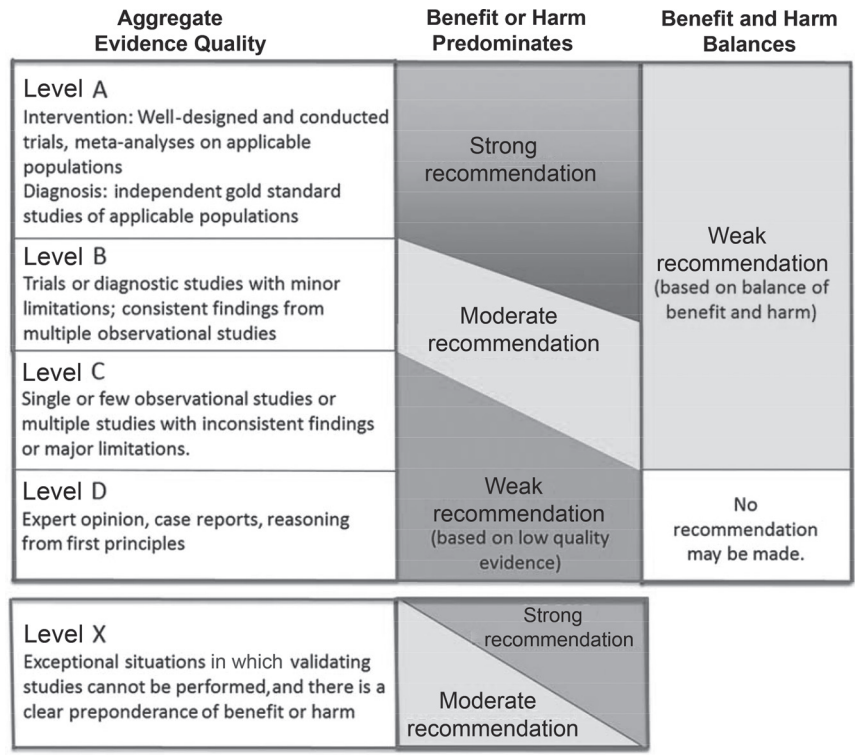


FIGURE 5 AAP rating of evidence and recommendations.

Spain; and the PECARN; and (4) committee members with active research and data collection projects provided ongoing study reports. Ongoing data analyses from these works in progress are consistent with cited references and support the recommendations.

Finally, after the formulation of a set of recommendations, there was further consideration by AAP Sections and Committees, external organizations, physician reviewers, and parents, as well as focus groups of pediatricians from general pediatrics, pediatric hospital medicine, pediatric emergency medicine, pediatric critical care, and pediatric infectious diseases (see Acknowledgments for review groups).

The committee's focus was to develop a guideline to improve the diagnosis and treatment of UTIs, bacteremia, and meningitis. Sometimes the term "SBI" is used because it was the only outcome measure reported in many investigations. In some analyses, bacteremia and bacterial meningitis are combined as IBIs because of the nature of those infections compared with UTIs.

Recommendations are contained in the algorithms for infants 8 to 21 days of age, 22 to 28 days of age, and 29 to 60 days of age and are expounded in the accompanying Key Action Statements. For each recommendation, the quality of available evidence on which the recommendation is based is rated, and the strength of each recommendation is provided (Fig 5). Risks and benefits also are indicated, and assessments of their balance are provided.

In accordance with recent suggestions by the National Academy of Medicine, the committee attempted transparency by occasionally commenting on value judgments.[74] A clinical decision

involves more than just knowing a specific risk. The decision about what action is appropriate with a given risk depends on the experience, value judgments, and risk tolerance and aversion of the interpreting clinician. To the extent possible, it is appropriate to incorporate parents' values and preferences in shared decision-making.

As noted above and consistent with all AAP clinical practice guidelines, each recommendation represents a consensus of the committee, although not necessarily universal agreement.

POPULATION ADDRESSED

This guideline addresses febrile infants who are well appearing. Infants appearing moderately or severely ill are at higher risk for IBIs and are NOT addressed in the guideline. Because of the difficulties assessing well appearance discussed previously in Challenges, we recommend that when clinicians are uncertain as to whether an infant is well appearing, this guideline should not be applied.

For eligibility, this guideline addresses febrile infants who (1) are well appearing, (2) have documented rectal temperatures of ≥38.0°C or 100.4°F at home in the past 24 hours or determined in a clinical setting, (3) had a gestation between ≥37 and <42 weeks, and (4) are 8 to 60 days of age and at home after discharge from a newborn nursery or born at home.

The following merit additional consideration specific to their condition and are intended to be excluded from the algorithms:

1. Preterm infants (<37 weeks' gestation).
2. Infants younger than 2 weeks of age whose perinatal courses were complicated by maternal fever, infection, and/or antimicrobial use.
3. Febrile infants with high suspicion of herpes simplex virus (HSV) infection (eg, vesicles).
4. Infants with a focal bacterial infection (eg, cellulitis, omphalitis, septic arthritis, osteomyelitis). These infections should be managed according to accepted standards.
5. Infants with clinical bronchiolitis, with or without positive test results for respiratory syncytial virus (RSV). A review by Ralston et al of 11 studies of bronchiolitis found no cases of meningitis, and researchers in 8 studies reported no cases of bacteremia.[51]
6. Infants with documented or suspected immune compromise.
7. Infants whose neonatal course was complicated by surgery or infection.
8. Infants with congenital or chromosomal abnormalities.
9. Medically fragile infants requiring some form of technology or ongoing therapeutic intervention to sustain life.
10. Infants who have received immunizations within the last 48 hours. The incidence of postimmunization fevers ≥38.0°C is estimated to be >40% within the first 48 hours.[75]

Infants with the following may be included:

1. Respiratory symptoms: the presence of upper respiratory tract infection symptoms or other respiratory symptoms not diagnostic of bronchiolitis should not exclude infants from inclusion in the pathway.
2. Diarrhea: infants suspected of having diarrhea caused by treatable bacterial pathogens should have stool specimens tested. If studies for bacteria are negative, infants may then enter the decision tree pathway. Loose stools do not exclude infants from the pathway.
3. Otitis media: diagnosing infants with presumed otitis media does not preclude their entry into the pathway.
4. Current or recent use of antimicrobial agents in infants older than 2 weeks of age requires individualized interpretation for febrile infants who enter the pathway.
5. Positive viral test results: the availability of rapid respiratory molecular testing for a variety of viruses is increasing, outpacing the availability of evidence for how such testing should be used.

The 2014 Cochrane review that included older infants and children did not recommend respiratory viral testing in the ED.[52] In evaluating the implications of a positive viral respiratory test result, numerous studies have documented lowering of IBI risk in subsets of patients. However, no prospective study has yet provided convincing data on whether a positive viral test result sufficiently reduces the IBI risk to change decision-making, after considering other historical, clinical, and available markers of inflammation.

In a 2004 study, Byington et al evaluated whether a positive respiratory viral test result lowered the risk of IBI in 1385 infants 1 to 90 days of age.[76] Viruses were detected in 35%, and the bacteremia risk in the viral-positive infants was 1%, significantly lower than the 2.7% in viral-negative infants. When positive viral test results were combined with the Rochester classification, there was no reduction in risk for infants already classified as low risk. Rochester high-risk group infants with positive viral test results had a similar prevalence of bacteremia as low-risk infants.

Emerging data from several large studies address viral testing in young febrile infants stratified by age. Infants <28 days of age with a positive viral test result have a risk of IBI from 1.1% to 2.1%.[44–50,76] One

TABLE 1 Summary of Key Action Statements

	Evidence Quality; Strength of Recommendation
Infants 8 to 21 d of age (KASs 1-7): Clinicians . . .	
KAS 1: Should obtain urine specimen by catheterization or suprapubic aspiration (SPA) of bladder for urinalysis and, if urinalysis result is positive, for culture.	Grade: A; Strong Recommendation
KAS 2: Should obtain a blood culture.	Grade: A; Strong Recommendation
KAS 3: May assess IMs.	Grade: B; Weak Recommendation
KAS 4: Should obtain CSF for analysis (WBC count, protein, glucose, Gram stain) and culture for bacteria. See notes for viral testing.	Grade: A; Strong Recommendation
KAS 5: Should initiate parenteral antimicrobial therapy.	Grade: A; Strong Recommendation
KAS 6: Should actively monitor infants while awaiting results of bacterial cultures in a hospital setting with nurses and staff experienced in the care of neonates/young infants.	Grade: B; Moderate Recommendation
KAS 7a: Should discontinue parenteral antimicrobial agents and discharge hospitalized patients when all of the following criteria are met: (1) culture results are negative for 24–36 h or only positive for contaminants; (2) the infant continues to appear clinically well or is improving (eg, fever, feeding); (3) there are no other reasons for hospitalization.	Grade: B; Strong Recommendation
KAS 7b: Should treat infants' positive bacterial pathogens in urine, blood, or CSF with targeted antimicrobial therapy for the duration of time consistent with the nature of the disease, responsible organism, and response of the infant to treatment.	Grade: A; Strong Recommendation
Infants 22 to 28 d of age (KASs 8–4): Clinicians . . .	
KAS 8: Should obtain urine specimen by catheterization or SPA of bladder for urinalysis and, if urinalysis result is positive, for culture.	Grade: A; Strong Recommendation
OR Should obtain urine specimen by bag, spontaneous void, or stimulated void for urinalysis and, if urinalysis result is positive, obtain a catheterization or SPA specimen for culture.	Grade: A Strong Recommendation
KAS 9: Should obtain a blood culture.	Grade: A; Strong Recommendation
KAS 10: Should assess IMs.	Grade: B; Strong Recommendation
KAS 11a: Clinicians may obtain a CSF analysis on infants 22–28 d of age even if all of the following criteria are met: (1) urinalysis result is negative or positive; (2) no IM obtained is abnormal; (3) blood and urine cultures have been obtained; (4) infant is hospitalized.	Grade: B; Moderate Recommendation
KAS 11b. Should obtain CSF for analysis (WBC count, protein, glucose, Gram stain), and bacterial culture if any IM obtained is abnormal.	Grade: C; Moderate Recommendation
KAS 12a. Should administer parenteral antimicrobial therapy in a hospital if either of the following apply: (1) CSF analysis suggests bacterial meningitis; (2) urinalysis result is positive.	Grade: A; Strong Recommendation
KAS 12b. May administer parenteral antimicrobial therapy in a hospital if ALL of the following apply: (1) CSF analysis is normal; (2) urinalysis is normal; (3) Any IM obtained is abnormal.	Grade: B; Moderate Recommendation
KAS 12c. May administer parenteral antimicrobial therapy to hospitalized infants even if ALL of the following are met: (1) urinalysis is normal; (2) no IM obtained is abnormal; (3) CSF analysis is normal or enterovirus-positive.	Grade: B; Weak Recommendation
KAS 12d: Should administer parenteral antimicrobial therapy for infants who will be managed at home even if ALL of the following are met: (1) urinalysis is normal; (2) No IM obtained is abnormal; (3) CSF analysis is normal.	Grade: C; Moderate Recommendation
KAS 13a: May manage infants at home if all of the following criteria are met: (1) Urinalysis is normal; (2) No IM obtained is abnormal. (3) CSF analysis is normal or enterovirus-positive. (4) Verbal teaching and written instructions have been provided for monitoring throughout the period of time at home. (5) Follow-up plans for reevaluation in 24 h have been developed and are in place. (6) Plans have been developed and are in place in case of change in clinical status, including means of communication between family and providers and access to emergency medical care.	Grade: B; Moderate Recommendation
KAS 13b: Should hospitalize infants in a facility with nurses and staff experienced in the care of neonates/young infants when CSF is not obtained or is uninterpretable.	Grade: B; Weak Recommendation
KAS 14a: Should discontinue antimicrobial agents and discharge hospitalized infants after 24 to 36 h of negative culture results if the following are met: (1) the infant is clinically well or improving (eg, fever, feeding); (2) there are no other reasons for hospitalization; (3) there is no other infection requiring treatment (eg, otitis media).	Grade: B; Strong Recommendation
KAS 14b: Should discontinue antimicrobial agents on infants managed at home when all of the following criteria are met: (1) infant is clinically well or improving (eg, fever, feeding) at time of reassessment; (2) all culture results are negative at 24–36 h; (3) there is no other infection requiring treatment (eg, otitis media).	Grade: B; Strong Recommendation
KAS 14c: Should treat infants' positive bacterial pathogens in urine, blood, or CSF with targeted antimicrobial therapy for the duration of time consistent with the nature of the disease, responsible organism, and response of the infant to treatment.	Grade: A; Strong Recommendation
Infants 29 to 60 d of age (KASs 15-21): Clinicians . . .	
KAS 15: Should obtain urine specimen by bag, spontaneous void, or stimulated void for urinalysis and, if urinalysis result is positive, obtain a catheterization or SPA specimen for culture.	Grade: A; Strong Recommendation
or Should obtain urine specimen by catheterization or SPA of bladder for urinalysis and, if result is positive, for culture.	Grade: A; Strong Recommendation

TABLE 1 Continued

	Evidence Quality; Strength of Recommendation
KAS 16: Should obtain a blood culture.	Grade: B; Moderate Recommendation
KAS 17: Should assess IMs.	Grade: B; Moderate Recommendation
KAS 18a: May obtain CSF for analysis (WBC count, differential, protein, glucose, Gram stain), culture for bacteria, and test for enterovirus when CSF pleocytosis is detected or during enterovirus season if any IM is abnormal.	Grade: C; Weak Recommendation
KAS 18b: Need not obtain CSF for analysis and culture if all IMs obtained are normal.	Grade: B; Moderate Recommendation
KAS 19a: Should use parenteral antimicrobial therapy if CSF analysis suggests bacterial meningitis.	Grade: A; Strong Recommendation
KAS 19b: May use parenteral antimicrobial therapy if both of the following apply: (1) CSF analysis (if CSF obtained) is normal; (2) any IM obtained is abnormal.	Grade: B; Moderate Recommendation
KAS 19c: Should initiate oral antimicrobial therapy if all of the following apply: (1) CSF analysis (if CSF obtained) is normal; (2) urinalysis result is positive; (3) no IM obtained is abnormal.	Grade: B; Strong Recommendation
KAS 19d: Need not use antimicrobial therapy while awaiting bacterial culture results if all of the following are met: (1) CSF analysis, if CSF obtained, is normal or enterovirus-positive; (2) urinalysis result is negative; (3) no IM obtained is abnormal.	Grade: B; Moderate Recommendation
KAS 20a: Should hospitalize infants in a unit with nurses and staff experienced in the care of 29- to 60-d-old infants if CSF analysis, if CSF obtained, is abnormal.	Grade: A; Strong recommendation
KAS 20b: May hospitalize infants in a unit with nurses and staff experienced in the care of 29- to 60-d-old infants if any IM obtained is abnormal.	Grade: B; Moderate recommendation
KAS 20c: Should manage patients at home if all of the following criteria are met: (1) CSF analysis, if CSF obtained, is normal; (2) urinalysis result is negative; (3) all IMs obtained are normal; (4) appropriate parental education has been provided; (5) follow-up plans for reevaluation in 24 h have been developed and are in place (6) plans have been developed and are in place in case of change in clinical status, including means of communication between family and providers and access to emergency medical care.	Grade: B; Moderate Recommendation
KAS 20d: May manage infants without antimicrobial treatment at home without having obtained interpretable CSF if all of the following are met: (1) urinalysis result is negative; (2) all IMs obtained are normal; (3) parents can return promptly if there is a change in infant condition and agree to follow-up in 24 to 36 h. Infants monitored at home should be reassessed in the following 24 h.	Grade: B; Moderate Recommendation
KAS 21a. Should discontinue antimicrobial agents when all of the following are met: (1) all bacterial culture results are negative at 24–36 h; (2) infant is clinically well or improving (eg, fever, feeding); (3) there is no other infection requiring treatment (eg, otitis media).	Grade: B; Strong Recommendation
KAS 21b: Should discharge hospitalized patients with positive urine culture (UTI) results if all of the following are met: (1) blood culture result is negative; (2) result of CSF culture, if obtained, is negative; (3) infant is clinically well or improving (eg, fever, feeding); (4) there are no other reasons for hospitalization.	Grade: B; Strong Recommendation
KAS 21c: Should discontinue parenteral antibiotics (if started) and begin or continue oral antimicrobial for infants with UTIs managed at home when all of the following are met: (1) urine culture result is positive; (2) all other bacterial culture results are negative at 24–36 h; (3) infant is clinically well or improving (eg, fever, feeding).	Grade: B; Strong Recommendation
KAS 21d: Should treat infants' positive bacterial pathogens in urine, blood, or CSF with targeted antimicrobial therapy for the duration of time consistent with the nature of the disease, responsible organism, and response of the infant to treatment.	Grade: A; Strong Recommendation

study found statistically significant reductions in the prevalence of IBI when compared with viral-negative infants.[50] Other studies revealed lower rates of IBI but not statistically significantly lower.[44,47,48] In a prospective PECARN study for infants <28 days of age, bacteremia was detected in 1.1% and meningitis in 0.8% of infants with detected viral infections.[48] The risks of IBI in viral-positive infants <28 days of age are sufficiently high to warrant similar testing and treatment as viral-negative infants.

For infants 29 to 60 days of age, the bacteremia rate was significantly lower in viral-positive infants compared with viral-negative infants (0.6% vs 1.8%).[48] Another recent study of 29- to 90-day old infants detected bacteremia in 3.7% of viral-negative infants, whereas those with rhinovirus infections had a prevalence of 1.4% and a reduced relative risk of 0.52 (95% confidence interval [CI], 0.34–0.81).[50] There are situations in which viral testing may augment the recommended evaluation and management of febrile infants 29 days and older, such as during RSV, bronchiolitis,[51] or influenza seasonal outbreaks. In these situations, individual tests for RSV or influenza can each be obtained at <3% the cost of a multiplex respiratory viral panel, according to the latest charges listed in *Current Procedural Terminology*; the cost of multiplex testing in other countries has been reported to be substantially lower. In

KAS 1: Clinicians should obtain urine specimen by catheterization or SPA of bladder for urinalysis and, if urinalysis result is positive, for culture. Evidence Quality: A; Strong Recommendation

Benefits	Identification of UTIs Basing culture on urinalysis results reduces likelihood of false-positive result attributable to contamination or misdiagnosis of asymptomatic bacteriuria.
Risks, harm, cost	Requiring positive urinalysis result may miss some true UTIs. Obtaining culture if negative urinalysis result may result in falsely positive culture attributable to contamination or misdiagnosis of asymptomatic bacteriuria leading to inaccurate documentation of a first UTI (which may prompt unnecessary imaging should a UTI occur subsequently). Discomfort of catheterization or SPA. Parent anxiety.
Benefit–harm assessment	Preponderance of benefit based on high rate of UTI.
Shared decision-making	Parents opposed to catheterization should be offered a choice of SPA and informed about the higher rate of ambiguous/false-positive culture results obtained from bagged or voided specimens.[77,78]
Key references	73, 77–93

summary, although viral testing should not affect entrance into the recommended pathway, for infants >28 days of age, it can be considered in individualizing evaluation and management decisions.

Summary of KASs for Evaluation and Management of Well-Appearing Febrile Infants: 8 to 21, 22 to 28, and 29 to 60 Days of Age (Table 1)

WELL-APPEARING 8- TO 21-DAY-OLD INFANTS

Diagnostic Evaluation

The following recommendations and options are for febrile (temperature ≥38.0°C), well-appearing, term infants 8 to 21 days of age without risk factors identified in the exclusion criteria.

KAS 1: Clinicians should obtain urine specimen by catheterization or SPA of bladder for urinalysis and, if urinalysis result is positive, for culture. Evidence Quality: A; Strong Recommendation

A positive urinalysis result for purposes of this guideline is defined as the presence of any leukocyte esterase (LE) on dipstick, >5 WBCs per high-powered field (hpf) in centrifuged urine, or >10 WBCs/mm^3 in uncentrifuged urine on microscopic urinalysis using a hemocytometer.

Urinalysis: Of the estimated 10% of febrile infants with UTIs, 94% have urinalysis positive for leukocyte esterase (LE) (95% CI, 91%– to 97%).[80] The sensitivity is even higher for UTI associated with bacteremia (97.6% and 100% in 2 studies).[80,86] Therefore, for 1000 infants, ∼approximately 94 to 98 infants with UTIs will be detected by a positive urinalysis result, and 2 to 6 may be "missed." It is unclear whether a "miss" represents a UTI, asymptomatic bacteriuria, or contamination. Consequently, if a urinalysis result is negative, an estimated 200 to 500 catheterizations or suprapubic aspirations (SPAs) followed by cultures would be required to detect 1 additional infant with bacteriuria, and that infant might have asymptomatic bacteriuria or contamination rather than a true UTI.

Culture: In the AAP clinical practice guideline on UTI from 2011, reaffirmed in 2016, addressing infants 2 to 24 months of age, the diagnosis of UTI was made on the basis of pyuria and at least 50 000 colony-forming units (cfu) per mL of a single uropathogenic organism in an appropriately collected specimen of urine.[73] Recent studies indicate it

KAS 2: Clinicians should obtain a blood culture. Evidence Quality: A; Strong Recommendation

Benefits	Identification of bacteremia: 3.9% to 5.1% of all febrile infants in this age group[17,24,61,94]; 15% to 20% of infants younger than 28 d with UTI.[91,93,94] Identification of organism (and sensitivities) for directed antimicrobial treatment. Early detection and treatment may prevent progression of infection.
Risks, harm, cost	False-positive results: Most positive blood cultures in febrile infants are attributable to contaminants (63% to 88%),[25,27,30] potentially leading to unnecessary use of antimicrobial agents, further or repeat testing, and prolonged hospitalization. Discomfort of venipuncture. Costs can be substantial depending on further testing, treatment, and hospitalization after a false-positive culture result.
Benefit–harm assessment	Preponderance of benefit.
Shared decision-making	Parents can be made aware that testing is based on the high likelihood of bacteremia, especially in infants with a positive urinalysis result. Parents can be informed of potential challenges that may be encountered in distinguishing pathogens from contaminants as part of explaining the evaluation process.
Key references	27,61,93

KAS 3: Clinicians may assess IMs. Evidence Quality: B; Weak Recommendation

Benefits	For infants with negative urinalysis and negative CSF analysis results, abnormal IM results may influence decisions regarding when to discontinue antimicrobial therapy and hospitalization in infants with negative culture results.
Risks, harm, cost	False-negative results, underestimating risk of bacteremia or bacterial meningitis with normal IMs.[16,27,39] False-positive results, overestimating the risk of bacteremia or bacterial meningitis. Adds additional, marginal cost as it is recommended all infants in this age group will be hospitalized.
Benefit–harm assessment	Balance of benefit and harm.
Key references	18–20, 39, 60, 107

A detailed discussion of IMs follows KAS 10.[95–105]

is reasonable to extend the recommendation of the AAP UTI guideline to infants addressed here,[77–80,85–89] although 10 000 colony-forming units/mL is now an acceptable threshold for diagnosing UTI from catheterized urine specimens when pyuria and fever are also present.[80,89] This new level also circumvents the problem of interpreting data from laboratories not reporting gradations from 10 000 to 100 000. Positive urine culture results obtained in the absence of an abnormal urinalysis indicating inflammation are likely to represent asymptomatic bacteriuria or contamination.

Culture of urine specimens not collected by catheterization or SPA is not recommended because of an unacceptable rate of false-positive results attributable to contamination of such specimens.[77,78] An initial urine specimen obtained by catheter or SPA obviates the delay and need for a second specimen by catheter or SPA following after a positive result from a bag urine. The sensitivity and specificity of urinalysis parameters for UTI from bagged specimens are somewhat less than those of catheterized specimens.[77,78]

For physicians with experience, SPA is effective, provides the "cleanest" specimen, and saves time; complications are rare.[81] In some situations, such as phimosis or labial adhesions, SPA may be required[73]; a training video is available online.[82]

KAS 4: Clinicians should obtain CSF for analysis (WBC count, protein, glucose, Gram stain), and culture for bacteria. See notes for viral testing. Evidence Quality: A; Strong Recommendation

Benefits	Early detection of bacterial meningitis. The prevalence of meningitis is 0.5%–1.3% in this age group.[24,94] Detection of CSF pleocytosis or elevated protein attributable to HSV infection. Early treatment may decrease neurologic morbidity. Identification of pathogen from CSF to target type and duration of antimicrobial treatment. A normal CSF analysis helps in the decision whether to discharge infants at 24 to 36 h. Avoids unnecessarily prolonged antimicrobial therapy if CSF was obtained after antimicrobial agents started and diagnosis of meningitis is uncertain.
Risks, harm, cost	Discomfort for infant. Potential for transient respiratory compromise during positioning for LP. Traumatic LPs yielding uninterpretable CSFs have been documented to prolong length of stay for hospitalized infants. False-positive CSF culture results[27,106,107] prolonging hospitalization. Substantial cost if hospitalizing because of ambiguous CSF or prolonged hospitalization for bacterial contaminant. Parental anxiety.
Benefit–harm assessment	Preponderance of benefit.
Shared decision-making	Parents must consent to this procedure. If, for whatever reason, a parent is resistant or unwilling to consent to an LP, the risk of meningitis, the evidence quality, benefit/harm assessment, and value judgments should be communicated to the parent to foster informed decision-making. The potential need for a future LP, depending on further clinical information and progress, is an important part of the discussion. These discussions should be documented.
Key references	66–70, 108, 111, 137

KAS 2: Clinicians should obtain a blood culture. Evidence Quality: A; Strong Recommendation

KAS 3: Clinicians may assess IMs. Evidence Quality: B; Weak Recommendation

Because it is recommended that all 8- to 21-day-old infants be hospitalized and treated, IMs are not required for these initial decisions. However, some clinicians consider them useful in decision-making about later management, such as whether to discontinue antimicrobial agents at 24 or 36 hours while awaiting final results of bacterial cultures.

KAS 4: Clinicians should obtain CSF for analysis (WBC count, protein, glucose, Gram stain), and culture for bacteria. See notes for viral testing. Evidence Quality: A; Strong Recommendation.

CSF with pleocytosis or from infants with HSV risk factors should be evaluated for HSV.[116,117] Population-based rates of HSV in neonates range from 2 to 5 per 100 000, with 15% having fever as the only symptom.[108–116] Although rare in well-appearing infants, prompt recognition and treatment of HSV in infants, especially those younger than 21 days with other risk factors, is essential. In addition to the presence of vesicles and/or seizures, infants should be

considered at increased risk of HSV if any of the following are present: CSF pleocytosis with a negative Gram stain, leukopenia, thrombocytopenia, hypothermia, mucous membrane ulcers, or maternal history of genital HSV lesions or fever from 48 hours before to 48 hours after delivery. If liver function tests were obtained, an elevated alanine aminotransferase (ALT) also indicates a higher risk of HSV. For further details of evaluation and management of HSV, see the AAP *Red Book*.[111]

Enterovirus (EV) PCR testing should be performed on CSF with pleocytosis and during months when there is a seasonal increase in enterovirus, regardless of pleocytosis. Rapid detection of enterovirus, along with HSV and an emerging viral cause of meningitis, human parechovirus (HPeV), can be accomplished with meningoencephalitis multiplex PCR panels identifying 14 pathogens.[43,118,119] When available in a timely fashion, multiplex PCR testing can enhance clinical decision-making.

Pleocytosis is detected overall in 8.8% of CSF analyses; the rate is higher in summer (17%) because of enterovirus.[117] The likelihood of bacterial meningitis in the presence of enterovirus in the CSF is low.[120] Therefore, the detection of CSF enterovirus can eliminate the need for further interventions.[121,122] Newer tests provide rapid identification of enterovirus.[123,124] CSF pleocytosis is often detected in febrile infants with

KAS 5: Clinicians should initiate parenteral antimicrobial therapy. Evidence Quality: A; Strong Recommendation

Benefits	Anticipated reduction in morbidity and mortality from bacterial infections.
Risks, harm, cost	Adverse drug reactions including anaphylaxis (rare). Complications related to intravenous lines including infiltration, infection, nerve compression (in ankle). Potential disruption of evolving microbiome. Development of antimicrobial resistance.
Benefit–harm assessment	Preponderance of benefit.
Key references	15, 17–20, 25, 27, 30, 145

UTIs who do not have bacterial, enterovirus or HSV meningitis.[126–128] These panels can give rapid results but should only be used as an addition to bacterial cultures. There are still relatively limited data on young infants so precise test accuracy is still uncertain, and there have been reports of both false-positive and false-negative results; *Listeria* is not in the panel.[118,119]

An LP is not always successful. The rate of failure and/or traumatic LP in infants younger than 90 days is 20% to 50%; the rate of unsuccessful or dry LP is 25% to 40%; the rate of bloody LP is 10% to 30%.[106,130–132] Ultrasonography may assist in obtaining CSF.[133] When using a bedside ultrasound landmark-guided technique, success in obtaining CSF on the first LP attempt was 58% compared with 31% without ultrasonography. Using ultrasonography resulted in a 75% success rate after 3 attempts.[135]

There is also a significant rate of nonpathogenic bacteria cultured from CSF. In a multisite study with 410 positive CSF bacterial culture results in infants <90 days of age, researchers found only 13% were pathogens and the rest were contaminants.[107] Authors of another study from Kaiser Permanente Northern California found only 22% of CSF isolates from infants <90 days to be pathogens.[27] Authors in a study of febrile infants in the second month of life found that 40 of 41 positive culture results were caused by contaminants.[106]

The CSF from a traumatic LP should be cultured and can be tested for HSV if indicated. In general, correction (or ratios) for red blood cells (RBCs) in CSF is discouraged because of lack of validating studies. It is reasonable to interpret CSF WBC counts at face value in CSF specimens with up to 10 000 RBCs per mm^3 (Table 2).[133]

INITIAL TREATMENT

The antimicrobial agents in Table 3 are recommended for initial empirical therapy and should be modified following results of cultures and sensitivities.

TABLE 2 CSF Values in Febrile Infants Without Evidence of UTI, IBI, HSV, Enterovirus, or Traumatic CSF

	Age, d	*n*	Mean	Median	Range
WBCs per mm^3	1–28	278	6.1	5.0	0–18
	29–60	318	3.1	3.0	0–8.5
Protein mg/dL	1–28	278	75.4	73.0	15.8–131.0
	29–60	318	58.9	54.0	5.5–105.5
Glucose	1–28	278	45.3	46.0	30.0–61.0
Glucose	29–60	318	48.0	48.0	20.6–65.5
RBCs per mm^3	1–28	278	95.5	5.5	0–236
RBCs per mm^3	29–60	318	75.5	2.0	0–64.5

Statistical outliers were removed. Other studies reveal slightly different ranges. Local laboratory tests may provide slightly different upper limits of normal. Adapted from Byington CL, Kendrick J, Sheng X. Normative cerebrospinal fluid profiles in febrile infants. *J Pediatr*. 2011;158(1):130–134.

KAS 6: Clinicians should actively monitor infants while awaiting results of bacterial cultures in a hospital setting with nurses and staff experienced in the care of neonates and young infants. Evidence Quality: B; Moderate Recommendation

Benefits	Hospitalization allows ongoing monitoring for a change in clinical status and the ability to change management and/or expeditiously transfer to a more intensively monitored unit if required. Relieves parents of monitoring responsibility and may reduce anxiety. Provides ability to administer intravenous antimicrobial agents.
Risks, harm, cost	Hospitalization increases risk of hospital-acquired infections. Increased risk of iatrogenic events related to intravenous catheters. Parental anxiety about infant's condition and financial strain. Stress to mothers because of breastfeeding challenges and separation from other children. Substantial cost.
Benefit–harm assessment	Preponderance of benefit.
Shared decision-making	Although monitoring in a hospital is recommended, parents have the right to refuse. Risks and consequences of IBI and of hospitalization should be discussed. In the event parents choose to return home, parents should understand criteria for returning to the hospital discussed in KAS 13.
Key references	57, 68–70, 136

KAS 5: Clinicians should initiate parenteral antimicrobial therapy. Evidence Quality: A; Strong Recommendation

The recommendation to treat all infants 8 to 21 d of age is based on the prevalence of IBIs being highest in this age category (Fig 4) and ~2% (number needed to treat 50) even in infants with negative urinalysis and or IMs. The preponderance of evidence indicates that infants with viral infections have a risk of IBI of ~1% or a number needed to treat of 100. See above discussion.

Overall, for studies since the year 2000 in infants <90 days of age, Gram-negative organisms have been responsible for the majority of infections (60% to 80%). *E coli* has been the most common pathogen detected, with a prevalence of 70% to 90% of UTIs, 30% to 60% of bacteremia infections, and 15% to 30% of bacterial meningitis.[17,26,31,39,61,94] The prevalence of GBS infection in the first week of life has declined because of prenatal screening and peripartum antimicrobial prophylaxis but is still encountered in >20% of febrile infants with bacteremia after the first week. In a 2013 series, GBS was the most common pathogen in the second month[30] and was the most common cause of meningitis in the 2019 Reducing Variability in the Infant Sepsis Evaluation study.[31] *L monocytogenes* is rarely encountered.[29–33]

Enteroviral testing of CSF has been shown to shorten length of stay and duration of antimicrobial use.[120,137] It is helpful if available within a time period that will assist clinical decision-making. In general, if CSF is positive for enterovirus, antimicrobial agents should be discontinued (or withheld), because concomitant enteroviral and bacterial meningitis is rare. However, in some cases of enterovirus meningitis or meningoencephalitis, CSF may reveal a significant pleocytosis with a neutrophil predominance. In such cases, or in cases in which there is otherwise reason to suspect a concomitant bacterial infection, such as abnormal IMs, it is reasonable to continue antimicrobial agents until CSF and blood cultures are negative for 24 to 36 hours.

In communities with circulation of *E coli* strains that produce extended-spectrum β-lactamases, gentamicin should be used instead of ceftazidime for treatment of suspected bacteremia or sepsis, and meropenem should be used

KAS 7a: Clinicians should discontinue parenteral antimicrobial agents and discharge hospitalized patients when all of the following criteria are met: (1) culture results are negative for 24–36 h or only positive for contaminants; (2) the infant continues to appear clinically well or is improving (eg, fever, feeding); and (3) there are no other reasons for hospitalization. Evidence Quality: B; Strong Recommendation

Benefits	Discontinuing antimicrobial agents minimizes risk of adverse treatment consequence. Reduces impact on microbiome. Contributes to antimicrobial stewardship. Discharge minimizes exposure to nosocomial infections and iatrogenic exposures. Limits family disruption. Reduces cost of illness episode.
Risks, harm, cost	Inadequate duration of therapy with antimicrobial (if treated) for bacterial pathogen not identified before discontinuation. Potential clinical deterioration at home if inadequate treatment of pathogen not detected before discharge.
Benefit–harm assessment	Preponderance of benefit.
Shared decision-making	Parents should be made aware of the low risk of undetected pathogens after 24 to 36 h and be able to return in a timely fashion for: Change in general appearance particularly a dusky color, or respiratory or other distress; Behavior change, including lethargy, irritability, inconsolable crying, difficulty in consoling or comforting, or other evidence of distress; Difficulty feeding; Vomiting; Decreased urine output.
Key references	57, 107, 138–144

KAS 7b: Clinicians should treat infants' positive bacterial pathogens in urine, blood, or CSF with targeted antimicrobial therapy for the duration of time consistent with the nature of the disease, responsible organism, and response of the infant to treatment. Evidence Quality: A; Strong Recommendation

Benefits	Treats infection. Reduces likelihood of morbidity. Contributes to antimicrobial stewardship.
Risks, harm, cost	Adverse reaction to antimicrobial. Interferes with infant's evolving microbiome. Accelerates emergence of antimicrobial resistance.
Benefit–harm assessment	Preponderance of benefit.
Key references	145

instead of ceftazidime when bacterial meningitis is suspected. Use of fourth- and fifth-generation cephalosporins may also be considered with expert consultation.

Cephalosporins do not provide adequate coverage for *Listeria* or enterococci. Ampicillin generally should be used as part of empirical therapy when these microbes are suspected.

FURTHER MANAGEMENT AND MONITORING

KAS 6: Clinicians should actively monitor infants while awaiting results of bacterial cultures in a hospital setting with nurses and staff experienced in the care of neonates and young infants. Evidence Quality: B; Moderate Recommendation

The committee recommends that, to improve the care of hospitalized infants, efforts should be directed at optimizing the environment to support maternal/child bonding and breastfeeding. This can be accomplished through the following effective measures: allow parents to room-in with the infant; encourage the continuation of breastfeeding and provide lactation support including access to breast pumps for nursing mothers; provide timely communication with families about the results and interpretation of testing and expected consequences of having a diagnosis of UTI, bacteremia, and/or bacterial meningitis on the basis of ongoing results; provide timely communication with the infant's primary care provider.

KAS 7a: Clinicians should discontinue parenteral antimicrobial agents and discharge hospitalized patients when all of the following criteria are met:

1. **culture results are negative for 24 to 36 hours or only positive for contaminants;**
2. **the infant continues to appear clinically well or is improving (eg, fever, feeding); and**
3. **there are no other reasons for hospitalization.**

Evidence Quality: B; Strong Recommendation

Although infants whose CSF is positive for enterovirus may be observed without antimicrobial agents, they should remain in a hospital setting for a minimum of 24 h because of the small risk of progression to enteroviral sepsis, which generally only occurs in infants <21 d of age.

Discontinuation of antimicrobial agents and discharge at 36 hours can potentially result in a lapse of treatment of a slow-growing pathogen and readmission, but this has seldom been reported. Automated blood culture techniques and multiplex PCR detection have reduced the time to identify pathogens.[40–42] Time to positivity of blood culture is dependent on the type and concentration of bacterial organism. Between 4% and 17.6% of pathogens take >24 hours to grow; less than 5% take >36 hours.[138–144] Compared with ill-appearing infants, infants not appearing ill are less likely to have pathogens identified in <24 hours (85.0% vs 92.9%). Pathogens vary in median times to positivity: GBS takes 9.3–14.3 hours[138–140,143]; *E coli* takes 11.3–13.6 hours[138,140,143]; and *S aureus* takes 18.5–19.9 hours.[138–140,143] For *E coli*, the most common organism identified, 24% take longer than 24 hours to grow, whereas only 5.9% of GBS grow after 24 hours.[138]

KAS 8: Clinicians should obtain urine specimen by catheterization or SPA of bladder for urinalysis and, if urinalysis result is positive, for culture, or should obtain urine specimen by bag, spontaneous void, or stimulated void for urinalysis and, if urinalysis is positive, obtain a catheterization or SPA specimen for culture. Evidence Quality: A; Strong Recommendation

Benefits	Identification of UTIs.
Risks, harm, cost	Falsely positive culture result (contamination) or misdiagnosis of asymptomatic bacteriuria leading to unnecessary and potentially harmful treatment and inaccurate documentation of a first UTI (which may prompt unnecessary imaging should a UTI occur subsequently). Discomfort of catheterization or SPA. Parent anxiety.
Benefit–harm assessment	Preponderance of benefit.
Role of parent preferences	Parents opposed to catheterization should be offered a choice of SPA and informed about the higher rate of ambiguous or false-positive culture results obtained from bagged or voided specimens.[77,78] A false-positive urine culture result can potentially prolong antimicrobial administration and duration of hospitalization.
Key references	73, 77, 93

For detailed discussion, see KAS 1.

KAS 9: Clinicians should obtain blood culture. Evidence Quality: A; Strong Recommendation

Benefits	Identification of bacteremia: 1.6% to 5% of all febrile infants in this age group[17,24,61,94]; 7.5% to 10% of infants with UTI.[10,26,91–93] Identification of organism (and sensitivities) for targeted antimicrobial treatment. Early detection and treatment may prevent progression of infection.
Risks, harm, cost	False-positive results: most positive blood cultures in febrile infants are attributable to contaminants,[23,27,30] potentially leading to unnecessary use of antimicrobial agents, further or repeat testing, and prolonged hospitalization. Discomfort of venipuncture. Costs can be substantial depending on further testing, treatment, and/or hospitalization after a false-positive culture result.
Benefit–harm assessment	Preponderance of benefit.
Key references	27, 30, 61

Nonpathogens generally take longer than 24 hours to grow in culture media. Approximately 25% of nonpathogens grow in the first 24 hours.[138] Antimicrobials can be stopped at 24 hours if a pure growth of a nonpathogen is identified. When available, multiplex PCR is capable of detecting many bacterial pathogens and antimicrobial resistance from a positive culture medium in an hour.[40–43]

KAS 7b: Clinicians should treat infants' positive bacterial pathogens in urine, blood, or CSF with targeted antimicrobial therapy for the duration of time consistent with the nature of the disease, responsible organism, and response of the infant to treatment. Evidence Quality: A; Strong Recommendation

WELL-APPEARING 22- TO 28-DAY-OLD INFANTS

The following recommendations and options are for febrile (temperature >38.0°C), well-appearing, term infants 22 to 28 days old without risk factors identified in the exclusion criteria.

The evidence indicates the risk of bacteremia and bacterial meningitis is lower in infants 22 to 28 days of age than in infants 8 to 21 days of age. However, they continue to be at higher risk than older infants, leading us to separate this group as discussed above in the section on "Evidence for Age-based Risk Stratification."

Diagnostic Evaluation

KAS 8: Clinicians should obtain urine specimen by catheterization or SPA of bladder for urinalysis and, if urinalysis result is positive, for culture, or should obtain urine specimen by bag, spontaneous void, or stimulated void for urinalysis and, if urinalysis is positive, obtain a catheterization or SPA specimen for culture. Evidence Quality: A; Strong Recommendation

KAS 9: Clinicians should obtain blood culture. Evidence Quality: A; Strong Recommendation

KAS 10: Clinicians should assess IMs. Evidence Quality: B; Strong Recommendation

IMs have been included in every strategy proposed to address febrile infants. No single IM, in isolation, is reliable for risk stratification. Further study will allow ongoing accumulation of evidence and more precise values for these markers. The committee anticipates modification and refinement as efforts to improve the care of febrile infants continue.

- Temperature >38.5°C: A sign of inflammation, fever is the most readily available marker of infection. Surprisingly, it was not included in early studies of decision models,[10–15] but there has been ongoing and recent work on the value of fever elevation in predicting IBI.[16,17,48,57,60,95,96,147] It emerged as an important predictor in studies using recursive partitioning analysis to derive threshold fever values for prediction rules.[16,17] In the PROS Network study of 3066 infants with 63 cases of IBI, a temperature >38.5°C, when combined with ill appearance and age <25 days, had a sensitivity of 93.7% and NPV of 99.6%.[17] A temperature ≥38.5°C at any point during the ED stay placed infants at higher risk in a study of 207 cases of IBI in well-appearing febrile infants ≤60 days seen in the EDs of 11 children's hospitals in the Febrile Young Infant Research Collaborative.[60] Researchers in a PECARN analysis addressing SBI documented an increased in adjusted odds ratio of 1.8 for each 1°C increase >38.0.[48] Also, a temperature <38.5°C is used in

KAS 10: Clinicians should assess IMs. Evidence Quality: B; Strong Recommendation

Benefits	For infants with negative urinalysis and/or pending urine results and/or blood and/or CSF cultures, IMs may influence the decision whether to initiate antimicrobial agents. For an infant with a negative urinalysis result and pending blood culture result, the absence of abnormal IMs may contribute to the decision of whether to perform LPs in infants 22 to 28 d of age. In the presence of a negative CSF analysis or bloody or failed LP, normal IMs may influence decisions regarding hospitalization, initiation of antimicrobial agents, and duration of treatment.
Risks, harm, cost	False-negative results, underestimating risk of bacteremia or bacterial meningitis with normal IMs. False-positive results, overestimating the risk of bacteremia and bacterial meningitis (see discussion below).
Benefit–harm assessment	Preponderance of benefit.
Key references	13–16, 18–20, 37–39, 60, 97–105, 146

For purposes of this guideline, IMs are considered abnormal at the following levels: temperature >38.5°C, ANC >4000, 5200 per mm^3, CRP >20 mg/L, procalcitonin >0.5 ng/mL.

Intermountain Healthcare's Care Process Model to distinguish whether there is a need for further testing in infants older than 28 days who test positive for RSV.[57] Recently, by adding a temperature >38.5°C as an additional high-risk criterion to the Rochester criteria in 7- to 28-day-old infants, the Roseville Protocol documented a sensitivity of 96.7%.[147] Therefore, moderately elevated temperatures are useful in predicting IBI and can immediately suggest how extensive an evaluation may be appropriate. However, as an independent predictor, 30% of febrile infants with IBI have maximum documented fevers of ≤38.5.[96] Temperature elevation is a useful predictor of IBI when combined with other clinical features, and laboratory-based IMs can improve the sensitivity for detecting IBI.

- Elevated WBC count and its components: These tests are widely available, but with an evolving epidemiology of IBI and availability of newer tests, their usefulness in predicting IBIs is changing. The arbitrary thresholds (WBC count >15 000 per mm^3, ANC >10 000 per mm^3, band count >1500 per mm^3, immature to total neutrophil ratio >0.2) that define "abnormal" have been used in numerous studies of predictive models.[10–15,19,20] These studies all used WBC count components in combination with other infant characteristics such as well appearance, or urinalysis results, to identify low-risk infants. Researchers who analyzed WBC count and/or ANC as independent predictors of IBI[16,39,103,104] have documented that as a stand-alone screen, neither is sufficiently sensitive nor specific, although ANC is substantially better than the WBC count. Researchers in an ED study of 5279 infants <90 days of age identified 68 infants with IBIs.[16] Using a derived multivariable prediction rule with recursive partitioning analysis, they found that there were 14 misclassified cases of bacteremia and 1 case of bacterial meningitis. Of these 15 infants, 9 had "normal" WBC counts (5000–15 000/mm^3). This study indicates that a normal WBC count is not reassuring.[16] In a French study of 2047 febrile infants seen in 15 pediatric EDs, the area under the curve (AUC) for WBC count was 0.48 compared with 0.61 for ANC.[39] In the PROS study, an abnormal WBC count (<5000/mm^3, >15 000/mm^3) was significant in a multivariate analysis with an adjusted odds ratio of 3.62 (95% CI, 2.13–6.15) and slightly increased the AUC of a non–laboratory-based model from 0.767 to 0.803. The committee does not recommend use of abnormal WBC count for risk stratification.
- ANC: >4000,[18] >5200[60] cells per mm^3. Although arbitrary values of ANC continue to be included in decision models, researchers in 2 studies methodologically derived optimal cutoffs. The subcommittee presents both values (>4000, >5200), reflecting the current state of the evidence.

1. In a prospective study of 1821 febrile infants with 30 cases of IBI younger than 60 days, the PECARN group used recursive partitioning to derive optimal thresholds for detecting IBI. This study found that an ANC of >4090 per mm^3, when combined with an abnormal urinalysis and a procalcitonin of greater than 1.7 ng/mL, detected 29 of 30 cases, 96.7% (95% CI, 83.3%–99.4%) with a specificity of 61.5%.[18] No case of meningitis was missed.
2. The Febrile Young Infant Research Collaborative study did not include procalcitonin but methodologically derived an ANC ≥5185 per mm^3 as part of a scoring system to identify IBIs retrospectively. The sensitivity of its scoring system for 207 cases of IBIs was 98.8% (95% CI, 95.7%–99.9%) but had a specificity of 31.3%; none of the 26 cases of bacterial meningitis was missed.[60]

The step-by-step method proposed by the European Collaborative of 11 EDs[19,20] selected a higher ANC threshold (10 000) for its model and detected 81 of 87 infants with IBIs. No cases of bacterial meningitis were missed; the sensitivity for IBIs was 92% (95% CI, 85.0%–97.2%), lower than the 2 American studies. The only prospective office-based study, using recursive partitioning, did not identify ANC as a predictor for the 63 cases of IBIs.[17]

ANC is helpful but not as accurate as newer IMs.[16] In a subset analysis of 46 infants 8 to 60 days of age with bacterial meningitis, blood ANC ranged from 600 to 24 500, with a median of 4700; 39% had ANCs <4000 and 80% had ANCs <10 000.[17,20] As used in a PECARN analysis, an ANC of <4090 combined with a negative urinalysis result had a sensitivity of 76.6% (95% CI, 0.59%–0.88%); addition of procalcitonin was required to achieve the high sensitivity of its decision rule for IBI.[18] Because of availability, timeliness, and these data, an elevated ANC is a useful IM when combined with other clinical and laboratory predictors.

Although several studies have identified ANC cutoffs for infants at low risk of IBI,[18–20,60] counts <1000 should raise concerns for sepsis in the youngest infants.

- CRP (≥20 mg/L): In studies addressing laboratory markers, CRP has been shown to be more accurate than WBC count or ANC in detecting

KAS 11a: Clinicians may obtain a CSF analysis on infants 22 to 28 days of age even if all of the following criteria are met: (1) urinalysis result is negative or positive; (2) no IM obtained is abnormal; (3) blood and urine cultures have been obtained; and (4) infant is hospitalized. Evidence Quality: B; Moderate Recommendation

Benefits of testing	Early detection of bacterial meningitis.
	Detection of CSF pleocytosis or elevated protein attributable to HSV infection.
	Early treatment may decrease neurologic morbidity.
	Identification of pathogen from CSF to target type and duration of antimicrobial treatment.
	A normal CSF analysis helps in the decision whether to discharge infants at 24–36 h.
	Avoids unnecessarily prolonged antimicrobial therapy if CSF was obtained after antimicrobial agents started and diagnosis of meningitis is uncertain. This situation may occur if a blood culture grows a pathogen in 24 h and clinical circumstances suggest an LP is indicated.
Benefits of not testing	Avoids consequences of LP: discomfort or harm.
	Avoids further medical interventions because of false-positive results from CSF pleocytosis or bacterial contaminants.
	Avoids unnecessary or prolonged hospitalizations because of false-positive culture results.
	Avoids cost of procedure and unnecessary hospitalization.
	Avoids transient respiratory compromise resulting from positioning.
Risk, harm, cost of testing	Discomfort for infant.
	Potential for transient respiratory compromise during positioning for LP.
	Traumatic LPs yielding uninterpretable CSFs have been documented to prolong length of stay for hospitalized infants.[132]
	Unnecessary prolongation of hospitalization from false-positive bacterial culture result.
	Substantial cost if hospitalizing because of ambiguous CSF or prolonged hospitalization for bacterial contaminant.
	Parental anxiety.
Risks, harm, cost of not testing	In otherwise low-risk infants, delayed recognition of bacterial meningitis with increased risk of morbidity.
	Prolonged treatment if delay in obtaining CSF raises concern for partially treated meningitis.
Benefit–harm assessment	Benefit in specified situations.
Shared decision-making	Parents must provide consent for this procedure. An option by the committee to not obtain CSF for analysis is based on a consensus regarding the rate and risks of meningitis and benefit–harm assessment. Parents should be sufficiently informed to participate in this decision.
Key references	17–20, 22, 60, 106, 148

Because the prevalence of bacterial meningitis, along with the prevalence of bacteremia, declines in 22- to 28-d-old infants, the committee's tolerance for this risk resulted in a recommendation that differs from the one for 8- to 21-d-old infants.

bacteremia and meningitis.[39,101,102] As independent predictors of IBIs, the AUC for CRP was documented as 0.77 compared with 0.61 for ANC,[39] with another study producing values of 0.75 and 0.65, respectively.[146] In the absence of procalcitonin and in combination with other clinical predictors, a CRP ≥20 mg/L has identified infants at higher risk.[19,20,101] It generally can be determined in a timely fashion and has recently become available as a point-of-care test.[37]

- Procalcitonin (>0.5 ng/mL): Serum procalcitonin, as an independent predictor of bacterial infections, has better test characteristics than other laboratory markers of inflammation. In a prospective study of 15 French EDs, Milcent et al[39] identified 21 infants 7 to 90 days of age with IBIs. The AUC for procalcitonin, CRP, ANC, and WBC count were documented to be 0.91, 0.77, 0.61, and 0.48, respectively. In this study, a procalcitonin value of 0.3 ng/mL best demarcated low- and high-risk infants and in multivariate analysis was the only independent predictor of IBIs. These findings were replicated in a recent ED study from Spain[146] with 38 infants <60 days of age with IBIs. The AUC for procalcitonin, CRP, and ANC was 0.82, 0.75, and 0.65, respectively. The value of procalcitonin when used in combination with other clinical and laboratory findings is becoming clear.[18–20,38,97–105] Using a procalcitonin level of >0.5 ng/mL, along with other clinical variables, was useful in identifying a low-risk group (0.7%) for IBIs in infants >21 days but an unacceptably low sensitivity of 44% for younger infants.[100] The PECARN study, described above, demonstrated a sensitivity of 96.7% by adding an elevated procalcitonin (1.7 ng/mL) to leukocyturia and ANC >4090 mm^3. Changing the procalcitonin level to 0.5 ng/mL (and the ANC to 4000 mm^3) only minimally decreased rule specificity, so it is advocated by the PECARN investigators as a safer and easier-to-apply cutoff. Procalcitonin is the earliest IM to increase but may still be negative in febrile infants,[18] including those evaluated in the first hours after onset of fever.[146] Although it is currently the best IM available, it should not be used alone for decision-making; 20% of febrile infants with bacterial meningitis had procalcitonin <0.5 ng/mL.[20]

The committee recommends procalcitonin in all age groups. Procalcitonin testing is not yet routinely available in many institutions in the United States. If procalcitonin is unavailable or results are not reported in a timely fashion, the committee recommends using a fever of >38.5°C in combination with other IMs for purposes of risk stratification.

KAS 11a: Clinicians may obtain a CSF analysis on infants 22 to 28 days of age even if all of the following criteria are met:

1. **urinalysis result is negative or positive;**
2. **no IM obtained is abnormal;**

KAS 11b: Clinicians should obtain CSF for analysis (WBC count, protein, glucose, Gram stain) and bacterial culture if any IM obtained Is abnormal. Evidence Quality: C; Moderate Recommendation

Benefits	Early detection of bacterial meningitis. The prevalence of bacterial meningitis in this age group is 0.4% to 0.6%. [24,94] Detection of CSF pleocytosis or elevated protein attributable to HSV infection. Early treatment may lead to decreased neurologic morbidity. Identification of pathogen from CSF to target type and duration of antimicrobial treatment. Avoids unnecessarily prolonged antimicrobial therapy if CSF was obtained after antimicrobial agents started and diagnosis of meningitis is uncertain.
Risks, harm, cost	Discomfort for infant. Potential for transient respiratory compromise during positioning for LP. Traumatic LPs have been documented to prolong length of stay for hospitalized infants. Unnecessary prolongation of hospitalization from false-positive bacterial culture result. Substantial cost if hospitalizing because of ambiguous CSF or prolonged hospitalization for bacterial contaminant. Parental anxiety.
Benefit–harm assessment	Preponderance of benefit for infants with specified risk factors if CSF obtained.
Role of patient preferences	Parents must provide consent for this procedure. KAS 4 extensively discusses rates and consequences of unsuccessful LPs, uninterpretable CSFs, and false-positive bacterial culture rates. If, for whatever reason, a parent is resistant or unwilling to consent to an LP, risk of meningitis, the evidence quality, and benefit/harm assessment should be communicated to the parent to foster informed decision-making. The potential need for a future LP, depending on further clinical information and progress, is an important part of the discussion. These discussions should be documented.
Key references	68–71, 106, 108–139

For detailed discussion, including viral testing, see KAS 4.

3. **blood and urine cultures have been obtained; and**
4. **infant is hospitalized.**

Evidence Quality: B; Moderate Recommendation

There are insufficient data to estimate the probability of meningitis in this age group if only 1 IM is abnormal or if only a urinalysis result is positive. Almost all current decision rules and models rely on a combination of at least 2 IMs and a urinalysis to define risk.

Recent studies from primary care and EDs document LPs in infants <28 days of age being performed in 60% to 82% of evaluations. There is wide regional variation ranging from 10.7% to 31.3% of infants going without an LP.[23,24,148] With recent data, Kaiser Northern California documents 39% of 7- to 28-day-old infants with fever did not undergo LP. Infants evaluated in the ED were 5 times more likely to have an LP than those evaluated in the office.[22] There were no reported cases of delayed recognition of bacterial meningitis in settings in which LPs were not universally performed.

In infants <28 days of age, none of the 21 cases of bacterial meningitis in the PROS, PECARN, and step-by-step studies were missed (sensitivity 100%; CI, 84%–100%). Using a bacterial meningitis prevalence in 22- to 28-day-old infants of 0.39[22] or 0.46[94] or ~1 in 200 to 250 and the lower end of the sensitivity CI (84%) suggests 1250 to 1560 interpretable CSF samples would be required to detect each additional case of bacterial meningitis (number needed to test = 1250–1560). Without procalcitonin, these studies detected 14 of 14 cases of bacterial meningitis (95% CI, 80%–100%), indicating a number needed to test of 1000 to 1250.

Researchers in a few studies have addressed a positive urinalysis result or UTI as a risk factor for meningitis. Data for 22- to 28-day-old infants are limited, as are data for UTI without abnormal IMs. For infants 7 to 30 days of age in the Reducing Variability in the Infant Sepsis Evaluation study of 1281 infants with positive urinalysis results who had an LP performed, 0.8% were treated for bacterial meningitis.[149] This was similar to the 1.0% of the 4644 infants with negative results on the urinalysis. The data also indicated that none of the 98 infants with positive urinalysis results did not have an LP ultimately had meningitis detected. Similarly, in an outpatient study of 100 infants with UTI <30 days of age, researchers found no cases of meningitis.[150] However, in both of these studies, the lower limits of the CI indicates up to 4% could be missed.

KAS 12a: Clinicians should administer parenteral antimicrobial therapy in a hospital if either of the following apply: (1) CSF analysis suggests bacterial meningitis; or (2) urinalysis result is positive. Evidence Quality: A; Strong Recommendation

Benefits	If diagnostic testing indicates the fever is attributable to UTI or bacterial meningitis, the infection would be treated promptly. Anticipated reduction in morbidity or mortality.
Risks, harm, cost	Adverse drug reactions including anaphylaxis (rare). Complications related to intravenous lines including infiltration, infection, nerve compression (in ankle). Potential disruption of evolving microbiome. Development of antimicrobial resistance.
Benefit–harm assessment	Preponderance of benefit.
Key references	3, 57, 145

KAS 12b: Clinicians may administer parenteral antimicrobial therapy in a hospital if all of the following apply: (1) CSF analysis is normal; (2) urinalysis is normal; and (3) any IM obtained is abnormal. Evidence Quality: B; Moderate Recommendation

Benefits	An abnormal IM indicates a risk of bacteremia >5%, a threshold sufficiently high to recommend empirical treatment. Anticipated reduction in morbidity and mortality.
Risks, harm, cost	Adverse drug reactions including anaphylaxis (rare). Complications related to intravenous lines including infiltration, infection, nerve compression (in ankle). Potential disruption of evolving microbiome. Development of antimicrobial resistance.
Benefit–harm assessment	Preponderance of benefit.
Key references	3, 57, 145

KAS 11b: Clinicians should obtain csf for analysis (WBC count, protein, glucose, Gram stain) and bacterial culture if any IM obtained is abnormal. Evidence Quality: C; Moderate Recommendation

See note on KAS11a.

INITIAL TREATMENT

The antimicrobial agents in Table 3 are recommended for initial empirical therapy and should be modified following results of cultures and sensitivities.

KAS 12a: Clinicians should administer parenteral antimicrobial therapy in a hospital if either of the following apply:

1. **CSF analysis suggests bacterial meningitis; or**
2. **urinalysis result is positive.**

Evidence Quality: A; Strong Recommendation

KAS 12b: Clinicians may administer parenteral antimicrobial therapy in a hospital if all of the following apply:

1. **CSF analysis is normal;**
2. **urinalysis is normal; and**
3. **any IM obtained is abnormal.**

Evidence Quality: B; Moderate Recommendation

KAS 12c: Clinicians may administer parenteral therapy to hospitalized infants even if all of the following are met:

1. **urinalysis is normal;**
2. **no IM obtained is abnormal; and**
3. **CSF analysis is normal or enterovirus-positive.**

Evidence Quality: B; Weak Recommendation

Recent evidence documents the sensitivity of LE for UTI of 94% (95% CI, 91%–97%),[79] even higher in UTI associated with bacteremia (97.6% and 100% in 2 studies)[80,86]; an NPV of 99% also supports a low likelihood of UTI.[78,85–89] There are insufficient data to estimate precisely the risk of bacterial meningitis with normal CSF analysis, but, based on the scarcity of cases in the literature, the risk appears to be quite low. However, as current prediction rules fail to

TABLE 3 Initial Empirical Antibacterial Therapy for Well-Appearing Febrile Infants 7 to 60 Days Old

Suspected Source of Infection	8–21 d Old	22–28 d Old	29–60 d Old
UTI[a]	Ampicillin IV or IM (150 mg/kg per d divided every 8 h) and either ceftazidime IV or IM (150 mg/kg per d divided every 8 h) or gentamicin IV or IM (4 mg/kg per dose every 24 h)	Ceftriaxone IV or IM (50 mg/kg per dose every 24 h)	Ceftriaxone IV or IM (50 mg/kg/dose every 24 h). Oral medications for infants older than 28 d.[b] Cephalexin 50–100 mg/kg per d in 4 doses or cefixime 8 mg/kg per d in 1 dose
No focus identified[c]	Ampicillin IV or IM (150 mg/kg per d divided every 8 h) and either ceftazidime IV or IM (150 mg/kg per d divided every 8 h) or gentamicin IV or IM (4 mg/kg per dose every 24 h)[d]	Ceftriaxone IV or IM (50 mg/kg per dose every 24 h)	Ceftriaxone IV or IM (50 mg/kg/dose every 24 h)
Bacterial meningitis[e]	Ampicillin IV or IM (300 mg/kg per d divided every 6 h) and ceftazidime IV or IM (150 mg/kg per d divided every 8 h)	Ampicillin IV or IM (300 mg/kg per d divided every 6 h) and ceftazidime IV or IM (150 mg/kg per d divided every 8 h)	Ceftriaxone IV (100 mg/kg or d once daily or divided every 12 h) or Ceftazidime IV (150 mg/kg or d divided every 8 h) and vancomycin[f] IV (60 mg/kg or d divided every 8 h)

Use of a local antibiogram, if available, can guide choices. Note: If a focus of infection such as pneumonia, cellulitis, gastroenteritis, or musculoskeletal infection is identified, different regimens that cover typical microbial pathogens for the site of infection should be administered. IM, intramuscular; IV, intravenous. Adapted from Bradley JS, Nelson JD, Barnett ED, et al, eds. *2019 Nelson's Pediatric Antimicrobial Therapy.* 25th ed. Itasca, IL: American Academy of Pediatrics; 2019; and Kimberlin DW, Brady MT, Jackson MA, Long SS, eds. *Red Book: 2018 Report of the Committee on Infectious Diseases.* 31st ed. Itasca, IL: American Academy of Pediatrics; 2018.

[a] On the basis of urinalysis results.

[b] AAP Subcommittee on Urinary Tract Infection.[73]

[c] For example, possible bacteremia. For 22 to 28 day old infants, providers may decide that observation without initiation of therapy is appropriate after risk versus benefit discussion with the infant's parents or caregivers.

[d] Gentamicin may provide clinical benefit because of synergy with ampicillin against GBS and enterococcal species.

[e] On the basis of CSF analysis results. Some experts will add gentamicin or another aminoglycoside to this regimen, particularly if the CSF Gram stain reveals Gram-negative organisms.

[f] Vancomycin is part of empirical therapy because of the possibility of resistant *S pneumoniae*. It should be stopped if an organism other than *S pneumoniae* is identified, even if susceptibilities are still pending.

KAS 12c: Clinicians may administer parenteral therapy to hospitalized infants even if all of the following are met: (1) urinalysis is normal; (2) no IM obtained is abnormal; and (3) CSF analysis is normal or enterovirus-positive. Evidence Quality: B; Weak Recommendation

Benefits	Of treating: If etiology of fever is bacteremia, the infection would be treated promptly. Anticipated reduction in morbidity and mortality. Of not treating: No adverse drug reactions. No complication of intramuscular administration. No disruption of infant's evolving microbiome. Delayed development of antimicrobial resistance.
Risks, harm, cost	Of treating: Adverse drug reactions including anaphylaxis (rare). Complication of intramuscular administration. Potential disruption of evolving microbiome. Development of antimicrobial resistance. Of not treating: If etiology of fever is bacteremia not suspected by risk stratification, the infection could potentially progress. Potential increase in morbidity or mortality.
Benefit–harm assessment	Balanced.
Key references	3, 57, 145

detect about 3% to 8% of bacteremia cases, antimicrobial agents may be administered.[18,20]

KAS 12d: Clinicians should use parenteral antimicrobial therapy for infants who will be managed at home even if all of the following are met:

1. **urinalysis is normal;**
2. **no IM obtained is abnormal; and**
3. **CSF analysis is normal.**

Evidence Quality: C; Moderate Recommendation

If all IMs are normal and urinalysis and CSF analysis do not suggest infection, the risk of bacteremia is between 1% and 2% (number needed to treat 50–100).

KAS 13a: Clinicians may manage infants at home if all of the following criteria are met:

1. **urinalysis is normal;**
2. **no IM obtained is abnormal;**
3. **CSF analysis is normal or enterovirus-positive;**
4. **verbal teaching and written instructions have been provided for monitoring throughout the period of time at home for the following:**
   - **change in general appearance, particularly a dusky color, or respiratory or other distress;**
   - **behavior change, including lethargy, irritability, inconsolable crying, difficulty in consoling/comforting, or other evidence of distress;**
   - **difficulty feeding;**
   - **vomiting; and**
   - **decreased urine output;**
5. **follow-up plans for reevaluation in 24 hours have been developed and are in place; and**
6. **plans have been developed and are in place in case of change in clinical status, including means of communication between family and providers and access to emergency medical care.**

Evidence Quality: B; Moderate Recommendation

Value judgments: The committee values careful infant monitoring provided by hospital staff skilled in the care of neonates and young infants. In some situations, infants may not be hospitalized because of lack of access to a local hospital unit able to care for young infants (in which case referral to a regional hospital is an acceptable alternative) or other circumstances. In primary care settings, in which close follow-up is possible, more than 30% of low-risk infants are managed at home after initial evaluation.[17,22] For infants seen in EDs, 15% to 30% are not hospitalized.[23,24] In these studies, the subsequent admission rate is 1% to 2%; delays in treating bacterial infections have been rare. Several recent studies suggest otherwise low-risk infants in the absence of CSF data may be of sufficiently low risk to safely be managed at home after initial evaluation.[18,20]

For infants discharged from the hospital after initial evaluation, phone or other telecommunication contact should be attempted and documented at appropriate intervals after returning home. Infants should be scheduled for repeat clinical evaluation within the next 24 hours or sooner, if deemed appropriate. If at 24 hours, the parents report no clinical worsening and all culture results are negative, a phone

KAS 12d: Clinicians should use parenteral antimicrobial therapy for infants who will be managed at home even if all of the following are met: (1) urinalysis is normal; (2) no IM obtained is abnormal; and (3) CSF analysis is normal. Evidence Quality: C; Moderate Recommendation

Benefits	If etiology of fever is bacteremia, the infection would be treated promptly without the delay involved in returning to hospital. Anticipated reduction in morbidity and mortality.
Risks, harm, cost	Adverse drug reactions including anaphylaxis (rare). Complication of intramuscular administration. Potential disruption of evolving microbiome. Development of antimicrobial resistance.
Benefit–harm assessment	Preponderance of benefit.
Key references	3, 57, 145

KAS 13a: Clinicians may manage infants at home if all of the following criteria are met: (1) urinalysis is normal; (2) no IM obtained is abnormal; (3) CSF analysis is normal or enterovirus-positive; (4) verbal teaching and written instructions have been provided for monitoring throughout the period of time at home; (5) follow-up plans for reevaluation in 24 h have been developed and are in place; and (6) plans have been developed and are in place in case of change in clinical status, including means of communication between family and providers and access to emergency medical care. Evidence Quality: B; Moderate Recommendation

Benefits	Potential reduction of family disruption and stress. Improved circumstances for breastfeeding. Decreased risk of iatrogenic consequences of hospitalization. Eliminates risk of hospital-acquired infection. Less costly.
Risks, harm, cost	Delayed response if there is a clinical change potentially indicating infection progression. Potential increase in parental anxiety and fatigue. Dependent on parental ability to judge clinical change in a newborn infant.
Benefit–harm assessment	Preponderance of benefit in low-risk infants if discharge criteria are met.
Shared decision-making	For low-risk infants, the decision whether to hospitalize or not should be made after physicians provide estimates of the risks of underlying IBIs and benefits of home versus hospital monitoring. Parents and physicians have different values for clinical outcomes in young febrile infants. It has been documented that parents place greater value on short-term benefits such as avoiding pain, discomfort, and errors in diagnostic testing while physicians gave greater wt to avoiding short- and long-term morbidity.[66,67] These and other inherent value differences should be considered when engaging in discussions. Also, individual parents and physicians have different tolerances for risk.[66–71]
Key references	17, 22–24

The benefit/harm ratio of hospitalizing depends, in large part, on reducing the risk of sending home an infant with undiagnosed, untreated meningitis. In KAS 11b, the committee estimated the risk of meningitis going undetected and can estimate that 1200 to 1500 febrile infants would require hospitalization to avoid 1 infant going home with undetected bacterial meningitis. The benefit/harm assessment is also dependent on the quality of observation and monitoring in each hospital compared with parents' abilities to recognize any worsening of illness and return promptly.

conversation may be sufficient for follow-up. Transportation difficulty is a contributor to health inequity. Given the importance of the ability to return for changes in clinical status and further evaluations we recommend institutions consider travel vouchers (taxi or ride-share) for families with transportation insecurity. Telemedicine is increasingly being used for follow-up visits and may be appropriate in some situations.

If the reevaluation will be performed at another location or by a different clinical evaluator, it is recommended that the site for medical reevaluation be arranged in advance and clinician-to-clinician communication be direct. Clear written and documented instructions should be given to parents as to the time and place of the return visit.

KAS 13b: Clinicians should hospitalize infants in a facility with nurses and staff experienced in the care of neonates/young infants when CSF is not obtained or is uninterpretable. Evidence Quality: B; Weak Recommendation

FURTHER MANAGEMENT AND MONITORING

KAS 14a: Clinicians should discontinue antimicrobial agents and discharge hospitalized infants after 24 to 36 hours of negative culture results if the following are met:

1. **the infant is clinically well or improving (eg, fever, feeding);**
2. **there are no other reasons for hospitalization; and**
3. **there is no other infection requiring treatment (eg, otitis media).**

Evidence Quality: B; Strong Recommendation

In the most recent large studies, bacterial pathogens were not detected by 24 h in 15% to 18% and longer than 36 h in 5% to 7%; for CSF, the respective times were 11% to 18% and 6% to 15%.[138,139] Growth by 24 h occurred in a lower proportion of well-appearing infants with bacteremia (85%) compared with ill-appearing infants (93%).[138]

KAS 14b: Clinicians should discontinue antimicrobial agents on infants managed at home when all of the following criteria are met:

1. **infant is clinically well or improving (eg, fever, feeding) at time of reassessment;**
2. **all cultures are negative at 24 to 36 hours; and**
3. **there is no other infection requiring treatment (eg, otitis media).**

Evidence Quality: B; Strong Recommendation

KAS 14c: Clinicians should treat infants' positive bacterial pathogens in urine, blood, or CSF with targeted antimicrobial therapy for the duration of time consistent with the nature of the disease, responsible organism, and response of the infant to treatment. Evidence Quality: A; Strong Recommendation

WELL-APPEARING 29- TO 60-DAY-OLD-INFANTS

Diagnostic Evaluation

The following recommendations and options are for febrile (temperature >38.0°C), well-appearing, term infants 29 to 60 days of age without risk factors identified in the exclusion criteria.

KAS 13b: Clinicians should hospitalize infants in a facility with nurses and staff experienced in the care of neonates/young infants when CSF is not obtained or is uninterpretable. Evidence Quality: B; Weak Recommendation

Benefits	Opportunity for observation by skilled, experienced staff and ability to administer treatment promptly if condition worsens.
Risks, harm, cost	Hospitalization increases risk of hospital-acquired infections. Increased risk of iatrogenic events related to intravenous catheters. Parental anxiety about infant's condition and financial strain. Stress to mothers because of breastfeeding challenges and separation from other children. Substantial cost.
Benefit–harm assessment	Balanced.
Shared decision-making	In 13a, criteria for an infant to be managed at home include normal CSF analysis. For clinicians and parents, having jointly decided on an LP, a result with inadequate or confusing CSF analysis presents a dilemma. Risks should be reviewed, and parents should understand the assessment of benefit- harm. Likelihood of missing meningitis with a variety of decision rules and models is discussed in KAS 10. For uninterpretable CSF, an ME panel may assist decision-making.
Key references	3, 57, 151

KAS 15: Clinicians should obtain urine specimen by bag, spontaneous void, or stimulated void for urinalysis and, if urinalysis result is positive, obtain a catheterization or SPA specimen for culture, or obtain urine specimen by catheterization or SPA of bladder for urinalysis and, if result is positive, for culture. Evidence Quality A; Strong Recommendation

Circumcised boys have a likelihood of UTI <1% and may be exempted from this recommendation.

Although the sensitivity of LE is not 100%, the rate of positive urine culture results without an abnormal urinalysis is roughly the same as the rate of asymptomatic bacteriuria and contamination. Moreover, renal scarring appears to be mediated by host WBCs rather than the presence of bacteria.

In one high-volume ED, limiting catheterizations to children with positive urine screen results from bag specimens reduced catheterization rates by more than half (63%–<30%) without increasing length of time in the facility or missing any UTIs.[85] Use of bladder-stimulation techniques[84] is more time-efficient than urine bag collection.[83] In newborn infants, bladder and lumbar stimulation was highly successful in facilitating midstream urine collection in a median time of 45 seconds.[90] Specimens obtained by methods other than catheterization or SPA are not suitable for culture because of a high contamination rate.[77,78]

KAS 14a: Clinicians should discontinue antimicrobial agents and discharge hospitalized infants after 24 to 36 hours of negative culture results if the following are met: (1) the infant is clinically well or improving (eg, fever, feeding); (2) there are no other reasons for hospitalization; and (3) there is no other infection requiring treatment (eg, otitis media). Evidence Quality: B; Strong Recommendation

Benefits	Minimizes exposure to hospital-acquired infections and iatrogenic exposures. Limits family disruption. Reduces cost of illness episode.
Risks, harm, cost	Inadequate duration of therapy with antimicrobial for bacterial pathogen not identified before discontinuation at 24 h (5%–18%) or 36 h (<5%).
Benefit–harm assessment	Preponderance of benefit.
Key references	57, 138–144

KAS 16: Clinicians should obtain a blood culture. Evidence Quality: B; Moderate Recommendation

The prevalence of bacteremia is lower than in the younger groups of infants but still high enough to warrant a blood culture (see Fig 4).

KAS 17: Clinicians should assess IMs. Evidence Quality: B; Moderate Recommendation

For detailed discussion of IMs, see KAS 10.

KAS 18a: Clinicians may obtain CSF for analysis (WBC count, differential, protein, glucose, Gram stain), culture for bacteria, and test for enterovirus when CSF pleocytosis is detected or during enterovirus season if any IM obtained is abnormal. Evidence Quality: C; Weak Recommendation

There is substantial evidence IMs are predictive of IBI including bacterial meningitis.[10–14,16,18–20] For this age group, the number of meningitis cases in published studies is still relatively small, 64 cases in 25 917 febrile infants (0.25%). Data are unavailable comparing prevalence in IM-positive versus IM-negative infants, but decision rules and models that include IMs have sensitivities greater than 90%. In KAS 10, the committee provided data indicating that individual IMs are seldom sensitive or specific for detecting bacteremia or meningitis. However, individual values that are exceedingly high or low or finding several abnormal IMs should be considered in decision-making, because they, in all likelihood, increase the risk of bacterial meningitis.

KAS 14b: Clinicians should discontinue antimicrobial agents on infants managed at home when all of the following criteria are met: (1) infant is clinically well or improving (eg, fever, feeding) at time of reassessment; (2) all cultures are negative at 24 to 36 hours; and (3) there is no other infection requiring treatment (eg, otitis media). Evidence Quality: B; Strong Recommendation

Benefits	Minimizes risk of adverse treatment consequences. Reduces impact on microbiome. Contributes to antimicrobial stewardship.
Risks, harm, cost	Inadequate duration of therapy with antimicrobial for bacterial pathogen not identified before discontinuation at 24 h (5%–18%) or 36 h (<5%).
Benefit–harm assessment	Preponderance of benefit.
Key references	138–144

KAS 18b: Clinicians need not obtain CSF for analysis and culture if all IMs obtained are normal. Evidence Quality: B; Moderate Recommendation

The committee supports not performing an LP in well-appearing infants meeting the specified criteria. For an estimated prevalence of meningitis in 29- to 60-d-old infants of 0.25% and using a prediction rule or model with a sensitivity of 90%, the chance of missing a case of meningitis would be 0.025%. Therefore, 4000 successful LPs would be required to avoid a delay in the detection of 1 case of bacterial meningitis.

If no IM is abnormal, the committee does not include a positive urinalysis result as an indicator for performing an LP.

INITIAL TREATMENT

The antimicrobial agents in Table 3 are recommended for initial empirical therapy and should be modified following results of cultures and sensitivities.

KAS 19a: Clinicians should use parenteral antimicrobial therapy if CSF analysis suggests bacterial meningitis. Evidence Quality: A; Strong Recommendation

If CSF is not available or is uninterpretable, clinicians should use parenteral antimicrobial agents.

KAS 19b: Clinicians may use parenteral antimicrobial therapy if both of the following apply:

1. **CSF analysis (if CSF obtained) is normal; and**
2. **any IM obtained is abnormal.**

Evidence Quality: B; Moderate Recommendation

If CSF is positive for enterovirus, clinicians may discontinue (or withhold) antimicrobial agents as long as there are no other factors suggesting a bacterial infection, including abnormal IMs.

KAS 14c: Clinicians should treat infants' positive bacterial pathogens in urine, blood, or CSF with targeted antimicrobial therapy for the duration of time consistent with the nature of the disease, responsible organism, and response of the infant to treatment. Evidence Quality: A; Strong Recommendation

Benefits	Inhibits further growth of bacterial pathogen. Cures infection. Reduces likelihood of morbidity. Contributes to antimicrobial stewardship.
Risks, harm, cost	Adverse reaction to antimicrobial. Interferes with infant's evolving microbiome. Accelerates emergence of antimicrobial resistance.
Benefit–harm assessment	Preponderance of benefit.
Key references	145

KAS 19c: Clinicians should initiate oral antimicrobial therapy if all of the following apply:

1. **CSF analysis (if CSF obtained) is normal;**
2. **urinalysis result is positive; and**
3. **no IM obtained is abnormal.**

Evidence Quality: B; Strong Recommendation

KAS 19d: Clinicians need not use antimicrobial therapy while awaiting bacterial culture results if all of the following are met:

1. **CSF analysis, if CSF obtained, is normal or enterovirus-positive;**
2. **urinalysis is negative; and**
3. **no IM obtained is abnormal.**

Evidence Quality: B; Moderate Recommendation

The risk for well-appearing infants with these negative findings having bacteremia is 0.1% for infants 29 to 60 days of age,[18] with a CI upper limit that indicates the number needed to test is >300. Recent evidence documents the sensitivity of LE for UTI of 94% (95% CI, 91%–97%),[80] even higher in UTI associated with bacteremia (97.6% and 100%) in 2 studies[80,86]; an NPV of 99% also supports a low likelihood of UTI.[38–40] There are insufficient data to estimate precisely the risk of bacterial meningitis with normal CSF analysis, but, based on the scarcity of cases in the literature, the risk appears to be quite low.

Value Judgments: There were different thresholds, within the committee, for treating with antimicrobial agents. The potential benefits are highlighted above. The overall sense of the committee was to administer antimicrobial agents if the number needed to test for bacteremia is 100 or less: that is, willing to treat as many as 100 infants with parenteral antimicrobial agents to avoid delaying treatment in 1 infant with

KAS 15: Clinicians should obtain urine specimen by bag, spontaneous void, or stimulated void for urinalysis and, if urinalysis result is positive, obtain a catheterization or SPA specimen for culture, or obtain urine specimen by catheterization or SPA of bladder for urinalysis and, if result is positive, for culture. Evidence Quality A; Strong Recommendation

Benefits	Identification of UTIs. A positive urinalysis result prompts initiation of empirical antimicrobial therapy. A positive urine culture result for pathogenic bacteria directs appropriate antimicrobial treatment. A negative urinalysis result signifies a low likelihood of a UTI and obviates catheterization or SPA (if not already performed).
Risks, harm, cost	Falsely positive culture result (contamination) or misdiagnosis of asymptomatic bacteriuria leading to unnecessary and potentially harmful treatment and inaccurate documentation of a first UTI (which may prompt unnecessary imaging should a UTI occur subsequently). Discomfort of catheterization or SPA. Parent anxiety.
Benefit–harm assessment	Preponderance of benefit.
Shared decision-making	Because nearly 90% of febrile infants will not have UTIs, obtaining a screening specimen through noninvasive methods is appropriate. Voided methods can be offered with explanations of a potential time delay and need for a second urine sample obtained by catheterization and/or SPA if initial urine screen result is positive. Parents opposed to catheterization should be offered a choice of SPA and informed about the higher rate of ambiguous or false-positive culture results obtained from bagged or voided specimens.[77] A false-positive urine culture result can potentially prolong antimicrobial administration.
Key references	73, 77–93

KAS 16: Clinicians should obtain a blood culture. Evidence Quality: B; Moderate Recommendation

Benefits	Identification of bacteremia: 1.1%–2.2% of all febrile infants in this age group[17,22,24,61,94] and 5%–10% in infants with UTI.[17,26,91–93,152,153] Identification of organism (and sensitivities) for directed antimicrobial treatment. Early detection and treatment may prevent progression of infection.
Risks, harm, cost	False-positive results: Most positive blood cultures in febrile infants are attributable to contaminants[25,27,28,30] potentially leading to unnecessary use of antimicrobial agents, further or repeat testing, and prolonged hospitalization. Discomfort of venipuncture. Costs can be substantial depending on further testing, treatment, and hospitalization after a false-positive culture result.
Benefit–harm assessment	Preponderance of benefit.
Role of patient preferences	Parents should understand that testing is based on the high likelihood of bacteremia, especially in infants with positive urinalysis result. Parents can be informed of potential challenges that may be encountered in distinguishing pathogens from contaminants as part of explaining the evaluation process.
Key references	22, 24, 30, 61

bacteremia. The committee recognizes that parents and practitioners have different levels of risk aversion and thresholds for treatment that should be incorporated into decision-making.

KAS 20a: Clinicians should hospitalize infants in a unit with nurses and staff experienced in the care of 29- to 60-day-old infants if CSF analysis, if CSF obtained, is abnormal. Evidence Quality: A; Strong Recommendation

KAS 20b: Clinicians may hospitalize infants in a unit with nurses and staff experienced in the care of 29- to 60-day-old-infants if any IM obtained is abnormal. Evidence Quality: B; Moderate Recommendation

In a PECARN substudy of 29- to 60-d-old infants, an ANC $>$ 4000 per mm^3 and/or procalcitonin $>$0.5 ng/mL had a bacteremia prevalence of 3.2%; the prevalence if these IMs were negative was 0.2%.[18]

KAS 20c: Clinicians should manage patients at home if all of the following criteria are met:

1. **CSF analysis, if CSF obtained, is normal;**
2. **urinalysis is negative;**
3. **all IMs obtained are normal;**
4. **appropriate parental education has been provided;**
5. **follow-up plans for reevaluation in 24 hours have been developed and are in place; and**
6. **plans have been developed and are in place in case of change in clinical status, including means of communication between family and providers and access to emergency medical care.**

Evidence Quality: B; Moderate Recommendation

Value judgments: The low risk of bacteremia and meningitis in infants without positive IMs can potentially reduce hospitalizations without compromising infant safety.

KAS 17: Clinicians should assess IMs. Evidence Quality: B; Moderate Recommendation

Benefits	For infants with negative urinalysis and/or pending urine and/or blood cultures, IMs may influence the decision whether to perform an LP, initiate antimicrobial agents, or hospitalize. For an infant with a negative urinalysis and pending blood culture, the absence of abnormal IMs may contribute to the decision of whether to send the infant home without antimicrobial agents.
Risks, harm, cost	False-negative results, underestimating risk of bacteremia and bacterial meningitis.[23,39] False-positive results, overestimating the risk of bacteremia or bacterial meningitis.
Benefit–harm assessment	Preponderance of benefit.
Key references	13–16, 18–20, 37–39, 60, 97–105, 146

KAS 20d: Clinicians may manage infants without antimicrobial treatment at home without having obtained interpretable CSF if all of the following are met:

1. **urinalysis is negative;**
2. **all IMs obtained are normal; and**
3. **parents can return promptly if there is a change in infant condition and agree to follow-up in 24 to 36 hours. Infants monitored at home should be reassessed in the following 24 hours.**

Evidence Quality: B; Moderate Recommendation

Value judgments: The low risk of bacteremia and meningitis in infants without positive IMs can potentially reduce hospitalizations without compromising infant safety.

KAS 18a: Clinicians may obtain CSF for analysis (WBC count, differential, protein, glucose, Gram stain), culture for bacteria, and test for enterovirus when CSF pleocytosis is detected or during enterovirus season if any IM obtained is abnormal. Evidence Quality: C; Weak Recommendation

Benefits	The prevalence of meningitis in this age group is 0.12–0.32.[17,22,24,61,94] Early detection of meningitis. Early treatment may lead to decreased neurologic morbidity. Identification of pathogen from CSF to target type and duration of antimicrobial treatment. Avoids unnecessarily prolonged antimicrobial therapy if CSF was obtained after antimicrobial agents started and diagnosis of meningitis is uncertain.
Risks, harm, cost	Discomfort for infant. Potential for transient respiratory compromise during positioning for LP. Traumatic LPs have been documented to prolong length of stay for hospitalized infants. Unnecessary prolongation of hospitalization from false-positive bacterial culture result. Substantial cost if hospitalizing because of ambiguous CSF or prolonged hospitalization for bacterial contaminant. Parental anxiety.
Benefit–harm assessment	Preponderance of benefit if CSF obtained.
Shared decision-making	Because parents must consent for this procedure, shared decision-making is required and their risk tolerances a consideration. KAS 4 extensively discusses rates and consequences of unsuccessful LPs, uninterpretable CSF analysis, and false-positive bacterial culture rates. If, for whatever reason, a parent is resistant or unwilling to consent to an LP, risk of meningitis, the evidence quality, benefit/harm assessment, and value judgments should be communicated to the parent to foster informed decision-making. The potential need for a future LP, depending on further clinical information and progress, is an important part of the discussion. These discussions should be documented.
Key references	17, 22, 24, 106, 132, 148

FURTHER MANAGEMENT AND MONITORING

KAS 21a: Clinicians should discontinue antimicrobial agents when all of the following are met:

1. **all bacterial cultures are negative at 24 to 36 hours;**
2. **infant is clinically well or improving (eg, fever, feeding); and**
3. **there is no other infection requiring treatment (eg, otitis media).**

Evidence Quality: B; Strong Recommendation

KAS 21b: Clinicians should discharge hospitalized patients with positive urine culture results (UTI) if all of the following are met:

1. **blood culture is negative;**
2. **CSF culture, if CSF obtained, is negative;**
3. **infant is clinically well or improving (eg, fever, feeding); and**
4. **there are no other reasons for hospitalization.**

Evidence Quality: B; Strong Recommendation

KAS 21c: Clinicians should discontinue parenteral antibiotics (if started) and begin or continue oral antimicrobial for infants with UTIs managed at home when all of the following are met:

1. **urine culture result is positive;**
2. **all other bacterial culture results are negative at 24 to 36 hours; and**
3. **infant is clinically well or improving (eg, fever, feeding).**

Evidence Quality: B; Strong Recommendation

KAS 18b: Clinicians need not obtain CSF for analysis and culture if all IMs obtained are normal. Evidence Quality: B; Moderate Recommendation

Benefits	Avoids unnecessary costs and discomfort of testing in low-risk infant.
Risks, harm, cost	Potential missed opportunity for early detection of developing meningitis.
Benefit–harm assessment	Preponderance of benefit.
Role of parent preferences	Parents should understand the benefit/harm assessment underlying this decision.
Key references	17, 22, 24, 106, 148

KAS 21d: Clinicians should treat infants' positive bacterial pathogens in urine, blood, or CSF with targeted antimicrobial therapy for the duration of time consistent with the nature of the disease, responsible organism, and response of the infant to treatment. Evidence Quality: A; Strong Recommendation

FUTURE RESEARCH

Many of the unanswered questions faced in the committee's review emanated from the challenges of conducting prospective research in clinical settings with a relatively uncommon symptom. Fever in this age group has an incidence rate of 14 per 1000 term, previously healthy births per year.[22] Although >10% of febrile infants will have UTIs, the likelihood of more IBIs is much less, with bacteremia detected in <2% of febrile infants and bacterial meningitis in <0.5%. Negative outcomes, such as permanent renal damage and organ damage or death, from sepsis are rare. Permanent neurologic sequelae from bacterial meningitis occur in variable rates depending on the severity of the infection, onset of treatment, and organism. Therefore, although use of administrative databases has recently provided important information, large, prospective studies will be required to answer a number of the following questions to further refine clinical recommendations for preventing negative outcomes.

KAS 19a: Clinicians should use parenteral antimicrobial therapy if CSF analysis suggests bacterial meningitis. Evidence Quality: A; Strong Recommendation

Benefits	Anticipated reduction in morbidity and mortality from bacterial meningitis.
Risks, harm, cost	Adverse drug reactions including anaphylaxis (rare). Complications related to intravenous lines including infiltration, infection, nerve compression (in ankle). Potential disruption of evolving microbiome. Development of antimicrobial resistance.
Benefit–harm assessment	Preponderance of benefit.
Key references	107, 145

KAS 19b: Clinicians may use parenteral antimicrobial therapy if both of the following apply: (1) CSF analysis (if CSF obtained) is normal; and (2) any IM obtained is abnormal. Evidence Quality: B; Moderate Recommendation

Benefits	Anticipated reduction in morbidity and mortality if infant has bacteremia. The risk of bacteremia is 1.1%–2.1% of all febrile infants in this age group.[17,22,24,94] Identification of organism (and sensitivities) for directed antimicrobial treatment. Early detection and treatment may prevent progression of infection.
Risks, harm, cost	Adverse drug reactions including anaphylaxis (rare). Complications related to intravenous lines including infiltration, infection, nerve compression (in ankle). Potential disruption of evolving microbiome. Development of antimicrobial resistance.
Benefit–harm assessment	Preponderance of benefit.
Key references	17, 22, 145

All of the following pertain to well appearing febrile infants 8 to 60 days of age.

1. Because analyzing data for SBI has obscured understanding of optimal approaches to detect and manage individual infections, the term "SBI" should be retired and the incidence of the following infections determined separately: a. bacterial meningitis; b. bacteremia; and c. UTI.
2. The incidence of each individual infection can then be used to identify the most appropriate age groupings expressed in days rather than the arbitrary ones currently in use (weeks, months). The age groupings used in this guideline are primarily based on data gathered by week of age, as set a priori; although expressed here in days corresponding to those weeks, age groupings in the future should be derived from day-by-day data, which may generate different age groupings from the ones used here.
3. What is the morbidity and mortality of each infection for each age group?
4. What is the current epidemiology of each infection for each age group?
5. What is the best predictive rule for each infection?
6. What is the optimal initial choice and route of antimicrobial agents?
7. What is the optimal duration of therapy?
8. What are the predictors for bacteremia and for bacterial meningitis in a patient with a positive urinalysis result?
9. When does bacteremia matter in an infant with a UTI? Should

KAS 19c: Clinicians should initiate oral antimicrobial therapy if all of the following apply: (1) CSF analysis (if CSF obtained) is normal; (2) urinalysis result is positive; and (3) no IM obtained is abnormal. Evidence Quality: B; Strong Recommendation

Benefits	Inhibits further growth of bacterial pathogen. Reduces likelihood of morbidity.
Risks, harm, cost	Antimicrobial reactions and altering microbiome.
Benefit–harm assessment	Preponderance of benefit.
Key references	155

bacteremia affect treatment duration?

10. In what ways do patients referred to EDs differ from patients initially seeking care in EDs and from patients seen in community practices, and should management differ accordingly?
11. What will be the impact of newer biomarkers and of genomic and other "omic" testing?
12. How should results of multiplex viral testing be incorporated into prediction models for IBI?
13. What is the best way to individualize care? Most guidelines seek to maximize care for the vast majority of patients while allowing for individualized judgments to incorporate certain circumstances. However, most guidelines sort on a small number of variables while most patients present with a vast number of relevant factors. Collaborative efforts that generate consistently acquired patient characteristics have an opportunity, using newer statistical techniques, to match a patient with a presenting symptom to others who most closely resemble the patient's own background and clinical features. In this way, it would be possible to create an individualized guideline for each patient or "one patient, one guideline."
14. Research to individualize care must include patient factors, including better understanding of the role of patient preferences, decision-making, perceptions of risk and vulnerability, satisfaction, and understanding of care.
15. What is the most effective way to provide ongoing monitoring and follow-up? The role of telehealth and differing systems of care approaches should be explored.
16. For low-risk infants, what impact will this guideline have on reducing the use of antimicrobial agents, decreasing invasive diagnostic testing, decreasing hospitalizations, and shortening hospital lengths of stay?
17. What is the impact of individual social determinants of health on risk of IBI, diagnostic testing, management, morbidity and

KAS 19d: Clinicians need not use antimicrobial therapy while awaiting bacterial culture results if all of the following are met: (1) CSF analysis, if CSF obtained, is normal or enterovirus-positive; (2) urinalysis is negative; and (3) no IM obtained is abnormal. Evidence Quality: B; Moderate Recommendation

Benefits	Reduced risk of adverse reaction to antimicrobial agents/ anaphylaxis. Minimize disruption in developing microbiome. Small cost savings.
Risks, harm, cost	Delay in treatment of UTI, bacteremia, or bacterial meningitis with potential disease progression and increased morbidity.
Benefit–harm assessment	This is a benefit for infants receiving close and active observation, as previously discussed.
Key references	17–20, 36

KAS 20a: Clinicians should hospitalize infants in a unit with nurses and staff experienced in the care of 29- to 60-day-old infants if CSF analysis, if CSF obtained, is abnormal. Evidence Quality: A; Strong Recommendation

Benefits	An infant with a positive CSF analysis requires hospitalization for treatment and monitoring. Having the infant immediately available facilitates antimicrobial changes when culture and sensitivity results are reported, particularly if the organism is not sensitive to antimicrobial agents being administered.
Risks, harm, cost	Hospitalization increases risk of hospital-acquired infections. Increased risk of iatrogenic events related to intravenous catheters. Parental anxiety about infant's condition and financial strain. Stress to mothers because of breastfeeding challenges and separation from other children. Substantial cost.
Benefit–harm assessment	Preponderance of benefit.
Key references	57

KAS 20b: Clinicians may hospitalize infants in a unit with nurses and staff experienced in the care of 29- to 60-day-old-infants if any IM obtained is abnormal. Evidence Quality: B; Moderate Recommendation

Benefits	The risk of bacteremia is increased if an IM is abnormal.
Risks, harm, cost	Hospitalization increases risk of hospital-acquired infections. Increased risk of iatrogenic events related to intravenous catheters. Parental anxiety about infant's condition and financial strain. Stress to mothers because of breastfeeding challenges and separation from other children. Substantial cost.
Shared decision-making	For low-risk infants, the decision whether to hospitalize or not should be made after physicians provide estimates of the risks of underlying IBIs and benefits of home versus hospital monitoring. Parents and physicians have different values for clinical outcomes in young febrile infants.[67–73] These inherent value differences should be considered when engaging in discussions. Also, individual parents and physicians have different tolerances for risk.
Benefit–harm assessment	Preponderance of benefit.
Key references	4, 17, 22, 24, 58

KAS 20c: Clinicians should manage patients at home if all of the following criteria are met: (1) CSF analysis, if CSF obtained, is normal; (2) urinalysis is negative; (3) all IMs obtained are normal; (4) appropriate parental education has been provided; (5) follow-up plans for reevaluation in 24 hours have been developed and are in place; and (6) plans have been developed and are in place in case of change in clinical status, including means of communication between family and providers and access to emergency medical care. Evidence Quality: B; Moderate Recommendation

Benefits	Active monitoring for infants at increased risk of bacteremia.
Risks, harm, cost	Delay in recognizing changing clinical course warranting further evaluation. Potential increase in parental anxiety.
Benefit–harm assessment	Preponderance of benefit. This is an important consideration for infants when close and active observation is available at home.
Shared decision-making	For low-risk infants, the decision whether to hospitalize or not should be made after physicians provide estimates of the risks of underlying IBIs and benefits of home versus hospital monitoring. Parents and physicians have different values for clinical outcomes in young febrile infants.
Key references	4, 10, 14, 15, 17–21, 36

KAS 20d: Clinicians may manage infants without antimicrobial treatment at home without having obtained interpretable CSF if all of the following are met: (1) urinalysis is negative; (2) all IMs obtained are normal; and (3) parents can return promptly if there is a change in infant condition and agree to follow-up in 24 to 36 hours. Infants monitored at home should be reassessed in the following 24 hours. Evidence Quality: B; Moderate Recommendation

Benefits	Minimize disruption to family attachment and maternal breastfeeding. Substantial cost savings. Reduced risk of iatrogenic events and hospital borne infections.
Risks, harm, cost	Delay in recognizing changing clinical course warranting further evaluation. Potential increase in parental anxiety.
Benefit–harm assessment	Preponderance of benefit.
Key references	4, 10, 14, 15, 17–20, 36

KAS 21a: Clinicians should discontinue antimicrobial agents when all of the following are met: (1) all bacterial cultures are negative at 24 to 36 hours; (2) infant is clinically well or improving (eg, fever, feeding); and (3) there is no other infection requiring treatment (eg, otitis media). Evidence Quality: B; Strong Recommendation

Benefits	Limits costs, disruption to microbiome, adverse reaction.
Risks, harm, cost	Potential inadequate treatment of bacteremia if pathogen grows after 24 h: 5%–15%; after 36 h: <5%.
Benefit–harm assessment	Preponderance of benefit.
Key references	57, 92, 138–144

KAS 21b: Clinicians should discharge hospitalized patients with positive urine culture results (UTI) if all of the following are met: (1) blood culture is negative; (2) CSF culture, if CSF obtained, is negative; (3) infant is clinically well or improving (eg, fever, feeding); and (4) there are no other reasons for hospitalization. Evidence Quality: B; Strong Recommendation

Benefits	Limits costs, exposure to hospital-acquired infections, family disruption.
Risks, harm, cost	Potential clinical deterioration if pathogen grows from blood after discharge.
Benefit–harm assessment	Preponderance of benefit.
Key references	153–155

KAS 21c: Clinicians should discontinue parenteral antibiotics (if started) and begin or continue oral antimicrobial for infants with UTIs managed at home when all of the following are met: (1) urine culture result is positive; (2) all other bacterial culture results are negative at 24 to 36 hours; and (3) infant is clinically well or improving (eg, fever, feeding). Evidence Quality: B; Strong Recommendation

Benefits	Ensures adequacy of treatment. Reduced discomfort from parenteral administration. Reduced risk of intravenous infiltration. Reduced disruption to family.
Risks, harm, cost	Potential inadequate treatment of bacteremia if pathogen grows after 24 h: 5%–15%; after 36 h: <5%.
Benefit/harm assessment	Preponderance of benefit.
Key references	138–144, 155

KAS 21d: Clinicians should treat infants' positive bacterial pathogens in urine, blood, or CSF with targeted antimicrobial therapy for the duration of time consistent with the nature of the disease, responsible organism, and response of the infant to treatment. Evidence Quality: A; Strong Recommendation

Benefits	Inhibits further growth of bacterial pathogen. Cures infection. Reduces likelihood of morbidity. Contributes to antimicrobial stewardship.
Risks, harm, cost	Adverse reaction to antimicrobial. Interferes with infant's evolving microbiome. Accelerates emergence of antimicrobial resistance.
Benefit–harm assessment	Preponderance of benefit.
Key references	145, 155

mortality, discharge planning, and follow-up?

As a first step, questions 1, 2, and 5 could be partially answered by an effort to combine existing data sets from the large clinical and research groups publishing in this area. There are also international networks with similar foci on febrile infants. Although this would be challenging, it would still provide the shortest time to obtain the most accurate current assessment of risks.

It is clear that both the bacteriology and the technology involved in risk stratification and organism identification are evolving. Future research would benefit from a collaborative effort among researchers to define a common data set, with uniform definitions of elements and agreements to combine data for specific analyses. This effort could also lead to a model to answer question 10. As for question 12, it is now both methodologically and technologically feasible for a clinician to be able to enter a number of demographic, clinical, and laboratory data for a febrile infant and get the best estimate of risk for that patient.

LEAD AUTHOR

Robert H. Pantell, MD, FAAP

SUBCOMMITTEE ON FEBRILE INFANTS

Robert H. Pantell, MD, FAAP, Chair
Kenneth B. Roberts, MD, FAAP, Vice Chair
Charles R. Woods Jr, MD, MS, FAAP, Epidemiologist
William G. Adams, MD, FAAP
Carrie L. Byington, MD, FAAP
Benard P. Dreyer, MD, FAAP
Nathan Kuppermann, MD, MPH, FAAP, FACEP
Jane M. Lavelle, MD
Patricia S. Lye, MD, FAAP
Michelle L. Macy, MD, MS, FAAP
Flor M. Munoz, MD, MSc, FAAP
Carrie E. Nelson, MD, MS
Sean T. O'Leary, MD, MPH, FAAP
Stephen J. Pearson, MD, FAAP
Keith R. Powell, MD, FAAP
Jeb S. Teichman, MD, FAAP

WRITING GROUP

Robert H. Pantell, MD, FAAP, Lead
Kenneth B. Roberts, MD, FAAP, Co-lead
William G. Adams, MD, FAAP
Benard P. Dreyer, MD, FAAP, Ex Officio
Nathan Kuppermann, MD, MPH,

FAAP, FACEP
Sean T. O'Leary, MD, MPH, FAAP

STAFF

Kymika Okechukwu, MPA
Kristin Ingstrup
Jeremiah Salmon, MPH
Vanessa Shorte, MPH
Caryn Davidson, MA

ACKNOWLEDGMENTS

The committee acknowledges the generosity of individuals who graciously performed additional analyses from their published data sets and wisdom for this endeavor: Paul Aronson, MD, for the Febrile Young Infant Research Collaborative; Richard Bachur, MD (Division of Emergency Medicine, Boston Children's Hospital); Carrie Byington, MD (University of Utah and Intermountain Healthcare); Borja Gomez, MD (Pediatric Emergency Department, Cruces University Hospital); Tara Greenhow, MD (Kaiser Permanente Northern California); Nate Kuppermann, MD, MPH (PECARN); and Matthew Pantell, MD, MS (PROS). We also thank Eric Biondi, MD, for leading a series of focus groups of primary care and subspecialty pediatricians who scrutinized the guideline and provided feedback on implementation. We especially recognize Borja Gomez, MD (Pediatric Emergency Department, Cruces University Hospital). In a truly collegial fashion, he regularly ran subanalyses for us on his previously published data that helped us fill in many gaps and provide a more refined set of recommendations. The following groups provided feedback and suggestions that were incorporated during the process of development: AAP committees: Committee on Fetus and Newborn, Committee on Hospital Care, Committee on Infectious Diseases, Committee on Medical Liability and Risk Management, Committee on Pediatric Emergency Medicine, and Committee on Practice and Ambulatory Medicine; AAP council(s): Council on Quality Improvement and Patient Safety; AAP sections: Section on Administration and Practice Management, Section on Critical Care, Section on Emergency Medicine, Section on Epidemiology, Public Health, and Evidence, Section on Hospital Medicine, and Section on Infectious Diseases; other AAP groups: Family Partnerships Network, PROS, Quality Improvement Innovation Networks; and external groups: American Academy of Family Physicians, American College of Emergency Physicians, and Pediatric Infectious Diseases Society.

ABBREVIATIONS

AAP: American Academy of Pediatrics
AHRQ: Agency for Healthcare Research and Quality
ANC: absolute neutrophil count
AUC: area under the curve
CI: confidence interval
CRP: C-reactive protein
CSF: cerebrospinal fluid
ED: emergency department
GBS: group B *Streptococcus*
HSV: herpes simplex virus
IBI: invasive bacterial infection
IM: inflammatory marker
KAS: key action statement
LE: leukocyte esterase
LP: lumbar puncture
NPV: negative predictive value
PCR: polymerase chain reaction
PECARN: Pediatric Emergency Care Applied Research Network
PROS: Pediatric Research in Office Settings
RBC: red blood cell
RSV: respiratory syncytial virus
SBI: serious bacterial illness
SPA: suprapubic aspiration
UTI: urinary tract infection
WBC: white blood cell

FINANCIAL DISCLOSURE: The authors have indicated they have no financial relationships relevant to this article to disclose.

FUNDING: No external funding.

POTENTIAL CONFLICT OF INTEREST: Dr Byington is affiliated with BioFire and IDbyDNA. Dr Woods is affiliated with UpToDate. Dr Munoz-Rivas is affiliated with UpToDate, Moderna, and Pfizer; the other authors have indicated they have no potential conflicts of interest to disclose.

REFERENCES

1. Roberts KB. Young, febrile infants: a 30-year odyssey ends where it started. *JAMA.* 2004;291(10):1261–1262
2. McCracken GH Jr. Group B streptococci: the new challenge in neonatal infections. *J Pediatr.* 1973;82(4):703–706
3. Caspe WB, Chamudes O, Louie B. The evaluation and treatment of the febrile infant. *Pediatr Infect Dis.* 1983;2(2):131–135
4. DeAngelis C, Joffe A, Wilson M, Willis E. Iatrogenic risks and financial costs of hospitalizing febrile infants. *Am J Dis Child.* 1983;137(12):1146–1149
5. Kaushal R, Bates DW, Landrigan C, et al. Medication errors and adverse drug events in pediatric inpatients. *JAMA.* 2001;285(16):2114–2120
6. Stockwell DC, Kirkendall E, Muething SE, Kloppenborg E, Vinodrao H, Jacobs BR. Automated adverse event detection collaborative: electronic adverse event identification, classification, and corrective actions across academic pediatric institutions. *J Patient Saf.* 2013;9(4):203–210

7. Makary MA, Daniel M. Medical error-the third leading cause of death in the US. *BMJ.* 2016;353:i2139
8. McCarthy PL, Sharpe MR, Spiesel SZ, et al. Observation scales to identify serious illness in febrile children. *Pediatrics.* 1982;70(5):802–809
9. Greene JW, Hara C, O'Connor S, Altemeier WA III. Management of febrile outpatient neonates. *Clin Pediatr (Phila).* 1981;20(6):375–380
10. Dagan R, Powell KR, Hall CB, Menegus MA. Identification of infants unlikely to have serious bacterial infection although hospitalized for suspected sepsis. *J Pediatr.* 1985;107(6):855–860
11. Bonadio WA, Hagen E, Rucka J, Shallow K, Stommel P, Smith D. Efficacy of a protocol to distinguish risk of serious bacterial infection in the outpatient evaluation of febrile young infants. *Clin Pediatr (Phila).* 1993;32(7):401–404
12. Baker MD, Bell LM, Avner JR. Outpatient management without antibiotics of fever in selected infants. *N Engl J Med.* 1993;329(20):1437–1441
13. Baskin MN, Fleisher GR, O'Rourke EJ. Identifying febrile infants at risk for a serious bacterial infection. *J Pediatr.* 1993;123(3):489–490
14. Dagan R, Sofer S, Phillip M, Shachak E. Ambulatory care of febrile infants younger than 2 months of age classified as being at low risk for having serious bacterial infections. *J Pediatr.* 1988;112(3):355–360
15. Baraff LJ, Bass JW, Fleisher GR, et al; Practice guideline for the management of infants and children 0 to 36 months of age with fever without source. *Pediatrics.* 1993;92(1):1–11
16. Bachur RG, Harper MB. Predictive model for serious bacterial infections among infants younger than 3 months of age. *Pediatrics.* 2001;108(2):311–316
17. Pantell RH, Newman TB, Bernzweig J, et al. Management and outcomes of care of fever in early infancy. *JAMA.* 2004;291(10):1203–1212
18. Kuppermann N, Dayan PS, Levine DA, et al; Febrile Infant Working Group of the Pediatric Emergency Care Applied Research Network (PECARN). A clinical prediction rule to identify febrile infants 60 days and younger at low risk for serious bacterial infections. *JAMA Pediatr.* 2019;173(4):342–351
19. Mintegi S, Bressan S, Gomez B, et al. Accuracy of a sequential approach to identify young febrile infants at low risk for invasive bacterial infection. *Emerg Med J.* 2014;31(e1):e19–e24
20. Gomez B, Mintegi S, Bressan S, Da Dalt L, Gervaix A, Lacroix L; European Group for Validation of the Step-by-Step Approach. Validation of the "Step-by-Step" approach in the management of young febrile infants. *Pediatrics.* 2016;138(2):e20154381
21. Young PC. The management of febrile infants by primary-care pediatricians in Utah: comparison with published practice guidelines. *Pediatrics.* 1995;95(5):623–627
22. Greenhow TL, Hung YY, Pantell RH. Management and outcomes of previously healthy, full-term, febrile infants ages 7 to 90 days. *Pediatrics.* 2016;138(6):e20160270
23. Jain S, Cheng J, Alpern ER, et al. Management of febrile neonates in US pediatric emergency departments. *Pediatrics.* 2014; 133(2):187–195
24. Aronson PL, Thurm C, Alpern ER, et al; Febrile Young Infant Research Collaborative. Variation in care of the febrile young infant <90 days in US pediatric emergency departments. *Pediatrics.* 2014;134(4):667–677
25. Greenhow TL, Hung YY, Herz AM. Changing epidemiology of bacteremia in infants aged 1 week to 3 months. *Pediatrics.* 2012;129(3). Available at: www.pediatrics.org/cgi/content/full/129/3/e590
26. Hui C, Neto G, Tsertsvadze A, et al. Diagnosis and management of febrile infants (0-3 months). *Evid Rep Technol Assess (Full Rep).* 2012;205(205):1–297
27. Greenhow TL, Hung YY, Herz AM, Losada E, Pantell RH. The changing epidemiology of serious bacterial infections in young infants. *Pediatr Infect Dis J.* 2014;33(6):595–599
28. Levasseur KA, Stankovic C, Duffy E, Du W, Mahajan P. Prevalence of serious bacterial infections in return visits to the emergency department among infants aged 90 days or younger. *Pediatr Emerg Care.* 2014;30(10): 694–698
29. Hassoun A, Stankovic C, Rogers A, et al. *Listeria* and enterococcal infections in neonates 28 days of age and younger: is empiric parenteral ampicillin still indicated? *Pediatr Emerg Care.* 2014;30(4):240–243
30. Biondi E, Evans R, Mischler M, et al. Epidemiology of bacteremia in febrile infants in the United States. *Pediatrics.* 2013;132(6):990–996
31. Biondi EA, McCulloh R, Staggs VS, et al; American Academy of Pediatrics' Revise Collaborative. Reducing Variability in the Infant Sepsis Evaluation (REVISE): a national quality initiative. *Pediatrics.* 2019;144(3):e20182201
32. Leazer R, Perkins AM, Shomaker K, Fine B. A meta-analysis of the rates of *Listeria monocytogenes* and *Enterococcus* in febrile infants. *Hosp Pediatr.* 2016;6(4):187–195
33. Veesenmeyer AF, Edmonson MB. Trends in US hospital stays for listeriosis in infants. *Hosp Pediatr.* 2016;6(4): 196–203
34. Lyons TW, Garro AC, Cruz AT, et al; Herpes Simplex Virus Study Group of the Pediatric Emergency Medicine Collaborative Research Committee (PEM CRC). Performance of the modified Boston and Philadelphia criteria for invasive bacterial infections. *Pediatrics.* 2020;145(4):e20193538
35. Bergman DA, Mayer ML, Pantell RH, Finch SA, Wasserman RC. Does clinical presentation explain practice variability in the treatment of febrile infants? *Pediatrics.* 2006;117(3):787–795
36. Schroeder AR, Harris SJ, Newman TB. Safely doing less: a missing component of the patient safety dialogue. *Pediatrics.* 2011;128(6). Available at: www.pediatrics.org/cgi/content/full/128/6/e1596
37. Hernández-Bou S, Trenchs V, Vanegas MI, Valls AF, Luaces C. Evaluation of the bedside Quikread go® CRP test in the management of febrile infants at the emergency department. *Eur J Clin Microbiol Infect Dis.* 2017;36(7): 1205–1211
38. England JT, Del Vecchio MT, Aronoff SC. Use of serum procalcitonin in evaluation of febrile infants: a meta-analysis

of 2317 patients. *J Emerg Med*. 2014;47(6):682–688

39. Milcent K, Faesch S, Gras-Le Guen C, et al. Use of procalcitonin assays to predict serious bacterial infection in young febrile infants. *JAMA Pediatr*. 2016;170(1):62–69
40. Banerjee R, Teng CB, Cunningham SA, et al. Randomized trial of rapid multiplex polymerase chain reaction-based blood culture identification and susceptibility testing. *Clin Infect Dis*. 2015;61(7):1071–1080
41. Blaschke AJ, Heyrend C, Byington CL, et al. Rapid identification of pathogens from positive blood cultures by multiplex polymerase chain reaction using the FilmArray system. *Diagn Microbiol Infect Dis*. 2012;74(4):349–355
42. Salimnia H, Fairfax MR, Lephart PR, et al. Evaluation of the FilmArray blood culture identification panel: results of a multicenter controlled trial. *J Clin Microbiol*. 2016;54(3):687–698
43. Leber AL, Everhart K, Balada-Llasat JM, et al. Multicenter evaluation of biofire filmarray meningitis/encephalitis panel for detection of bacteria, viruses, and yeast in cerebrospinal fluid specimens. *J Clin Microbiol*. 2016;54(9):2251–2261
44. Krief WI, Levine DA, Platt SL, et al; Multicenter RSV-SBI Study Group of the Pediatric Emergency Medicine Collaborative Research Committee of the American Academy of Pediatrics. Influenza virus infection and the risk of serious bacterial infections in young febrile infants. *Pediatrics*. 2009;124(1):30–39
45. Mintegi S, Garcia-Garcia JJ, Benito J, et al. Rapid influenza test in young febrile infants for the identification of low-risk patients. *Pediatr Infect Dis J*. 2009;28(11):1026–1028
46. Bender JM, Taylor CS, Cumpio J, et al. Infants 1-90 days old hospitalized with human rhinovirus infection. *J Clin Lab Anal*. 2014;28(5):349–352
47. Levine DA, Platt SL, Dayan PS, et al; Multicenter RSV-SBI Study Group of the Pediatric Emergency Medicine Collaborative Research Committee of the American Academy of Pediatrics. Risk of serious bacterial infection in young febrile infants with respiratory syncytial virus infections. *Pediatrics*. 2004;113(6):1728–1734
48. Mahajan P, Browne LR, Levine DA, et al; Febrile Infant Working Group of the Pediatric Emergency Care Applied Research Network (PECARN). Risk of bacterial coinfections in febrile infants 60 days old and younger with documented viral infections. *J Pediatr*. 2018;203:86–91.e2
49. Nicholson EG, Avadhanula V, Ferlic-Stark L, Patel K, Gincoo KE, Piedra PA. The risk of serious bacterial infection in febrile infants 0-90 days of life with a respiratory viral infection. *Pediatr Infect Dis J*. 2019;38(4):355–361
50. Blaschke AJ, Korgenski EK, Wilkes J, et al. Rhinovirus in febrile infants and risk of bacterial infection. *Pediatrics*. 2018;141(2):e20172384
51. Ralston S, Hill V, Waters A. Occult serious bacterial infection in infants younger than 60 to 90 days with bronchiolitis: a systematic review. *Arch Pediatr Adolesc Med*. 2011;165(10):951–956
52. Doan Q, Enarson P, Kissoon N, Klassen TP, Johnson DW. Rapid viral diagnosis for acute febrile respiratory illness in children in the emergency department. *Cochrane Database Syst Rev*. 2014;(9):CD006452
53. Kadambari S, Braccio S, Ribeiro S, et al. Enterovirus and parechovirus meningitis in infants younger than 90 days old in the UK and Republic of Ireland: a British Paediatric Surveillance Unit study. *Arch Dis Child*. 2019;104(6):552–557
54. Nguyen DK, Friedlander S, Fleischman RJ, Zangwill KM. Length of stay and complications associated with febrile infants <90 days of age hospitalized in the United States, 2000-2012. *Hosp Pediatr*. 2018;8(12):746–752
55. Mahajan P, Kuppermann N, Suarez N, et al; Febrile Infant Working Group for the Pediatric Emergency Care Applied Research Network (PECARN). RNA transcriptional biosignature analysis for identifying febrile infants with serious bacterial infections in the emergency department: a feasibility study. *Pediatr Emerg Care*. 2015;31(1):1–5
56. Wilson MR, Sample HA, Zorn KC, et al. Clinical metagenomic sequencing for diagnosis of meningitis and encephalitis. *N Engl J Med*. 2019;380(24):2327–2340
57. Byington CL, Reynolds CC, Korgenski K, et al. Costs and infant outcomes after implementation of a care process model for febrile infants. *Pediatrics*. 2012;130(1). Available at: www.pediatrics.org/cgi/content/full/130/1/e16
58. Paxton RD, Byington CL. An examination of the unintended consequences of the rule-out sepsis evaluation: a parental perspective. *Clin Pediatr (Phila)*. 2001;40(2):71–77
59. Segal MR. Extending the elements of tree-structured regression. *Stat Methods Med Res*. 1995;4(3):219–236
60. Aronson PL, Shabanova V, Shapiro ED, et al; Febrile Young Infant Research Collaborative. A Prediction model to identify febrile infants ≤60 days at low risk of invasive bacterial infection. *Pediatrics*. 2019;144(1):e20183604
61. Powell EC, Mahajan PV, Roosevelt G, et al; Febrile Infant Working Group of the Pediatric Emergency Care Applied Research Network (PECARN). Epidemiology of bacteremia in febrile infants aged 60 days and younger. *Ann Emerg Med*. 2018;71(2):211–216
62. Ladhani SN, Henderson KL, Muller-Pebody B, Ramsay ME, Riordan A. Risk of invasive bacterial infections by week of age in infants: prospective national surveillance, England, 2010-2017. *Arch Dis Child*. 2019;104(9):874–878
63. Baker MD, Avner JR, Bell LM. Failure of infant observation scales in detecting serious illness in febrile, 4- to 8-week-old infants. *Pediatrics*. 1990;85(6):1040–1043
64. Nigrovic LE, Mahajan PV, Blumberg SM, et al; Febrile Infant Working Group of the Pediatric Emergency Care Applied Research Network (PECARN). The Yale Observation Scale score and the risk of serious bacterial infections in febrile infants. *Pediatrics*. 2017;140(1):e20170695
65. Roberts KB, Borzy MS. Fever in the first eight weeks of life. *Johns Hopkins Med J*. 1977;141(1):9–13
66. Kramer MS, Etezadi-Amoli J, Ciampi A, et al. Parents' versus physicians'

values for clinical outcomes in young febrile children. *Pediatrics.* 1994;93(5): 697–702

67. Madsen KA, Bennett JE, Downs SM. The role of parental preferences in the management of fever without source among 3- to 36-month-old children: a decision analysis. *Pediatrics.* 2006;117(4):1067–1076
68. De S, Tong A, Isaacs D, Craig JC. Parental perspectives on evaluation and management of fever in young infants: an interview study. *Arch Dis Child.* 2014;99(8):717–723
69. Aronson PL, Fraenkel L. Is shared decision-making the right approach for febrile infants? *Pediatrics.* 2017;140(3):e20170225
70. Aronson PL, Schaeffer P, Niccolai LM, Shapiro ED, Fraenkel L. Parents' perspectives on communication and shared decision making for febrile infants <60 days [published online ahead of print January 21, 2020]. *Pediatr Emerg Care.* doi:10.1097/PEC.0000000000001977
71. Aronson PL, Politi MC, Schaeffer P, et al. Development of an app to facilitate communication and shared decision-making with parents of febrile infants ≤ 60 days old. *Acad Emerg Med.* 2021;28(1):46–59
72. Djulbegovic B, Guyatt G. Evidence vs consensus in clinical practice guidelines. *JAMA.* 2019;322(8):725–726
73. Roberts KB; Subcommittee on Urinary Tract Infection, Steering Committee on Quality Improvement and Management. Urinary tract infection: clinical practice guideline for the diagnosis and management of the initial UTI in febrile infants and children 2 to 24 months. *Pediatrics.* 2011;128(3):595–610. Reaffirmed December 2016
74. Eden J, Levit L, Berg A, Morton S, eds; Institute of Medicine. *Finding What Works in Health Care: Standards for Systematic Reviews.* Washington, DC: National Academies Press; 2011
75. Prymula R, Siegrist C-A, Chlibek R, et al. Effect of prophylactic paracetamol administration at time of vaccination on febrile reactions and antibody responses in children: two open-label, randomised controlled trials. *Lancet.* 2009;374(9698):1339–1350
76. Byington CL, Enriquez FR, Hoff C, et al. Serious bacterial infections in febrile infants 1 to 90 days old with and without viral infections. *Pediatrics.* 2004;113(6):1662–1666
77. Schroeder AR, Newman TB, Wasserman RC, Finch SA, Pantell RH. Choice of urine collection methods for the diagnosis of urinary tract infection in young, febrile infants. *Arch Pediatr Adolesc Med.* 2005;159(10):915–922
78. Finnell SME, Carroll AE, Downs SM; Subcommittee on Urinary Tract Infection. Technical report—diagnosis and management of an initial UTI in febrile infants and young children. *Pediatrics.* 2011;128(3). Available at: www.pediatrics.org/cgi/content/full/128/3/e749
79. Glissmeyer EW, Korgenski EK, Wilkes J, et al. Dipstick screening for urinary tract infection in febrile infants. *Pediatrics.* 2014;133(5). Available at: www.pediatrics.org/cgi/content/full/133/5/e1121
80. Tzimenatos L, Mahajan P, Dayan PS, et al; Pediatric Emergency Care Applied Research Network (PECARN). Accuracy of the urinalysis for urinary tract infections in febrile infants 60 days and younger. *Pediatrics.* 2018;141(2):e20173068
81. Nelson JD, Peters PC. Suprapubic aspiration of urine in premature and term infants. *Pediatrics.* 1965;36(1):132–134
82. Marin JR, Shaikh N, Docimo SG, Hickey RW, Hoberman A. Videos in clinical medicine. Suprapubic bladder aspiration. *N Engl J Med.* 2014;371(10):e13
83. Kaufman J, Knight AJ, Bryant PA, Babl FE, Dalziel K. Liquid gold: the cost-effectiveness of urine sample collection methods for young precontinent children. *Arch Dis Child.* 2020;105(3): 253–259
84. Tran A, Fortier C, Giovannini-Chami L, et al. Evaluation of the bladder stimulation technique to collect midstream urine in infants in a pediatric emergency department. *PLoS One.* 2016;11(3):e0152598
85. Lavelle JM, Blackstone MM, Funari MK, et al. Two-step process for ED UTI screening in febrile young children: reducing catheterization rates. *Pediatrics.* 2016;138(1):e20153023
86. Schroeder AR, Chang PW, Shen MW, Biondi EA, Greenhow TL. Diagnostic accuracy of the urinalysis for urinary tract infection in infants <3 months of age. *Pediatrics.* 2015;135(6):965–971
87. Roberts KB. The diagnosis of UTI: liquid gold and the problem of gold standards. *Pediatrics.* 2015;135(6):1126–1127
88. Herreros ML, Tagarro A, García-Pose A, Sánchez A, Cañete A, Gili P. Performing a urine dipstick test with a clean-catch urine sample is an accurate screening method for urinary tract infections in young infants. *Acta Paediatr.* 2018;107(1):145–150
89. Roberts KB, Wald ER. The diagnosis of UTI: colony count criteria revisited. *Pediatrics.* 2018;141(2): e20173239
90. Herreros Fernández ML, González Merino N, Tagarro García A, et al. A new technique for fast and safe collection of urine in newborns. *Arch Dis Child.* 2013;98(1):27–29
91. Bachur R, Caputo GL. Bacteremia and meningitis among infants with urinary tract infections. *Pediatr Emerg Care.* 1995;11(5):280–284
92. Newman TB, Bernzweig JA, Takayama JI, Finch SA, Wasserman RC, Pantell RH. Urine testing and urinary tract infections in febrile infants seen in office settings: the Pediatric Research in Office Settings' Febrile Infant Study. *Arch Pediatr Adolesc Med.* 2002;156(1):44–54
93. Roman HK, Chang PW, Schroeder AR. Diagnosis and management of bacteremic urinary tract infection in infants. *Hosp Pediatr.* 2015;5(1):1–8
94. Blaschke AJ, Korgnski EK, Byington CL. Meningitis in well-appearing febrile infants aged 1–90 days. *Open Forum Infect Dis.* 2018;5(suppl 1):S133
95. Bonadio WA, Romine K, Gyuro J. Relationship of fever magnitude to rate of serious bacterial infections in neonates. *J Pediatr.* 1990;116(5): 733–735
96. Michelson KA, Neuman MI, Pruitt CM, et al; Febrile Young Infant Research Collaborative. Height of fever and invasive bacterial infection [published online August 20, 2020]. *Arch Dis Child.* 2021;106(6):594–596. doi:10.1136/archdischild-2019-318548

97. Gomez B, Bressan S, Mintegi S, et al. Diagnostic value of procalcitonin in well-appearing young febrile infants. *Pediatrics*. 2012;130(5):815–822

98. Woelker JU, Sinha M, Christopher NC, Powell KR. Serum procalcitonin concentration in the evaluation of febrile infants 2 to 60 days of age. *Pediatr Emerg Care*. 2012;28(5):410–415

99. Olaciregui I, Hernández U, Muñoz JA, Emparanza JI, Landa JJ. Markers that predict serious bacterial infection in infants under 3 months of age presenting with fever of unknown origin. *Arch Dis Child*. 2009;94(7):501–505

100. Gomez B, Diaz H, Carro A, Benito J, Mintegi S. Performance of blood biomarkers to rule out invasive bacterial infection in febrile infants under 21 days old. *Arch Dis Child*. 2019;104(6):547–551

101. Andreola B, Bressan S, Callegaro S, Liverani A, Plebani M, Da Dalt L. Procalcitonin and C-reactive protein as diagnostic markers of severe bacterial infections in febrile infants and children in the emergency department. *Pediatr Infect Dis J*. 2007;26(8):672–677

102. Pulliam PN, Attia MW, Cronan KM. C-reactive protein in febrile children 1 to 36 months of age with clinically undetectable serious bacterial infection. *Pediatrics*. 2001;108(6):1275–1279

103. Bonsu BK, Chb M, Harper MB. Identifying febrile young infants with bacteremia: is the peripheral white blood cell count an accurate screen? *Ann Emerg Med*. 2003;42(2):216–225

104. Cruz AT, Mahajan P, Bonsu BK, et al; Febrile Infant Working Group of the Pediatric Emergency Care Applied Research Network. Accuracy of complete blood cell counts to identify febrile infants 60 days or younger with invasive bacterial infections. *JAMA Pediatr*. 2017;171(11):e172927

105. Gómez B, Mintegi S, Benito J, Egireun A, Garcia D, Astobiza E. Blood culture and bacteremia predictors in infants less than three months of age with fever without source. *Pediatr Infect Dis J*. 2010;29(1):43–47

106. Scarfone R, Murray A, Gala P, Balamuth F. Lumbar puncture for all febrile infants 29-56 days old: a retrospective cohort reassessment study. *J Pediatr*. 2017;187:200–205.e1

107. Leazer R, Erickson N, Paulson J, et al. Epidemiology of cerebrospinal fluid cultures and time to detection in term infants. *Pediatrics*. 2017;139(5):e20163268

108. Curfman AL, Glissmeyer EW, Ahmad FA, et al. Initial presentation of neonatal herpes simplex virus infection. *J Pediatr*. 2016;172:121–126.e1

109. Flagg EW, Weinstock H. Incidence of neonatal herpes simplex virus infections in the United States, 2006. *Pediatrics*. 2011;127(1). Available at: www.pediatrics.org/cgi/content/full/127/1/e1

110. Caviness AC, Demmler GJ, Almendarez Y, Selwyn BJ. The prevalence of neonatal herpes simplex virus infection compared with serious bacterial illness in hospitalized neonates. *J Pediatr*. 2008;153(2):164–169

111. American Academy of Pediatrics. Herpes simplex. In: Kimberlin DW, Jackson MA, Long SS, eds. *Red Book: 2018 Report of the Committee on Infectious Diseases*. 32nd ed. Itasca, IL: American Academy of Pediatrics; 2021:407–417

112. Long SS, Pool TE, Vodzak J, Daskalaki I, Gould JM. Herpes simplex virus infection in young infants during 2 decades of empiric acyclovir therapy. *Pediatr Infect Dis J*. 2011;30(7):556–561

113. Kotzbauer D, Frank G, Dong W, Shore S. Clinical and laboratory characteristics of disseminated herpes simplex virus infection in neonates. *Hosp Pediatr*. 2014;4(3):167–171

114. Sampath A, Maduro G, Schillinger JA. Infant deaths due to herpes simplex virus, congenital syphilis, and HIV in New York City. *Pediatrics*. 2016;137(4):e20152387

115. Morris SR, Bauer HM, Samuel MC, Gallagher D, Bolan G. Neonatal herpes morbidity and mortality in California, 1995-2003. *Sex Transm Dis*. 2008;35(1):14–18

116. Kotzbauer D, Andresen D, Doelling N, Shore S. Clinical and laboratory characteristics of central nervous system herpes simplex virus infection in neonates and young infants. *Pediatr Infect Dis J*. 2014;33(11):1187–1189

117. Meehan WP III, Bachur RG. Predictors of cerebrospinal fluid pleocytosis in febrile infants aged 0 to 90 days. *Pediatr Emerg Care*. 2008;24(5):287–293

118. Liesman RM, Strasburg AP, Heitman AK, Theel ES, Patel R, Binnicker MJ. Evaluation of a commercial multiplex molecular panel for diagnosis of infectious meningitis and encephalitis. *J Clin Microbiol*. 2018;56(4):e01927-e17

119. Fleischer E, Aronson PL. Rapid diagnostic tests for meningitis and encephalitis–Biofire. *Pediatr Emerg Care*. 2020;36(8):397–401

120. Nigrovic LE, Malley R, Agrawal D, Kuppermann N; Pediatric Emergency Medicine Collaborative Research Committee of the American Academy of Pediatrics. Low risk of bacterial meningitis in children with a positive enteroviral polymerase chain reaction test result. *Clin Infect Dis*. 2010;51(10):1221–1222

121. Rittichier KR, Bryan PA, Bassett KE, et al. Diagnosis and outcomes of enterovirus infections in young infants. *Pediatr Infect Dis J*. 2005;24(6):546–550

122. Wallace SS, Lopez MA, Caviness AC. Impact of enterovirus testing on resource use in febrile young infants: a systematic review. *Hosp Pediatr*. 2017;7(2):96–102

123. Ramers C, Billman G, Hartin M, Ho S, Sawyer MH. Impact of a diagnostic cerebrospinal fluid enterovirus polymerase chain reaction test on patient management. *JAMA*. 2000;283(20):2680–2685

124. Dewan M, Zorc JJ, Hodinka RL, Shah SS. Cerebrospinal fluid enterovirus testing in infants 56 days or younger. *Arch Pediatr Adolesc Med*. 2010;164(9):824–830

125. Wylie TN, Wylie KM, Buller RS, Cannella M, Storch GA. Development and evaluation of an enterovirus D68 real-time reverse transcriptase PCR assay. *J Clin Microbiol*. 2015;53(8):2641–2647

126. Adler-Shohet FC, Cheung MM, Hill M, Lieberman JM. Aseptic meningitis in infants younger than six months of age hospitalized with urinary tract infections. *Pediatr Infect Dis J*. 2003;22(12):1039–1042

127. Schnadower D, Kuppermann N, Macias CG, et al; Pediatric Emergency Medicine Collaborative Research Committee of the American Academy of Pediatrics. Sterile cerebrospinal fluid pleocytosis in young febrile infants with urinary tract infections. *Arch Pediatr Adolesc Med.* 2011;165(7):635–641

128. Doby EH, Stockmann C, Korgenski EK, Blaschke AJ, Byington CL. Cerebrospinal fluid pleocytosis in febrile infants 1-90 days with urinary tract infection. *Pediatr Infect Dis J.* 2013;32(9): 1024–1026

129. Mintegi S, Benito J, Astobiza E, Capapé S, Gomez B, Eguireun A. Well appearing young infants with fever without known source in the emergency department: are lumbar punctures always necessary? *Eur J Emerg Med.* 2010;17(3):167–169

130. Nigrovic LE, Kuppermann N, Neuman MI. Risk factors for traumatic or unsuccessful lumbar punctures in children. *Ann Emerg Med.* 2007;49(6): 762–771

131. Hanson AL, Ros S, Soprano J. Analysis of infant lumbar puncture success rates: sitting flexed versus lateral flexed positions. *Pediatr Emerg Care.* 2014;30(5):311–314

132. Pingree EW, Kimia AA, Nigrovic LE. The effect of traumatic lumbar puncture on hospitalization rate for febrile infants 28 to 60 days of age. *Acad Emerg Med.* 2015;22(2):240–243

133. Byington CL, Kendrick J, Sheng X. Normative cerebrospinal fluid profiles in febrile infants. *J Pediatr.* 2011;158(1): 130–134

134. Neal JT, Kaplan SL, Woodford AL, Desai K, Zorc JJ, Chen AE. The effect of bedside ultrasonographic skin marking on infant lumbar puncture success: a randomized controlled trial. *Ann Emerg Med.* 2017;69(5):610–619.e1

135. Ayalin T, Lam SH. Ultrasound-assisted lumbar puncture in infants. *Acad Emerg Med.* 2011;18(4):e36

136. Pruitt CM, Neuman MI, Shah SS, et al; Febrile Young Infant Research Collaborative. Factors associated with adverse outcomes among febrile young infants with invasive bacterial infections. *J Pediatr.* 2019;204: 177–182.e1

137. King RL, Lorch SA, Cohen DM, Hodinka RL, Cohn KA, Shah SS. Routine cerebrospinal fluid enterovirus polymerase chain reaction testing reduces hospitalization and antibiotic use for infants 90 days of age or younger. *Pediatrics.* 2007;120(3):489–496

138. Aronson PL, Wang ME, Nigrovic LE, et al; Febrile Young Infant Research Collaborative. Time to pathogen detection for non-ill versus ill-appearing infants ≤60 days old with bacteremia and meningitis. *Hosp Pediatr.* 2018;8(7):379–384

139. Alpern ER, Kuppermann N, Blumberg S, et al; Pediatric Emergency Care Applied Research Network (PECARN). Time to positive blood and cerebrospinal fluid cultures in febrile infants ≤60 days of age. *Hosp Pediatr.* 2020;10(9):719–727

140. Biondi EA, Mischler M, Jerardi KE, et al; Pediatric Research in Inpatient Settings (PRIS) Network. Blood culture time to positivity in febrile infants with bacteremia. *JAMA Pediatr.* 2014;168(9):844–849

141. Kumar Y, Qunibi M, Neal TJ, Yoxall CW. Time to positivity of neonatal blood cultures. *Arch Dis Child Fetal Neonatal Ed.* 2001;85(3):F182–F186

142. Vamsi SR, Bhat RY, Lewis LE, Vandana KE. Time to positivity of blood cultures in neonates. *Pediatr Infect Dis J.* 2014;33(2):212–214

143. Jardine L, Davies MW, Faoagali J. Incubation time required for neonatal blood cultures to become positive. *J Paediatr Child Health.* 2006;42(12):797–802

144. Lefebvre CE, Renaud C, Chartrand C. Time to positivity of blood cultures in infants 0 to 90 days old presenting to the emergency department: is 36 hours enough? *J Pediatric Infect Dis Soc.* 2017;6(1):28–32

145. Kimberlin DW, Barnett ED, Lynfield R, Sawyer MH, eds. *Red Book: 2021 Report of the Committee on Infectious Diseases.* 32nd ed. Itasca, IL: American Academy of Pediatrics; 2021

146. Velasco R, Gomez B, Benito J, et al. Accuracy of PECARN rule for predicting serious bacterial infection in infants with fever without a source. *Arch Dis Child.* 2020;106(2):143–148

147. Nguyen THP, Young BR, Poggel LE, Alabaster A, Greenhow TL. Roseville protocol for the management of febrile infants 7–60 days. *Hosp Pediatr.* 2020;11(1):52–60

148. Bhansali P, Wiedermann BL, Pastor W, McMillan J, Shah N. Management of hospitalized febrile neonates without CSF analysis: a study of US pediatric hospitals. *Hosp Pediatr.* 2015;5(10): 528–533

149. Wang ME, Biondi EA, McCulloh RJ, et al. Testing for meningitis in febrile well-appearing young infants with a positive urinalysis. *Pediatrics.* 2019;144(3):e20183979

150. Bonadio W, Maida G. Urinary tract infection in outpatient febrile infants younger than 30 days of age: a 10-year evaluation. *Pediatr Infect Dis J.* 2014;33(4):342–344

151. Pantell RH, Roberts KB, Greenhow TL, Pantell MS. Advances in the diagnosis and management of febrile infants: challenging tradition. *Adv Pediatr.* 2018;65(1):173–208

152. Carmon L, Goldbart A, Greenberg D, Ben-Shimol S. Serious bacterial infections in hospitalized febrile infants in the first and second months of life. *Pediatr Infect Dis J.* 2017;36(10):924–929

153. Schnadower D, Kuppermann N, Macias CG, et al; American Academy of Pediatrics Pediatric Emergency Medicine Collaborative Research Committee. Febrile infants with urinary tract infections at very low risk for adverse events and bacteremia. *Pediatrics.* 2010;126(6): 1074–1083

154. Young BR, Nguyen THP, Alabaster A, Greenhow TL. The prevalence of bacterial meningitis in febrile infants 29-60 days with positive urinalysis. *Hosp Pediatr.* 2018;8(8):450–457

155. Hoberman A, Wald ER, Hickey RW, et al. Oral versus initial intravenous therapy for urinary tract infections in young febrile children. *Pediatrics.* 1999; 104(1, pt 1):79–86

Well-Appearing Febrile Infants Clinical Practice Guideline Quick Reference Tools

- Action Statement Summary
  — Evaluation and Management of Well-Appearing Febrile Infants 8 to 60 Days Old
- *ICD-10-CM* Coding Quick Reference for Well-Appearing Febrile Infants

Action Statement Summary

Evaluation and Management of Well-Appearing Febrile Infants 8 to 60 Days Old

Infants 8 to 21 d of age (Key Action Statements 1–7): Clinicians…

Key Action Statement 1

Should obtain urine specimen by catheterization or suprapubic aspiration (SPA) of bladder for urinalysis and, if urinalysis result is positive, for culture. (Grade: A; Strong Recommendation)

Key Action Statement 2

Should obtain a blood culture. (Grade: A; Strong Recommendation)

Key Action Statement 3

May assess inflammatory markers (IMs). (Grade: B; Weak Recommendation)

Key Action Statement 4

Should obtain cerebrospinal fluid (CSF) for analysis (white blood cell [WBC], protein, glucose, Gram stain) and culture for bacteria. See notes for viral testing. (Grade: A; Strong Recommendation)

Key Action Statement 5

Should initiate parenteral antimicrobial therapy. (Grade: A; Strong Recommendation)

Key Action Statement 6

Should actively monitor infants while awaiting results of bacterial cultures in a hospital setting with nurses and staff experienced in the care of neonates/young infants. (Grade: B; Moderate Recommendation)

Key Action Statement 7a

Should discontinue parenteral antimicrobial agents and discharge hospitalized patients when all of the following criteria are met: (1) culture results are negative for 24–36 h or only positive for contaminants; (2) the infant continues to appear clinically well or is improving (eg, fever, feeding); (3) there are no other reasons for hospitalization. (Grade: B; Strong Recommendation)

Key Action Statement 7b

Should treat infants' positive bacterial pathogens in urine, blood, or CSF with targeted antimicrobial therapy for the duration of time consistent with the nature of the disease, responsible organism, and response of the infant to treatment. (Grade: A; Strong Recommendation)

Infants 22 to 28 d of age (KASs 8–14): Clinicians…
Key Action Statement 8

Should obtain urine specimen by catheterization or SPA of bladder for urinalysis and, if urinalysis result is positive, for culture. (Grade: A; Strong Recommendation)

OR

Should obtain urine specimen by bag, spontaneous void, or stimulated void for urinalysis and, if urinalysis result is positive, obtain a catheterization or SPA specimen for culture. (Grade: A; Strong Recommendation)

Key Action Statement 9

Should obtain a blood culture. (Grade: A; Strong Recommendation)

Key Action Statement 10

Should assess IMs. (Grade: B; Strong Recommendation)

Key Action Statement 11a

May obtain a CSF analysis on infants 22–28 d of age even if all of the following criteria are met: (1) urinalysis result is negative or positive; (2) no IM obtained is abnormal; (3) blood and urine cultures have been obtained; (4) infant is hospitalized. (Grade: C; Moderate Recommendation)

Key Action Statement 11b

Should obtain CSF for analysis (WBC, protein, glucose, Gram stain), and bacterial culture if any IM obtained is positive. (Grade: B; Moderate Recommendation)

Key Action Statement 12a

Should administer parenteral antimicrobial therapy in a hospital if either of the following apply: (1) CSF analysis suggests bacterial meningitis; (2) urinalysis result is positive. (Grade: A; Strong Recommendation)

Key Action Statement 12b

May administer parenteral antimicrobial therapy in a hospital if ALL of the following apply: (1) CSF analysis is normal; (2) urinalysis is normal; (3) any IM obtained is abnormal. (Grade: B; Moderate Recommendation)

Key Action Statement 12c

May administer parenteral antimicrobial therapy to hospitalized infants even if ALL of the following are met: (1) urinalysis is normal; (2) no IM obtained is abnormal; (3) CSF analysis is normal or enterovirus-positive. (Grade: B; Weak Recommendation)

Key Action Statement 12d

Should administer parenteral antimicrobial therapy for infants who will be managed at home even if ALL of the following are met: (1) urinalysis is normal; (2) no IM obtained is abnormal; (3) CSF analysis is normal. (Grade: C; Moderate Recommendation)

Key Action Statement 13a

May manage infants at home if all of the following criteria are met: (1) urinalysis is normal; (2) no IM obtained is abnormal. (3) CSF analysis is normal or enterovirus-positive. (4) verbal teaching and written instructions have been provided for monitoring throughout the period of time at home. (5) follow-up plans for reevaluation in 24 h have been developed and are in place. (6) plans have been developed and are in place in case of change in clinical status, including means of communication between family and providers and access to emergency medical care. (Grade: B; Moderate Recommendation)

Key Action Statement 13b

Should hospitalize infants in a facility with nurses and staff experienced in the care of neonates/young infants when CSF is not obtained or is uninterpretable. (Grade: B; Weak Recommendation)

Key Action Statement 14a

Should discontinue antimicrobial agents and discharge hospitalized infants after 24 to 36 h of negative culture results if both of the following are met: (1) the infant is clinically well or improving (eg, fever, feeding); (2) there are no other reasons for hospitalization. (Grade: B; Strong Recommendation)

Key Action Statement 14b

Should discontinue antimicrobial agents on infants managed at home when all of the following criteria are met: (1) infant is clinically well or improving (eg, fever, feeding) at time of reassessment; (2) all culture results are negative at 24–36 h; (3) there is no other infection requiring treatment (eg, otitis media). (Grade: B; Strong Recommendation)

Key Action Statement 14c

Should treat infants' positive bacterial pathogens in urine, blood, or CSF with targeted antimicrobial therapy for the duration of time consistent with the nature of the disease, responsible organism, and response of the infant to treatment. (Grade: A; Strong Recommendation)

Infants 29 to 60 d of age (KASs 15–21): Clinicians…
Key Action Statement 15

Should obtain urine specimen by bag, spontaneous void, or stimulated void for urinalysis and, if urinalysis result is positive, obtain a catheterization or SPA specimen for culture. (Grade: A; Strong Recommendation)

OR

Should obtain urine specimen by catheterization or SPA of bladder for urinalysis and, if result is positive, for culture. (Grade: A; Strong Recommendation)

Key Action Statement 16

Should obtain a blood culture. (Grade: B; Moderate Recommendation)

Key Action Statement 17

Should assess IMs. (Grade: B; Moderate Recommendation)

Key Action Statement 18a

May obtain CSF for analysis (WBC, differential, protein, glucose, Gram stain), culture for bacteria, and test for enterovirus when CSF pleocytosis is detected or during enterovirus season if any IM is abnormal. (Grade: C; Weak Recommendation)

Key Action Statement 18b

Need not obtain CSF for analysis and culture if all IMs obtained are normal. (Grade: B; Moderate Recommendation)

Key Action Statement 19a

Should use parenteral antimicrobial therapy if CSF analysis suggests bacterial meningitis. (Grade: A; Strong Recommendation)

Key Action Statement 19b

May use parenteral antimicrobial therapy if both of the following apply: (1) CSF analysis (if CSF obtained) is normal; (2) any IM obtained is abnormal. (Grade: B; Moderate Recommendation)

Key Action Statement 19c

Should initiate oral antimicrobial therapy if all of the following apply: (1) CSF analysis (if CSF obtained) is normal; (2) urinalysis result is positive; (3) no IM obtained is abnormal. (Grade: B; Strong Recommendation)

Key Action Statement 19d

Need not use antimicrobial therapy while awaiting bacterial culture results if all of the following are met: (1) CSF analysis, if obtained, or normal or enterovirus-positive; (2) urinalysis result is negative; (3) no IM obtained is abnormal. (Grade: B; Moderate Recommendation)

Key Action Statement 20a

Should hospitalize infants in a unit with nurses and staff experienced in the care of 29- to 60-d-old infants if CSF analysis, if obtained, is abnormal. (Grade: A; Strong Recommendation)

Key Action Statement 20b

May hospitalize infants in a unit with nurses and staff experienced in the care of 29- to 60-d-old infants if any IM obtained is abnormal. (Grade: B; Moderate Recommendation)

Key Action Statement 20c

Should manage patients at home if all of the following criteria are met: (1) CSF analysis, if CSF obtained, is normal; (2) urinalysis result is negative; (3) all IMs obtained are normal; (4) appropriate parental education has been provided; (5) follow-up plans for reevaluation in 24 h have been developed and are in place; (6) plans have been developed and are in place in case of change in clinical status, including means of communication between family and providers and access to emergency medical care. (Grade: B; Moderate Recommendation)

Key Action Statement 20d

May manage infants without antimicrobial treatment at home without having obtained interpretable CSF if all of the following are met: (1) urinalysis result is negative; (2) all IMs obtained are normal; (3) parents can return promptly if there is a change in infant condition and agree to follow-up in 24 to 36 h. Infants monitored at home should be reassessed in the following 24 h. (Grade: B; Moderate Recommendation)

Key Action Statement 20e

Need not treat with antimicrobial therapy if all of the following apply: (1) CSF analysis (if CSF obtained) is normal; (2) urinalysis result is negative; (3) no IM obtained is abnormal. (Grade: C; Moderate Recommendation)

Key Action Statement 21a

Should discontinue antimicrobial agents when all of the following are met: (1) all bacterial culture results are negative at 24–36 h; (2) infant is clinically well or improving (eg, fever, feeding); (3) there is no other infection requiring treatment (eg, otitis media). (Grade: B; Strong Recommendation)

Key Action Statement 21b

Should discharge hospitalized patients with positive urine culture results if all of the following are met: (1) blood culture result is negative; (2) result of CSF culture, if obtained, is negative; (3) infant is clinically well or improving (eg, fever, feeding); (4) there are no other reasons for hospitalization. (Grade: B; Strong Recommendation)

Key Action Statement 21c

Should discontinue parenteral antibiotics (if started) and begin or continue oral antimicrobial for infants with urinary tract infections managed at home when all of the following are met: (1) urine culture result is positive; (2) all other bacterial culture results are negative at 24–36 h; (3) infant is clinically well or improving (eg, fever, feeding). (Grade: B; Strong Recommendation)

Key Action Statement 21d

Should treat infants' positive bacterial pathogens in urine, blood, or CSF with targeted antimicrobial therapy for the duration of time consistent with the nature of the disease, responsible organism, and response of the infant to treatment. (Grade: A; Strong Recommendation)

Coding Quick Reference for Well-Appearing Febrile Infants
ICD-10-CM
P81.9 Disturbance of temperature regulation of newborn, unspecified (Fever of newborn NOS)
R50.9 Fever, unspecified (fever of unknown origin)

SECTION 2

Endorsed Clinical Practice Guidelines

The American Academy of Pediatrics endorses and accepts as its policy the following guidelines from other organizations.

CARDIOVASCULAR HEALTH

Expert Panel on Integrated Guidelines for Cardiovascular Health and Risk Reduction in Children and Adolescents: Summary Report

National Heart, Lung, and Blood Institute

INTRODUCTION (EXCERPT). Atherosclerotic cardiovascular disease (CVD) remains the leading cause of death in North Americans, but manifest disease in childhood and adolescence is rare. By contrast, risk factors and risk behaviors that accelerate the development of atherosclerosis begin in childhood, and there is increasing evidence that risk reduction delays progression toward clinical disease. In response, the former director of the National Heart, Lung, and Blood Institute (NHLBI), Dr Elizabeth Nabel, initiated development of cardiovascular health guidelines for pediatric care providers based on a formal evidence review of the science with an integrated format addressing all the major cardiovascular risk factors simultaneously. An expert panel was appointed to develop the guidelines in the fall of 2006. (10/12)

CEREBRAL PALSY

Diagnostic Assessment of the Child With Cerebral Palsy

Quality Standards Subcommittee of the American Academy of Neurology and the Practice Committee of the Child Neurology Society

ABSTRACT. ***Objective.*** The Quality Standards Subcommittee of the American Academy of Neurology and the Practice Committee of the Child Neurology Society develop practice parameters as strategies for patient management based on analysis of evidence. For this parameter the authors reviewed available evidence on the assessment of a child suspected of having cerebral palsy (CP), a nonprogressive disorder of posture or movement due to a lesion of the developing brain.

Methods. Relevant literature was reviewed, abstracted, and classified. Recommendations were based on a four-tiered scheme of evidence classification.

Results. CP is a common problem, occurring in about 2 to 2.5 per 1,000 live births. In order to establish that a brain abnormality exists in children with CP that may, in turn, suggest an etiology and prognosis, neuroimaging is recommended with MRI preferred to CT (Level A). Metabolic and genetic studies should not be routinely obtained in the evaluation of the child with CP (Level B). If the clinical history or findings on neuroimaging do not determine a specific structural abnormality or if there are additional and atypical features in the history or clinical examination, metabolic and genetic testing should be considered (Level C). Detection of a brain malformation in a child with CP warrants consideration of an underlying genetic or metabolic etiology. Because the incidence of cerebral infarction is high in children with hemiplegic CP, diagnostic testing for coagulation disorders should be considered (Level B). However, there is insufficient evidence at present to be precise as to what studies should be ordered. An EEG is not recommended unless there are features suggestive of epilepsy or a specific epileptic syndrome (Level A). Because children with CP may have associated deficits of mental retardation, ophthalmologic and hearing impairments, speech and language disorders, and oral-motor dysfunction, screening for these conditions should be part of the initial assessment (Level A).

Conclusions. Neuroimaging results in children with CP are commonly abnormal and may help determine the etiology. Screening for associated conditions is warranted as part of the initial evaluation. (3/04, reaffirmed 7/07, 11/13)

CERUMEN IMPACTION

Cerumen Impaction

American Academy of Otolaryngology—Head and Neck Surgery Foundation

ABSTRACT. This update of the 2008 American Academy of Otolaryngology—Head and Neck Surgery Foundation cerumen impaction clinical practice guideline provides evidence-based recommendations on managing cerumen impaction. Cerumen impaction is defined as an accumulation of cerumen that causes symptoms, prevents assessment of the ear, or both. Changes from the prior guideline include

- a consumer added to the development group;
- new evidence (3 guidelines, 5 systematic reviews, and 6 randomized controlled trials);
- enhanced information on patient education and counseling;
- a new algorithm to clarify action statement relationships;
- expanded action statement profiles to explicitly state quality improvement opportunities, confidence in the evidence, intentional vagueness, and differences of opinion;
- an enhanced external review process to include public comment and journal peer review; and
- new key action statements on managing cerumen impaction that focus on primary prevention, contraindicated intervention, and referral and coordination of care. (1/17)

CONGENITAL MUSCULAR DYSTROPHY

Evidence-based Guideline Summary: Evaluation, Diagnosis, and Management of Congenital Muscular Dystrophy. Report of the Guideline Development Subcommittee of the American Academy of Neurology and the Practice Issues Review Panel of the American Association of Neuromuscular & Electrodiagnostic Medicine

American Academy of Neurology and American Association of Neuromuscular & Electrodiagnostic Medicine

ABSTRACT. ***Objective.*** To delineate optimal diagnostic and therapeutic approaches to congenital muscular dystrophy (CMD) through a systematic review and analysis of the currently available literature.

Methods. Relevant, peer-reviewed research articles were identified using a literature search of the MEDLINE, EMBASE, and Scopus databases. Diagnostic and therapeutic data from these articles were extracted and analyzed in accordance with the American Academy of Neurology classification of evidence schemes for diagnostic, prognostic, and therapeutic studies. Recommendations were linked to the strength of the evidence, other related literature, and general principles of care.

Results. The geographic and ethnic backgrounds, clinical features, brain imaging studies, muscle imaging studies, and muscle biopsies of children with suspected CMD help predict subtype-specific diagnoses. Genetic testing can confirm some subtype-specific diagnoses, but not all causative genes for CMD have been described. Seizures and respiratory complications occur in specific subtypes. There is insufficient evidence to determine the efficacy of various treatment interventions to optimize respiratory, orthopedic, and nutritional outcomes, and more data are needed regarding complications.

Recommendations. Multidisciplinary care by experienced teams is important for diagnosing and promoting the health of children with CMD. Accurate assessment of clinical presentations and genetic data will help in identifying the correct subtype-specific diagnosis in many cases. Multiorgan system complications occur frequently; surveillance and prompt interventions are likely to be beneficial for affected children. More research is needed to fill gaps in knowledge regarding this category of muscular dystrophies. (3/15, reaffirmed 7/18, 9/21)

DEPRESSION

Guidelines for Adolescent Depression in Primary Care (GLAD-PC): Part I. Practice Preparation, Identification, Assessment, and Initial Management

Rachel A. Zuckerbrot, MD; Amy Cheung, MD; Peter S. Jensen, MD; Ruth E.K. Stein, MD; Danielle Laraque, MD; and GLAD-PC Steering Group

ABSTRACT. ***Objectives***. To update clinical practice guidelines to assist primary care (PC) clinicians in the management of adolescent depression. This part of the updated guidelines is used to address practice preparation, identification, assessment, and initial management of adolescent depression in PC settings.

Methods. By using a combination of evidence- and consensus-based methodologies, guidelines were developed by an expert steering committee in 2 phases as informed by (1) current scientific evidence (published and unpublished) and (2) draft revision and iteration among the steering committee, which included experts, clinicians, and youth and families with lived experience.

Results. Guidelines were updated for youth aged 10 to 21 years and correspond to initial phases of adolescent depression management in PC, including the identification of at-risk youth, assessment and diagnosis, and initial management. The strength of each recommendation and its evidence base are summarized. The practice preparation, identification, assessment, and initial management section of the guidelines include recommendations for (1) the preparation of the PC practice for improved care of adolescents with depression; (2) annual universal screening of youth 12 and over at health maintenance visits; (3) the identification of depression in youth who are at high risk; (4) systematic assessment procedures by using reliable depression scales, patient and caregiver interviews, and *Diagnostic and Statistical Manual of Mental Disorders, Fifth Edition* criteria; (5) patient and family psychoeducation; (6) the establishment of relevant links in the community; and (7) the establishment of a safety plan.

Conclusions. This part of the guidelines is intended to assist PC clinicians in the identification and initial management of adolescents with depression in an era of great clinical need and shortage of mental health specialists, but they cannot replace clinical judgment; these guidelines are not meant to be the sole source of guidance for depression management in adolescents. Additional research that addresses the identification and initial management of youth with depression in PC is needed, including empirical testing of these guidelines. (2/18)

Guidelines for Adolescent Depression in Primary Care (GLAD-PC): Part II. Treatment and Ongoing Management

Amy H. Cheung, MD; Rachel A. Zuckerbrot, MD; Peter S. Jensen, MD; Danielle Laraque, MD; Ruth E.K. Stein, MD; and GLAD-PC Steering Group

ABSTRACT. ***Objectives***. To update clinical practice guidelines to assist primary care (PC) in the screening and assessment of depression. In this second part of the updated guidelines, we address treatment and ongoing management of adolescent depression in the PC setting.

Methods. By using a combination of evidence- and consensus-based methodologies, the guidelines were updated in 2 phases as informed by (1) current scientific evidence (published and unpublished) and (2) revision and iteration among the steering committee, including youth and families with lived experience.

Results. These updated guidelines are targeted for youth aged 10 to 21 years and offer recommendations for the management of adolescent depression in PC, including (1) active monitoring of mildly depressed youth, (2) treatment with evidence-based medication and psychotherapeutic approaches in cases of moderate and/or severe depression, (3) close monitoring of side effects, (4) consultation and comanagement of care with mental health specialists, (5) ongoing tracking of outcomes, and (6) specific steps to be taken in instances of partial or no improvement after an initial treatment has begun. The strength of each recommendation and the grade of its evidence base are summarized.

Conclusions. The Guidelines for Adolescent Depression in Primary Care cannot replace clinical judgment, and they should not be the sole source of guidance for adolescent depression management. Nonetheless, the guidelines may assist PC clinicians in the management of depressed adolescents in an era of great clinical need and a shortage of mental health specialists. Additional research concerning the management of depressed youth in PC is needed, including the usability, feasibility, and sustainability of guidelines, and determination of the extent to which the guidelines actually improve outcomes of depressed youth. (2/18)

DUCHENNE MUSCULAR DYSTROPHY

Practice Guideline Update Summary: Corticosteroid Treatment of Duchenne Muscular Dystrophy

David Gloss, MD, MPH&TM; Richard T. Moxley III, MD; Stephen Ashwal, MD; and Maryam Oskoui, MD, for the American Academy of Neurology Guideline Development Subcommittee

ABSTRACT. ***Objective.*** To update the 2005 American Academy of Neurology (AAN) guideline on corticosteroid treatment of Duchenne muscular dystrophy (DMD).

Methods. We systematically reviewed the literature from January 2004 to July 2014 using the AAN classification scheme for therapeutic articles and predicated recommendations on the strength of the evidence.

Results. Thirty-four studies met inclusion criteria.

Recommendations. In children with DMD, prednisone should be offered for improving strength (Level B) and pulmonary function (Level B). Prednisone may be offered for improving timed motor function (Level C), reducing the need for scoliosis surgery (Level C), and delaying cardiomyopathy onset by 18 years of age (Level C). Deflazacort may be offered for improving strength and timed motor function and delaying age at loss of ambulation by 1.4–2.5 years (Level C). Deflazacort may be offered for improving pulmonary function, reducing the need for scoliosis surgery, delaying cardiomyopathy onset, and increasing survival at 5–15 years of follow-up (Level C for each). Deflazacort and prednisone may be equivalent in improving motor function (Level C). Prednisone may be associated with greater weight gain in the first years of treatment than deflazacort (Level C). Deflazacort may be associated with a greater risk of cataracts than prednisone (Level C). The preferred dosing regimen of prednisone is 0.75 mg/kg/d (Level B). Over 12 months, prednisone 10 mg/kg/weekend is equally effective (Level B), with no long-term data available. Prednisone 0.75 mg/kg/d is associated with significant risk of weight gain, hirsutism, and cushingoid appearance (Level B). *Neurology*® 2016;86:465–472 (2/16, reaffirmed 1/19)

DYSPLASIA OF THE HIP

Guideline on Detection and Nonoperative Management of Pediatric Developmental Dysplasia of the Hip in Infants up to Six Months of Age: Evidence-based Clinical Practice Guideline

American Academy of Orthopaedic Surgeons

OVERVIEW. This clinical practice guideline is based upon a systematic review of published articles related to the detection and early management of hip instability and dysplasia in typically developing children less than 6 months of age. This guideline provides practice recommendations for the early screening and detection of hip instability and dysplasia and also highlights gaps in the published literature that should stimulate additional research. This guideline is intended towards appropriately

trained practitioners involved in the early examination and assessment of typically developing children for hip instability and dysplasia. (9/14)

FOOD ALLERGY

Guidelines for the Diagnosis and Management of Food Allergy in the United States: Report of the NIAID-Sponsored Expert Panel

National Institute of Allergy and Infectious Diseases

ABSTRACT. Food allergy is an important public health problem that affects children and adults and may be increasing in prevalence. Despite the risk of severe allergic reactions and even death, there is no current treatment for food allergy: the disease can only be managed by allergen avoidance or treatment of symptoms. The diagnosis and management of food allergy also may vary from one clinical practice setting to another. Finally, because patients frequently confuse nonallergic food reactions, such as food intolerance, with food allergies, there is an unfounded belief among the public that food allergy prevalence is higher than it truly is. In response to these concerns, the National Institute of Allergy and Infectious Diseases, working with 34 professional organizations, federal agencies, and patient advocacy groups, led the development of clinical guidelines for the diagnosis and management of food allergy. These Guidelines are intended for use by a wide variety of health care professionals, including family practice physicians, clinical specialists, and nurse practitioners. The Guidelines include a consensus definition for food allergy, discuss comorbid conditions often associated with food allergy, and focus on both IgE-mediated and non-IgE-mediated reactions to food. Topics addressed include the epidemiology, natural history, diagnosis, and management of food allergy, as well as the management of severe symptoms and anaphylaxis. These Guidelines provide 43 concise clinical recommendations and additional guidance on points of current controversy in patient management. They also identify gaps in the current scientific knowledge to be addressed through future research. (12/10)

HEMORRHAGE

An Evidence-based Prehospital Guideline for External Hemorrhage Control

American College of Surgeons Committee on Trauma

ABSTRACT. This report describes the development of an evidence-based guideline for external hemorrhage control in the prehospital setting. This project included a systematic review of the literature regarding the use of tourniquets and hemostatic agents for management of life-threatening extremity and junctional hemorrhage. Using the GRADE methodology to define the key clinical questions, an expert panel then reviewed the results of the literature review, established the quality of the evidence and made recommendations for EMS care. A clinical care guideline is proposed for adoption by EMS systems. (3/14)

HIV

Guidelines for the Prevention and Treatment of Opportunistic Infections in HIV-Exposed and HIV-Infected Children

US Department of Health and Human Services

SUMMARY. This report updates the last version of the Guidelines for the Prevention and Treatment of Opportunistic Infections (OIs) in HIV-Exposed and HIV-Infected Children, published in 2009. These guidelines are intended for use by clinicians and other health-care workers providing medical care for HIV-exposed and HIV-infected children in the United States. The guidelines discuss opportunistic pathogens that occur in the United States and ones that might be acquired during international travel, such as malaria. Topic areas covered for each OI include a brief description of the epidemiology, clinical presentation, and diagnosis of the OI in children; prevention of exposure; prevention of first episode of disease; discontinuation of primary prophylaxis after immune reconstitution; treatment of disease; monitoring for adverse effects during treatment, including immune reconstitution inflammatory syndrome (IRIS); management of treatment failure; prevention of disease recurrence; and discontinuation of secondary prophylaxis after immune reconstitution. A separate document providing recommendations for prevention and treatment of OIs among HIV-infected adults and post-pubertal adolescents (*Guidelines for the Prevention and Treatment of Opportunistic Infections in HIV-Infected Adults and Adolescents*) was prepared by a panel of adult HIV and infectious disease specialists (see http://aidsinfo.nih.gov/guidelines).

These guidelines were developed by a panel of specialists in pediatric HIV infection and infectious diseases (the Panel on Opportunistic Infections in HIV-Exposed and HIV-Infected Children) from the U.S. government and academic institutions. For each OI, one or more pediatric specialists with subject-matter expertise reviewed the literature for new information since the last guidelines were published and then proposed revised recommendations for review by the full Panel. After these reviews and discussions, the guidelines underwent further revision, with review and approval by the Panel, and final endorsement by the National Institutes of Health (NIH), Centers for Disease Control and Prevention (CDC), the HIV Medicine Association (HIVMA) of the Infectious Diseases Society of America (IDSA), the Pediatric Infectious Disease Society (PIDS), and the American Academy of Pediatrics (AAP). So that readers can ascertain how best to apply the recommendations in their practice environments, the recommendations are rated by a letter that indicates the strength of the recommendation, a Roman numeral that indicates the quality of the evidence supporting the recommendation, and where applicable, a * notation that signifies a hybrid of higher-quality adult study evidence and consistent but lower-quality pediatric study evidence.

More detailed methodologic considerations are listed in Appendix 1 (Important Guidelines Considerations), including a description of the make-up and organizational structure of the Panel, definition of financial disclosure and management of conflict of interest, funding sources for the guidelines, methods of collecting and synthesizing evidence and formulating recommendations, public commentary, and plans for updating the guidelines. The names and financial disclosures for each of the Panel members are listed in Appendices 2 and 3, respectively.

An important mode of childhood acquisition of OIs and HIV infection is from infected mothers. HIV-infected women may be more likely to have coinfections with opportunistic pathogens (e.g., hepatitis C) and more likely than women who are not HIV-infected to transmit these infections to their infants. In addition, HIV-infected women or HIV-infected family members coinfected with certain opportunistic pathogens may be more likely to transmit these infections horizontally to their children, resulting in increased likelihood of primary acquisition of such infections in young children. Furthermore, transplacental transfer of antibodies that protect infants against serious infections may be lower in HIV-infected women than in women who are HIV-uninfected. Therefore, infections with opportunistic pathogens may affect not just HIV-infected infants but also HIV-exposed, uninfected infants. These guidelines for treating OIs in children, therefore, consider treatment of infections in all children—HIV-infected and HIV-uninfected—born to HIV-infected women.

In addition, HIV infection increasingly is seen in adolescents with perinatal infection who are now surviving into their teens and in youth with behaviorally acquired HIV infection. Guidelines for postpubertal adolescents can be found in the adult OI guidelines, but drug pharmacokinetics (PK) and response to treatment may

differ in younger prepubertal or pubertal adolescents. Therefore, these guidelines also apply to treatment of HIV-infected youth who have not yet completed pubertal development.

Major changes in the guidelines from the previous version in 2009 include:

- Greater emphasis on the importance of antiretroviral therapy (ART) for prevention and treatment of OIs, especially those OIs for which no specific therapy exists;
- Increased information about diagnosis and management of IRIS;
- Information about managing ART in children with OIs, including potential drug-drug interactions;
- Updated immunization recommendations for HIV-exposed and HIV-infected children, including pneumococcal, human papillomavirus, meningococcal, and rotavirus vaccines;
- Addition of sections on influenza, giardiasis, and isosporiasis;
- Elimination of sections on aspergillosis, bartonellosis, and HHV-6 and HHV-7 infections; and
- Updated recommendations on discontinuation of OI prophylaxis after immune reconstitution in children.

The most important recommendations are highlighted in boxed major recommendations preceding each section, and a table of dosing recommendations appears at the end of each section. The guidelines conclude with summary tables that display dosing recommendations for all of the conditions, drug toxicities and drug interactions, and 2 figures describing immunization recommendations for children aged 0 to 6 years and 7 to 18 years.

The terminology for describing use of antiretroviral (ARV) drugs for treatment of HIV infection has been standardized to ensure consistency within the sections of these guidelines and with the *Guidelines for the Use of Antiretroviral Agents in Pediatric HIV Infection.* Combination antiretroviral therapy (cART) indicates use of multiple (generally 3 or more) ARV drugs as part of an HIV treatment regimen that is designed to achieve virologic suppression; highly active antiretroviral therapy (HAART), synonymous with cART, is no longer used and has been replaced by cART; the term ART has been used when referring to use of ARV drugs for HIV treatment more generally, including (mostly historical) use of one- or two-agent ARV regimens that do not meet criteria for cART.

Because treatment of OIs is an evolving science, and availability of new agents or clinical data on existing agents may change therapeutic options and preferences, these recommendations will be periodically updated and will be available at http://AIDSinfo.nih.gov. (11/13, updated 11/18, 3/21)

INFANTILE SPASMS

Evidence-based Guideline Update: Medical Treatment of Infantile Spasms

American Academy of Neurology and Child Neurology Society

ABSTRACT. ***Objective.*** To update the 2004 American Academy of Neurology/Child Neurology Society practice parameter on treatment of infantile spasms in children.

Methods. MEDLINE and EMBASE were searched from 2002 to 2011 and searches of reference lists of retrieved articles were performed. Sixty-eight articles were selected for detailed review; 26 were included in the analysis. Recommendations were based on a 4-tiered classification scheme combining pre-2002 evidence and more recent evidence.

Results. There is insufficient evidence to determine whether other forms of corticosteroids are as effective as adrenocorticotropic hormone (ACTH) for short-term treatment of infantile spasms. However, low-dose ACTH is probably as effective as high-dose ACTH. ACTH is more effective than vigabatrin (VGB) for short-term treatment of children with infantile spasms (excluding those with tuberous sclerosis complex). There is insufficient evidence to show that other agents and combination therapy are effective for short-term treatment of infantile spasms. Short lag time to treatment leads to better long-term developmental outcome. Successful short-term treatment of cryptogenic infantile spasms with ACTH or prednisolone leads to better long-term developmental outcome than treatment with VGB.

Recommendations. Low-dose ACTH should be considered for treatment of infantile spasms. ACTH or VGB may be useful for short-term treatment of infantile spasms, with ACTH considered preferentially over VGB. Hormonal therapy (ACTH or prednisolone) may be considered for use in preference to VGB in infants with cryptogenic infantile spasms, to possibly improve developmental outcome. A shorter lag time to treatment of infantile spasms with either hormonal therapy or VGB possibly improves long-term developmental outcomes. (6/12, reaffirmed 1/18, 5/21)

MEDULLARY THYROID CARCINOMA

Revised American Thyroid Association Guidelines for the Management of Medullary Thyroid Carcinoma

American Thyroid Association Guidelines Task Force on Medullary Thyroid Carcinoma

ABSTRACT. ***Introduction.*** The American Thyroid Association appointed a Task Force of experts to revise the original Medullary Thyroid Carcinoma: Management Guidelines of the American Thyroid Association.

Methods. The Task Force identified relevant articles using a systematic PubMed search, supplemented with additional published materials, and then created evidence-based recommendations, which were set in categories using criteria adapted from the United States Preventive Services Task Force Agency for Healthcare Research and Quality. The original guidelines provided abundant source material and an excellent organizational structure that served as the basis for the current revised document.

Results. The revised guidelines are focused primarily on the diagnosis and treatment of patients with sporadic medullary thyroid carcinoma (MTC) and hereditary MTC.

Conclusions. The Task Force developed 67 evidence-based recommendations to assist clinicians in the care of patients with MTC. The Task Force considers the recommendations to represent current, rational, and optimal medical practice. (6/15)

MIGRAINE HEADACHE

Practice Guideline Update: Acute Treatment of Migraine in Children and Adolescents. Report of the Guideline Development, Dissemination, and Implementation Subcommittee of the American Academy of Neurology and the American Headache Society

Maryam Oskoui, MD, MSc; Tamara Pringsheim, MD; Yolanda Holler-Managan, MD; Sonja Potrebic, MD, PhD; Lori Billinghurst, MD, MSc; David Gloss, MD; Andrew D. Hershey, MD, PhD; Nicole Licking, DO; Michael Sowell, MD; M. Cristina Victorio, MD; Elaine M. Gersz; Emily Leininger; Heather Zanitsch; Marcy Yonker, MD; and Kenneth Mack, MD, PhD

ABSTRACT. ***Objective.*** To provide evidence-based recommendations for the acute symptomatic treatment of children and adolescents with migraine.

Methods. We performed a systematic review of the literature and rated risk of bias of included studies according to the American Academy of Neurology classification of evidence criteria. A multidisciplinary panel developed practice recommendations, integrating findings from the systematic review and following an

Institute of Medicine–compliant process to ensure transparency and patient engagement. Recommendations were supported by structured rationales, integrating evidence from the systematic review, related evidence, principles of care, and inferences from evidence.

Results. There is evidence to support the efficacy of the use of ibuprofen, acetaminophen (in children and adolescents), and triptans (mainly in adolescents) for the relief of migraine pain, although confidence in the evidence varies between agents. There is high confidence in the evidence that adolescents receiving oral sumatriptan/naproxen and zolmitriptan nasal spray are more likely to be headache-free at 2 hours than those receiving placebo. No acute treatments were effective for migraine-related nausea or vomiting; some triptans were effective for migraine-related phonophobia and photophobia.

Recommendations. Recommendations for the treatment of acute migraine in children and adolescents focus on the importance of early treatment, choosing the route of administration best suited to the characteristics of the individual migraine attack, and providing counseling on lifestyle factors that can exacerbate migraine, including trigger avoidance and medication overuse. (8/19)

Practice Guideline Update: Pharmacologic Treatment for Pediatric Migraine Prevention. Report of the Guideline Development, Dissemination, and Implementation Subcommittee of the American Academy of Neurology and the American Headache Society

Maryam Oskoui, MD, MSc; Tamara Pringsheim, MD; Lori Billinghurst, MD; Sonja Potrebic, MD, PhD; Elaine M. Gersz; David Gloss, MD, MPH&TM; Yolanda Holler-Managan, MD; Emily Leininger; Nicole Licking, DO; Kenneth Mack, MD, PhD; Scott W. Powers, PhD, ABPP; Michael Sowell, MD; M. Cristina Victorio, MD; Marcy Yonker; Heather Zanitsch; and Andrew D. Hershey, MD, PhD

ABSTRACT. ***Objective.*** To provide updated evidence-based recommendations for migraine prevention using pharmacologic treatment with or without cognitive behavioral therapy in the pediatric population.

Methods. The authors systematically reviewed literature from January 2003 to August 2017 and developed practice recommendations using the American Academy of Neurology 2011 process, as amended.

Results. Fifteen Class I–III studies on migraine prevention in children and adolescents met inclusion criteria. There is insufficient evidence to determine if children and adolescents receiving divalproex, onabotulinumtoxinA, amitriptyline, nimodipine, or flunarizine are more or less likely than those receiving placebo to have a reduction in headache frequency. Children with migraine receiving propranolol are possibly more likely than those receiving placebo to have an at least 50% reduction in headache frequency. Children and adolescents receiving topiramate and cinnarizine are probably more likely than those receiving placebo to have a decrease in headache frequency. Children with migraine receiving amitriptyline plus cognitive behavioral therapy are more likely than those receiving amitriptyline plus headache education to have a reduction in headache frequency.

Recommendations. The majority of randomized controlled trials studying the efficacy of preventive medications for pediatric migraine fail to demonstrate superiority to placebo. Recommendations for the prevention of migraine in children include counseling on lifestyle and behavioral factors that influence headache frequency and assessment and management of comorbid disorders associated with headache persistence. Clinicians should engage in shared decision-making with patients and caregivers regarding the use of preventive treatments for migraine, including discussion of the limitations in the evidence to support pharmacologic treatments. (8/19)

NOSEBLEED (EPISTAXIS)

Clinical Practice Guideline: Nosebleed (Epistaxis)

David E. Tunkel, MD; Samantha Anne, MD, MS; Spencer C. Payne, MD; Stacey L. Ishman, MD, MPH; Richard M. Rosenfeld, MD, MPH, MBA; Peter J. Abramson, MD; Jacqueline D. Alikhaani; Margo McKenna Benoit, MD; Rachel S. Bercovitz, MD, MS; Michael D. Brown, MD, MSc; Boris Chernobilsky, MD; David A. Feldstein, MD; Jesse M. Hackell, MD; Eric H. Holbrook, MD; Sarah M. Holdsworth, MSN, APRN; Kenneth W. Lin, MD, MPH; Meredith Merz Lind, MD; David M. Poetker, MD, MA; Charles A. Riley, MD; John S. Schneider, MD, MA; Michael D. Seidman, MD; Venu Vadlamudi, MD; Tulio A. Valdez, MD; Lorraine C. Nnacheta, MPH, DrPH; Taskin M. Monjur

ABSTRACT. **Objective.** Nosebleed, also known as epistaxis, is a common problem that occurs at some point in at least 60% of people in the United States. While the majority of nosebleeds are limited in severity and duration, about 6% of people who experience nosebleeds will seek medical attention. For the purposes of this guideline, we define the target patient with a nosebleed as a patient with bleeding from the nostril, nasal cavity, or nasopharynx that is sufficient to warrant medical advice or care. This includes bleeding that is severe, persistent, and/or recurrent, as well as bleeding that impacts a patient's quality of life. Interventions for nosebleeds range from self-treatment and home remedies to more intensive procedural interventions in medical offices, emergency departments, hospitals, and operating rooms. Epistaxis has been estimated to account for 0.5% of all emergency department visits and up to one-third of all otolaryngology-related emergency department encounters. Inpatient hospitalization for aggressive treatment of severe nosebleeds has been reported in 0.2% of patients with nosebleeds.

Purpose. The primary purpose of this multidisciplinary guideline is to identify quality improvement opportunities in the management of nosebleeds and to create clear and actionable recommendations to implement these opportunities in clinical practice. Specific goals of this guideline are to promote best practices, reduce unjustified variations in care of patients with nosebleeds, improve health outcomes, and minimize the potential harms of nosebleeds or interventions to treat nosebleeds.

The target patient for the guideline is any individual aged ≥3 years with a nosebleed or history of nosebleed who needs medical treatment or seeks medical advice. The target audience of this guideline is clinicians who evaluate and treat patients with nosebleed. This includes primary care providers such as family medicine physicians, internists, pediatricians, physician assistants, and nurse practitioners. It also includes specialists such as emergency medicine providers, otolaryngologists, interventional radiologists/neuroradiologists and neurointerventionalists, hematologists, and cardiologists. The setting for this guideline includes any site of evaluation and treatment for a patient with nosebleed, including ambulatory medical sites, the emergency department, the inpatient hospital, and even remote outpatient encounters with phone calls and telemedicine. Outcomes to be considered for patients with nosebleed include control of acute bleeding, prevention of recurrent episodes of nasal bleeding, complications of treatment modalities, and accuracy of diagnostic measures.

This guideline addresses the diagnosis, treatment, and prevention of nosebleed. It focuses on nosebleeds that commonly present to clinicians via phone calls, office visits, and emergency room encounters. This guideline discusses first-line treatments such as nasal compression, application of vasoconstrictors, nasal packing, and nasal cautery. It also addresses more complex epistaxis management, which includes the use of endoscopic arterial

ligation and interventional radiology procedures. Management options for 2 special groups of patients—patients with hereditary hemorrhagic telangiectasia syndrome and patients taking medications that inhibit coagulation and/or platelet function—are included in this guideline.

This guideline is intended to focus on evidence-based quality improvement opportunities judged most important by the guideline development group. It is not intended to be a comprehensive, general guide for managing patients with nosebleed. In this context, the purpose is to define useful actions for clinicians, generalists, and specialists from a variety of disciplines to improve quality of care. Conversely, the statements in this guideline are not intended to limit or restrict care provided by clinicians based on their experience and assessment of individual patients. (1/20)

PALLIATIVE CARE

Clinical Practice Guidelines for Quality Palliative Care, 4th Edition
National Consensus Project for Quality Palliative Care (2018)

POSITIONAL PLAGIOCEPHALY

Systematic Review and Evidence-based Guidelines for the Management of Patients With Positional Plagiocephaly
Congress of Neurologic Surgeons

ABSTRACT. *Background.* Positional plagiocephaly is a common problem seen by pediatricians, pediatric neurologists, and pediatric neurosurgeons. Currently, there are no evidence-based guidelines on the management of positional plagiocephaly. The topics addressed in subsequent chapters of this guideline include: diagnosis, repositioning, physical therapy, and orthotic devices.

Objective. To evaluate topics relevant to the diagnosis and management of patients with positional plagiocephaly. The rigorous systematic process in which this guideline was created is presented in this chapter.

Methods. This guideline was prepared by the Plagiocephaly Guideline Task Force, a multidisciplinary team comprised of physician volunteers (clinical experts), medical librarians, and clinical guidelines specialists. The task force conducted a series of systematic literature searches of the National Library of Medicine and the Cochrane Library, according to standard protocols described below, for each topic addressed in subsequent chapters of this guideline.

Results. The systematic literature searches returned 396 abstracts relative to the 4 main topics addressed in this guideline. The results were analyzed and are described in detail in each subsequent chapter included in this guideline.

Conclusion. Evidence-based guidelines for the management of infants with positional plagiocephaly will help practitioners manage this common disorder. (11/16)

RHINOPLASTY

Improving Nasal Form and Function after Rhinoplasty
American Academy of Otolaryngology—Head and Neck Surgery Foundation

ABSTRACT. Rhinoplasty, a surgical procedure that alters the shape or appearance of the nose while preserving or enhancing the nasal airway, ranks among the most commonly performed cosmetic procedures in the United States, with >200,000 procedures reported in 2014. While it is difficult to calculate the exact economic burden incurred by rhinoplasty patients following surgery with or without complications, the average rhinoplasty procedure typically exceeds $4000. The costs incurred due to complications, infections, or revision surgery may include the cost of long-term antibiotics, hospitalization, or lost revenue from hours/days of missed work. The resultant psychological impact of rhinoplasty can also be significant. Furthermore, the health care burden from psychological pressures of nasal deformities/aesthetic shortcomings, surgical infections, surgical pain, side effects from antibiotics, and nasal packing materials must also be considered for these patients. Prior to this guideline, limited literature existed on standard care considerations for pre- and postsurgical management and for standard surgical practice to ensure optimal outcomes for patients undergoing rhinoplasty. The impetus for this guideline is to utilize current evidence-based medicine practices and data to build unanimity regarding the peri- and postoperative strategies to maximize patient safety and to optimize surgical results for patients. (2/17)

SEIZURE

Treatment of the Child With a First Unprovoked Seizure
Quality Standards Subcommittee of the American Academy of Neurology and the Practice Committee of the Child Neurology Society

ABSTRACT. The Quality Standards Subcommittee of the American Academy of Neurology and the Practice Committee of the Child Neurology Society develop practice parameters as strategies for patient management based on analysis of evidence regarding risks and benefits. This parameter reviews published literature relevant to the decision to begin treatment after a child or adolescent experiences a first unprovoked seizure and presents evidence-based practice recommendations. Reasons why treatment may be considered are discussed. Evidence is reviewed concerning risk of recurrence as well as effect of treatment on prevention of recurrence and development of chronic epilepsy. Studies of side effects of anticonvulsants commonly used to treat seizures in children are also reviewed. Relevant articles are classified according to the Quality Standards Subcommittee classification scheme. Treatment after a first unprovoked seizure appears to decrease the risk of a second seizure, but there are few data from studies involving only children. There appears to be no benefit of treatment with regard to the prognosis for long-term seizure remission. Antiepileptic drugs (AED) carry risks of side effects that are particularly important in children. The decision as to whether or not to treat children and adolescents who have experienced a first unprovoked seizure must be based on a risk–benefit assessment that weighs the risk of having another seizure against the risk of chronic AED therapy. The decision should be individualized and take into account both medical issues and patient and family preference. (1/03, reaffirmed 7/06, 7/10, 7/13, 1/16, 10/18, 9/21)

SEPTIC SHOCK AND SEPSIS-ASSOCIATED ORGAN DYSFUNCTION

Surviving Sepsis Campaign International Guidelines for the Management of Septic Shock and Sepsis-Associated Organ Dysfunction in Children
Scott L. Weiss, MD, MSCE, FCCM (Co-Vice Chair); Mark J. Peters, MD, PhD (Co-Vice Chair); Waleed Alhazzani, MD, MSc, FRCPC (Methodology Chair); Michael S. D. Agus, MD, FCCM, FAAP; Heidi R. Flori, MD, FAAP; David P. Inwald, MB, BChir, FRCPCH, FFICM, PhD; Simon Nadel, MBBS, MRCP, FRCP; Luregn J. Schlapbach, FCICM, FMH-ICU, FMH-Paeds, FMH-Neonatology; Robert C. Tasker, MB BS, MA, AM, MD, FRCPHC, FRCP; Andrew C. Argent, MB BCh, MMed, MD (Paediatrics); Joe Brierley, MD, MA; Joseph Carcillo, MD; Enitan D. Carrol, MB ChB, MD, FRCPCH, DTMH; Christopher L. Carroll, MD, MS, FCCM, FAAP; Ira M. Cheifetz, MD, FCCM; Karen Choong, MB, BCh, FRCP(C) (methodologist); Jeffrey J. Cies, PharmD, MPH, BCPS-AQ ID, BCPPS, FCCP, FCCM, FPPAG; Andrea T. Cruz, MD, MPH, FAAP; Daniele De Luca, MD, PhD; Akash Deep, MB BS, MD, FRCPCH; Saul N. Faust,

MA, MB BS, FRCPCH, PhD, FHEA; Claudio Flauzino De Oliveira, MD, PhD; Mark W. Hall, MD, FCCM, FAAP; Paul Ishimine, MD, FACEP, FAAP; Etienne Javouhey, MD, PhD; Koen F. M. Joosten, MD, PhD; Poonam Joshi, PhD; Oliver Karam, MD, PhD; Martin C. J. Kneyber, MD, PhD, FCCM; Joris Lemson, MD, PhD; Graeme MacLaren, MD, MSc, FCCM; Nilesh M. Mehta, MD; Morten Hylander Møller, MD, PhD; Christopher J. L. Newth, MD, ChB, FRCPC, FRACP; Trung C. Nguyen, MD, FAAP; Akira Nishisaki, MD, MSCE, FAAP; Mark E. Nunnally, MD, FCCM (methodologist); Margaret M. Parker, MD, MCCM, FAAP; Raina M. Paul, MD, FAAP; Adrienne G. Randolph, MD, MS, FCCM, FAAP; Suchitra Ranjit, MD, FCCM; Lewis H. Romer, MD; Halden F. Scott, MD, MSCS, FAAP, FACEP; Lyvonne N. Tume, BS, MSN, PhD, RN; Judy T. Verger, RN, PhD, CPNP-AC, FCCM, FAAN; Eric A. Williams, MD, MS, MMM, FCCM, FAAP; Joshua Wolf, MBBS, PhD, FRACP; Hector R. Wong, MD; Jerry J. Zimmerman, MD, PhD, FCCM; Niranjan Kissoon, MB BS, MCCM, FRCP(C), FAAP, FACPE (Co-Chair); and Pierre Tissieres, MD, DSc (Co-Chair)

ABSTRACT. ***Objectives.*** To develop evidence-based recommendations for clinicians caring for children (including infants, school-aged children, and adolescents) with septic shock and other sepsis-associated organ dysfunction.

Design. A panel of 49 international experts, representing 12 international organizations, as well as three methodologists and three public members was convened. Panel members assembled at key international meetings (for those panel members attending the conference), and a stand-alone meeting was held for all panel members in November 2018. A formal conflict-of-interest policy was developed at the onset of the process and enforced throughout. Teleconferences and electronic-based discussion among the chairs, co-chairs, methodologists, and group heads, as well as within subgroups, served as an integral part of the guideline development process.

Methods. The panel consisted of six subgroups: recognition and management of infection, hemodynamics and resuscitation, ventilation, endocrine and metabolic therapies, adjunctive therapies, and research priorities. We conducted a systematic review for each Population, Intervention, Control, and Outcomes question to identify the best available evidence, statistically summarized the evidence, and then assessed the quality of evidence using the Grading of Recommendations Assessment, Development, and Evaluation approach. We used the evidence-to-decision framework to formulate recommendations as strong or weak, or as a best practice statement. In addition, "in our practice" statements were included when evidence was inconclusive to issue a recommendation, but the panel felt that some guidance based on practice patterns may be appropriate.

Results. The panel provided 77 statements on the management and resuscitation of children with septic shock and other sepsis-associated organ dysfunction. Overall, six were strong recommendations, 52 were weak recommendations, and nine were best-practice statements. For 13 questions, no recommendations could be made; but, for 10 of these, "in our practice" statements were provided. In addition, 49 research priorities were identified.

Conclusions. A large cohort of international experts was able to achieve consensus regarding many recommendations for the best care of children with sepsis, acknowledging that most aspects of care had relatively low quality of evidence resulting in the frequent issuance of weak recommendations. Despite this challenge, these recommendations regarding the management of children with septic shock and other sepsis-associated organ dysfunction provide a foundation for consistent care to improve outcomes and inform future research. (2/20)

STATUS EPILEPTICUS

Diagnostic Assessment of the Child With Status Epilepticus (An Evidence-based Review)

Quality Standards Subcommittee of the American Academy of Neurology and the Practice Committee of the Child Neurology Society

ABSTRACT. ***Objective.*** To review evidence on the assessment of the child with status epilepticus (SE).

Methods. Relevant literature were reviewed, abstracted, and classified. When data were missing, a minimum diagnostic yield was calculated. Recommendations were based on a four-tiered scheme of evidence classification.

Results. Laboratory studies (Na^{++} or other electrolytes, Ca^{++}, glucose) were abnormal in approximately 6% and are generally ordered as routine practice. When blood or spinal fluid cultures were done on these children, blood cultures were abnormal in at least 2.5% and a CNS infection was found in at least 12.8%. When antiepileptic drug (AED) levels were ordered in known epileptic children already taking AEDs, the levels were low in 32%. A total of 3.6% of children had evidence of ingestion. When studies for inborn errors of metabolism were done, an abnormality was found in 4.2%. Epileptiform abnormalities occurred in 43% of EEGs of children with SE and helped determine the nature and location of precipitating electroconvulsive events (8% generalized, 16% focal, and 19% both). Abnormalities on neuroimaging studies that may explain the etiology of SE were found in at least 8% of children.

Recommendations. Although common clinical practice is that blood cultures and lumbar puncture are obtained if there is a clinical suspicion of a systemic or CNS infection, there are insufficient data to support or refute recommendations as to whether blood cultures or lumbar puncture should be done on a routine basis in children in whom there is no clinical suspicion of a systemic or CNS infection (Level U). AED levels should be considered when a child with treated epilepsy develops SE (Level B). Toxicology studies and metabolic studies for inborn errors of metabolism may be considered in children with SE when there are clinical indicators for concern or when the initial evaluation reveals no etiology (Level C). An EEG may be considered in a child with SE as it may be helpful in determining whether there are focal or generalized epileptiform abnormalities that may guide further testing for the etiology of SE, when there is a suspicion of pseudostatus epilepticus (nonepileptic SE), or nonconvulsive SE, and may guide treatment (Level C). Neuroimaging may be considered after the child with SE has been stabilized if there are clinical indications or if the etiology is unknown (Level C). There is insufficient evidence to support or refute routine neuroimaging in a child presenting with SE (Level U). (11/06, Reaffirmed 7/10, 7/13, 7/16, 1/19)

TELEHEALTH

Operating Procedures for Pediatric Telehealth

American Telemedicine Association

INTRODUCTION. Children represent one of our most vulnerable populations, and, as such, require special considerations when participating in telehealth encounters. Some services provided to adult patients by telehealth may not be easily adapted to or appropriate for pediatric patients due to physical factors (patient size), legal factors (consent, confidentiality), the ability to communicate and provide a history, developmental stage, unique pediatric conditions, and age-specific differences in both normal and disease states (AHRQ, n.d.; Alverson, 2008). These operating procedures for pediatric telehealth aim to improve the overall telehealth experience for pediatric patients, providers, and patient families. Telehealth holds particular promise in facilitating the management and coordination of care for medically

complex children and those with chronic conditions, such as asthma, chronic lung disease, autism, diabetes, and behavioral health conditions.

Through the use of telehealth, providers can provide appointment flexibility, increase access, promote continuity of care, and improve quality, either as a part of or as a complement to care delivered through the patient-centered medical home (PCMH). Whether telehealth services are delivered through the PCMH or as a complement to it, telehealth providers **should** routinely communicate with a patient's primary care provider and any relevant specialists regarding a telehealth encounter. Telehealth providers **shall** have a standard mechanism in place to share secure documentation of the encounter with the PCMH (AAP, 2015) in a timely manner.

These operating procedures do reference general telehealth operating principles that apply beyond pediatrics and that warrant particular emphasis, but they are not meant to serve as a comprehensive stand-alone guide to the development and operation of a telemedicine service. ATA has developed and published core standards for telehealth operations that provide overarching guidance for clinical, technical and administrative standards (ATA, 2014a). The Pediatric Operating Procedures complement existing professional organization guidance from the American Academy of Pediatrics, the American Psychological Association, the American Association of Family Physicians and the Society of Adolescent Health and Medicine. (4/17)

THYROID NODULES AND DIFFERENTIATED THYROID CANCER

Management Guidelines for Children With Thyroid Nodules and Differentiated Thyroid Cancer

American Thyroid Association Guidelines Task Force on Pediatric Thyroid Cancer

ABSTRACT. ***Background.*** Previous guidelines for the management of thyroid nodules and cancers were geared toward adults. Compared with thyroid neoplasms in adults, however, those in the pediatric population exhibit differences in pathophysiology, clinical presentation, and long-term outcomes. Furthermore, therapy that may be recommended for an adult may not be appropriate for a child who is at low risk for death but at higher risk for long-term harm from overly aggressive treatment. For these reasons, unique guidelines for children and adolescents with thyroid tumors are needed.

Methods. A task force commissioned by the American Thyroid Association (ATA) developed a series of clinically relevant questions pertaining to the management of children with thyroid nodules and differentiated thyroid cancer (DTC). Using an extensive literature search, primarily focused on studies that included subjects ≤18 years of age, the task force identified and reviewed relevant articles through April 2014. Recommendations were made based upon scientific evidence and expert opinion and were graded using a modified schema from the United States Preventive Services Task Force.

Results. These inaugural guidelines provide recommendations for the evaluation and management of thyroid nodules in children and adolescents, including the role and interpretation of ultrasound, fine-needle aspiration cytology, and the management of benign nodules. Recommendations for the evaluation, treatment, and follow-up of children and adolescents with DTC are outlined and include preoperative staging, surgical management, postoperative staging, the role of radioactive iodine therapy, and goals for thyrotropin suppression. Management algorithms are proposed and separate recommendations for papillary and follicular thyroid cancers are provided.

Conclusions. In response to our charge as an independent task force appointed by the ATA, we developed recommendations based on scientific evidence and expert opinion for the management of thyroid nodules and DTC in children and adolescents. In our opinion, these represent the current optimal care for children and adolescents with these conditions. (7/15)

TOBACCO USE

Treating Tobacco Use and Dependence: 2008 Update

US Department of Health and Human Services

ABSTRACT. *Treating Tobacco Use and Dependence: 2008 Update,* a Public Health Service-sponsored Clinical Practice Guideline, is a product of the Tobacco Use and Dependence Guideline Panel ("the Panel"), consortium representatives, consultants, and staff. These 37 individuals were charged with the responsibility of identifying effective, experimentally validated tobacco dependence treatments and practices. The updated Guideline was sponsored by a consortium of eight Federal Government and nonprofit organizations: the Agency for Healthcare Research and Quality (AHRQ); Centers for Disease Control and Prevention (CDC); National Cancer Institute (NCI); National Heart, Lung, and Blood Institute (NHLBI); National Institute on Drug Abuse (NIDA); American Legacy Foundation; Robert Wood Johnson Foundation (RWJF); and University of Wisconsin School of Medicine and Public Health's Center for Tobacco Research and Intervention (UW-CTRI). This Guideline is an updated version of the 2000 *Treating Tobacco Use and Dependence: Clinical Practice Guideline* that was sponsored by the U.S. Public Health Service, U. S. Department of Health and Human Services.

An impetus for this Guideline update was the expanding literature on tobacco dependence and its treatment. The original 1996 Guideline was based on some 3,000 articles on tobacco treatment published between 1975 and 1994. The 2000 Guideline entailed the collection and screening of an additional 3,000 articles published between 1995 and 1999. The 2008 Guideline update screened an additional 2,700 articles; thus, the present Guideline update reflects the distillation of a literature base of more than 8,700 research articles. Of course, this body of research was further reviewed to identify a much smaller group of articles that served as the basis for focused Guideline data analyses and review.

This Guideline contains strategies and recommendations designed to assist clinicians; tobacco dependence treatment specialists; and health care administrators, insurers, and purchasers in delivering and supporting effective treatments for tobacco use and dependence. The recommendations were made as a result of a systematic review and meta-analysis of 11 specific topics identified by the Panel (proactive quitlines; combining counseling and medication relative to either counseling or medication alone; varenicline; various medication combinations; long-term medications; cessation interventions for individuals with low socioeconomic status/limited formal education; cessation interventions for adolescent smokers; cessation interventions for pregnant smokers; cessation interventions for individuals with psychiatric disorders, including substance use disorders; providing cessation interventions as a health benefit; and systems interventions, including provider training and the combination of training and systems interventions). The strength of evidence that served as the basis for each recommendation is indicated clearly in the Guideline update. A draft of the Guideline update was peer reviewed prior to publication, and the input of 81 external reviewers was considered by the Panel prior to preparing the final document. In addition, the public had an opportunity to comment through a *Federal Register* review process. The key recommendations of the updated Guideline, *Treating Tobacco Use and Dependence: 2008 Update,* based on the literature review and expert Panel opinion, are as follows:

Ten Key Guideline Recommendations

The overarching goal of these recommendations is that clinicians strongly recommend the use of effective tobacco dependence counseling and medication treatments to their patients who use tobacco, and that health systems, insurers, and purchasers assist clinicians in making such effective treatments available.

1. Tobacco dependence is a chronic disease that often requires repeated intervention and multiple attempts to quit. Effective treatments exist, however, that can significantly increase rates of long-term abstinence.
2. It is essential that clinicians and health care delivery systems consistently identify and document tobacco use status and treat every tobacco user seen in a health care setting.
3. Tobacco dependence treatments are effective across a broad range of populations. Clinicians should encourage every patient willing to make a quit attempt to use the counseling treatments and medications recommended in this Guideline.
4. Brief tobacco dependence treatment is effective. Clinicians should offer every patient who uses tobacco at least the brief treatments shown to be effective in this Guideline.
5. Individual, group, and telephone counseling are effective, and their effectiveness increases with treatment intensity. Two components of counseling are especially effective, and clinicians should use these when counseling patients making a quit attempt:
   - Practical counseling (problem solving/skills training)
   - Social support delivered as part of treatment
6. Numerous effective medications are available for tobacco dependence, and clinicians should encourage their use by all patients attempting to quit smoking—except when medically contraindicated or with specific populations for which there is insufficient evidence of effectiveness (i.e., pregnant women, smokeless tobacco users, light smokers, and adolescents).
   - Seven first-line medications (5 nicotine and 2 non-nicotine) reliably increase long-term smoking abstinence rates:
     – Bupropion SR
     – Nicotine gum
     – Nicotine inhaler
     – Nicotine lozenge
     – Nicotine nasal spray
     – Nicotine patch
     – Varenicline
     – Clinicians also should consider the use of certain combinations of medications identified as effective in this Guideline.
7. Counseling and medication are effective when used by themselves for treating tobacco dependence. The combination of counseling and medication, however, is more effective than either alone. Thus, clinicians should encourage all individuals making a quit attempt to use both counseling and medication.
8. Telephone quitline counseling is effective with diverse populations and has broad reach. Therefore, both clinicians and health care delivery systems should ensure patient access to quitlines and promote quitline use.
9. If a tobacco user currently is unwilling to make a quit attempt, clinicians should use the motivational treatments shown in this Guideline to be effective in increasing future quit attempts.
10. Tobacco dependence treatments are both clinically effective and highly cost-effective relative to interventions for other clinical disorders. Providing coverage for these treatments increases quit rates. Insurers and purchasers should ensure that all insurance plans include the counseling and medication identified as effective in this Guideline as covered benefits.

The updated Guideline is divided into seven chapters that provide an overview, including methods (Chapter 1); information on the assessment of tobacco use (Chapter 2); clinical interventions, both for patients willing and unwilling to make a quit attempt at this time (Chapter 3); intensive interventions (Chapter 4); systems interventions for health care administrators, insurers, and purchasers (Chapter 5); the scientific evidence supporting the Guideline recommendations (Chapter 6); and information relevant to specific populations and other topics (Chapter 7).

A comparison of the findings of the updated Guideline with the 2000 Guideline reveals the considerable progress made in tobacco research over the brief period separating these two publications. Tobacco dependence increasingly is recognized as a chronic disease, one that typically requires ongoing assessment and repeated intervention. In addition, the updated Guideline offers the clinician many more effective treatment strategies than were identified in the original Guideline. There now are seven different first-line effective agents in the smoking cessation pharmacopoeia, allowing the clinician and patient many different medication options. In addition, recent evidence provides even stronger support for counseling (both when used alone and with other treatments) as an effective tobacco cessation strategy; counseling adds to the effectiveness of tobacco cessation medications, quitline counseling is an effective intervention with a broad reach, and counseling increases tobacco cessation among adolescent smokers.

Finally, there is increasing evidence that the success of any tobacco dependence treatment strategy cannot be divorced from the health care system in which it is embedded. The updated Guideline contains new evidence that health care policies significantly affect the likelihood that smokers will receive effective tobacco dependence treatment and successfully stop tobacco use. For instance, making tobacco dependence treatment a covered benefit of insurance plans increases the likelihood that a tobacco user will receive treatment and quit successfully. Data strongly indicate that effective tobacco interventions require coordinated interventions. Just as the clinician must intervene with his or her patient, so must the health care administrator, insurer, and purchaser foster and support tobacco intervention as an integral element of health care delivery. Health care administrators and insurers should ensure that clinicians have the training and support to deliver consistent, effective intervention to tobacco users.

One important conclusion of this Guideline update is that the most effective way to move clinicians to intervene is to provide them with information regarding multiple effective treatment options and to ensure that they have ample institutional support to use these options. Joint actions by clinicians, administrators, insurers, and purchasers can encourage a culture of health care in which failure to intervene with a tobacco user is inconsistent with standards of care. (5/08, last reviewed 9/19)

TURNER SYNDROME

Clinical Practice Guidelines for the Care of Girls and Women With Turner Syndrome: Proceedings From the 2016 Cincinnati International Turner Syndrome Meeting

Claus H. Gravholt; Niels H. Andersen; Gerard S. Conway; Olaf M. Dekkers; Mitchell E. Geffner; Karen O. Klein; Angela E. Lin; Nelly Mauras; Charmian A. Quigley; Karen Rubin; David E. Sandberg; Theo C. J. Sas; Michael Silberbach; Viveca Söderström-Anttila; Kirstine Stochholm; Janielle A. van Alfen-van derVelden;

Joachim Woelfle; and Philippe F. Backeljauw (on behalf of the International Turner Syndrome Consensus Group)

ABSTRACT. Turner syndrome affects 25–50 per 100,000 females and can involve multiple organs through all stages of life, necessitating multidisciplinary approach to care. Previous guidelines have highlighted this, but numerous important advances have been noted recently. These advances cover all specialty fields involved in the care of girls and women with TS. This paper is based on an international effort that started with exploratory meetings in 2014 in both Europe and the USA, and culminated with a Consensus Meeting held in Cincinnati, Ohio, USA in July 2016. Prior to this meeting, five groups each addressed important areas in TS care: 1) diagnostic and genetic issues, 2) growth and development during childhood and adolescence, 3) congenital and acquired cardiovascular disease, 4) transition and adult care, and 5) other comorbidities and neurocognitive issues. These groups produced proposals for the present guidelines. Additionally, four pertinent questions were submitted for formal GRADE (Grading of Recommendations, Assessment, Development and Evaluation) evaluation with a separate systematic review of the literature. These four questions related to the efficacy and most optimal treatment of short stature, infertility, hypertension, and hormonal replacement therapy. The guidelines project was initiated by the European Society of Endocrinology and the Pediatric Endocrine Society, in collaboration with the European Society for Paediatric Endocrinology, the Endocrine Society, the European Society of Human Reproduction and Embryology, the American Heart Association, the Society for Endocrinology, and the European Society of Cardiology. The guideline has been formally endorsed by the European Society of Endocrinology, the Pediatric Endocrine Society, the European Society for Paediatric Endocrinology, the European Society of Human Reproduction and Embryology and the Endocrine Society. Advocacy groups appointed representatives who participated in pre-meeting discussions and in the consensus meeting. (9/17)

SECTION 3

2021 Policies

From the American Academy of Pediatrics

- *Policy Statements*
  ORGANIZATIONAL PRINCIPLES TO GUIDE AND DEFINE THE CHILD HEALTH CARE SYSTEM AND TO IMPROVE THE HEALTH OF ALL CHILDREN

- *Clinical Reports*
  GUIDANCE FOR THE CLINICIAN IN RENDERING PEDIATRIC CARE

- *Technical Reports*
  BACKGROUND INFORMATION TO SUPPORT AMERICAN ACADEMY OF PEDIATRICS POLICY

Includes policy statements, clinical reports, and technical reports published between January 1, 2021, and December 31, 2021

INTRODUCTION

This section of ***Pediatric Clinical Practice Guidelines & Policies: A Compendium of Evidence-based Research for Pediatric Practice*** is composed of policy statements, clinical reports, and technical reports issued by the American Academy of Pediatrics (AAP) and is designed as a quick reference tool for AAP members, AAP staff, and other interested parties. Section 3 includes the full text of all AAP policies published in 2021. Section 4 is a compilation of all active AAP policies (through December 31, 2021) arranged alphabetically, with abstracts where applicable. A subject index is also available. These materials should help answer questions that arise about the AAP position on child health care issues. **However, remember that AAP policy statements, clinical reports, and technical reports do not indicate an exclusive course of treatment or serve as a standard of medical care. Variations, taking into account individual circumstances, may be appropriate.**

Policy statements have been written by AAP committees, councils, sections, or task forces and approved by the AAP Board of Directors. Most of these statements have appeared previously in ***Pediatrics*** or ***AAP News***.

This section does not contain all AAP policies. It does not include

- Press releases.
- Motions and resolutions that were approved by the Board of Directors. These can be found in the Board of Directors' minutes.
- Policies in manuals, pamphlets, booklets, or other AAP publications. These items can be ordered through the AAP. To order, visit http://shop.aap.org/books or call 866/843-2271.
- Testimony before Congress or government agencies.

All policy statements, clinical reports, and technical reports from the American Academy of Pediatrics automatically expire 5 years after publication unless reaffirmed, revised, or retired at or before that time. Please check the American Academy of Pediatrics website at www.aap.org for up-to-date reaffirmations, revisions, and retirements.

2021 Recommendations for Preventive Pediatric Health Care

- *Policy Statement*

POLICY STATEMENT Organizational Principles to Guide and Define the Child Health Care System and/or Improve the Health of all Children

American Academy of Pediatrics

DEDICATED TO THE HEALTH OF ALL CHILDREN®

2021 Recommendations for Preventive Pediatric Health Care

COMMITTEE ON PRACTICE AND AMBULATORY MEDICINE, BRIGHT FUTURES PERIODICITY SCHEDULE WORKGROUP

DOI: https://doi.org/10.1542/peds.2020-049776

PEDIATRICS (ISSN Numbers: Print, 0031-4005; Online, 1098-4275).

FINANCIAL DISCLOSURE: The authors have indicated they have no financial relationships relevant to this article to disclose.

FUNDING: No external funding.

POTENTIAL CONFLICT OF INTEREST: The authors have indicated they have no potential conflicts of interest to disclose.

To cite: COMMITTEE ON PRACTICE AND AMBULATORY MEDICINE, BRIGHT FUTURES PERIODICITY SCHEDULE WORKGROUP. 2021 Recommendations for Preventive Pediatric Health Care. *Pediatrics*. 2021;147(3):e2020049776

The 2021 Recommendations for Preventive Pediatric Health Care (Periodicity Schedule) has been approved by the American Academy of Pediatrics (AAP) and represents a consensus of the AAP and the Bright Futures Periodicity Schedule Workgroup. Each child and family is unique; therefore, these recommendations are designed for the care of children who are receiving competent parenting, have no manifestations of any important health problems, and are growing and developing in a satisfactory fashion. Developmental, psychosocial, and chronic disease issues for children and adolescents may require frequent counseling and treatment visits separate from preventive care visits. Additional visits also may become necessary if circumstances suggest variations from normal.

The AAP continues to emphasize the great importance of continuity of care in comprehensive health supervision and the need to avoid fragmentation of care.[1]

The Periodicity Schedule will not be published in *Pediatrics*. Readers are referred to the AAP website (www.aap.org/periodicityschedule) for the most recent version of the Periodicity Schedule and the full set of footnotes. This process will ensure that health care professionals have the most current recommendations. The Periodicity Schedule will be reviewed and revised annually to reflect current recommendations.

Following are the changes made to the Periodicity Schedule since it was last published in March 2020.

DEVELOPMENTAL

- Footnote 11 has been updated to read, "Screening should occur per 'Promoting Optimal Development: Identifying Infants and Young Children with Developmental Disorders Through Developmental Surveillance and Screening' (https://pediatrics.aappublications.org/content/145/1/e20193449)."

AUTISM SPECTRUM DISORDER

- Footnote 12 has been updated to read, "Screening should occur per 'Identification, Evaluation, and Management of Children With Autism Spectrum Disorder' (https://pediatrics.aappublications.org/content/145/1/e20193447)."

HEPATITIS C VIRUS INFECTION

Screening for hepatitis C virus (HCV) infection has been added to occur at least once between the ages of 18 and 79 years (to be consistent with recommendations of the US Preventive Services Task Force [USPSTF] and Centers for Disease Control and Prevention [CDC]).

- Footnote 31 has been added to read, "All individuals should be screened for hepatitis C virus (HCV) infection according to the USPSTF (https://www.uspreventiveservicestaskforce.org/uspstf/recommendation/hepatitis-c-screening) and CDC recommendations (https://www.cdc.gov/mmwr/volumes/69/rr/rr6902a1.htm) at least once between the ages of 18 and 79. Those at increased risk of HCV infection, including those who are persons with past or current injection drug use, should be tested for HCV infection and reassessed annually."

COMMITTEE ON PRACTICE AND AMBULATORY MEDICINE, 2020–2021

Jesse M. Hackell, MD, FAAP, Chairperson
Joseph J. Abularrage, MD, MPH, MPhil, FAAP
Yvette M. Almendarez, MD, FAAP
Alexy D. Arauz Boudreau, MD, FAAP
Abeba M. Berhane, MD, FAAP
Patricia E. Cantrell, MD, FAAP
Lisa M. Kafer, MD, FAAP
Katherine S. Schafer, DO, FAAP
Alisa Skatrud, MPA, Family Liaison
Robin Warner, MD, FAAP

STAFF

Elisha Ferguson
Bright Futures Periodicity Schedule Workgroup
Alexy D. Arauz Boudreau, MD, FAAP
Patricia E. Cantrell, MD, FAAP
Joseph F. Hagan Jr, MD, FAAP
Alex R. Kemper, MD, MPH, MS, FAAP, Bright Futures Evidence Expert
Judith S. Shaw, EdD, MPH, RN, FAAP
Alisa Skatrud, MPA, Family Liaison

STAFF

Jane B. Bassewitz, MA
Kathryn M. Janies

ABBREVIATIONS

AAP: American Academy of Pediatrics
CDC: Centers for Disease Control and Prevention
HCV: hepatitis C virus
USPSTF: US Preventive Services Task Force

REFERENCES

1. Hagan JF, Shaw JS, Duncan PM. *Bright Futures: Guidelines for Health Supervision of Infants, Children, and Adolescents*. 4th ed. Elk Grove Village, IL: American Academy of Pediatrics; 2017

Access to Optimal Emergency Care for Children

- *Policy Statement*

POLICY STATEMENT Organizational Principles to Guide and Define the Child Health Care System and/or Improve the Health of all Children

American Academy of Pediatrics

DEDICATED TO THE HEALTH OF ALL CHILDREN®

Access to Optimal Emergency Care for Children

Kathleen M. Brown, MD, FAAP, FACEP,[a] Alice D. Ackerman, MD, MBA, FAAP,[b] Timothy K. Ruttan, MD, FACEP, FAAP,[c] Sally K. Snow, RN, BSN, CPEN, FAEN,[d] COMMITTEE ON PEDIATRIC EMERGENCY MEDICINE; AMERICAN COLLEGE OF EMERGENCY PHYSICIANS, PEDIATRIC EMERGENCY MEDICINE COMMITTEE; EMERGENCY NURSES ASSOCIATION, PEDIATRIC COMMITTEE, 2018–2019

Every year, millions of pediatric patients seek emergency care. Significant barriers limit access to optimal emergency services for large numbers of children. The American Academy of Pediatrics, American College of Emergency Physicians, and Emergency Nurses Association have a strong commitment to identifying these barriers, working to overcome them, and encouraging, through education and system changes, improved access to emergency care for all children.

abstract

Departments of [a]Pediatrics and Emergency Medicine and Children's National Medical Center, School of Medicine of Health Sciences, George Washington University, Washington, DC; [b]Department of Pediatrics, Virginia Tech Carilion School of Medicine, Roanoke, Virginia; [c]Department of Pediatrics, University of Texas at Austin Dell Medical School, Department of Pediatrics, Dell Children's Medical Center of Central Texas, Pediatric Emergency Medicine, Austin, Texas; and [d]Emergency Nurses Association, Schaumburg, Illinois

Published simultaneously in Annals of Emergency Medicine.

DOI: https://doi.org/10.1542/peds.2021-050787

To cite: Brown KM, Ackerman AD, Ruttan TK, et al. AAP COMMITTEE ON PEDIATRIC EMERGENCY MEDICINE; AMERICAN COLLEGE OF EMERGENCY PHYSICIANS, PEDIATRIC EMERGENCY MEDICINE COMMITTEE; EMERGENCY NURSES ASSOCIATION, PEDIATRIC COMMITTEE, 2018–2019. Access to Optimal Emergency Care for Children. *Pediatrics.* 2021;147(5): e2021050787

All children deserve access to optimal (safe and high-quality) emergency care. Given the inherent vulnerabilities of children and potential lifelong consequences of poorly treated health conditions, access to optimal emergency health care is particularly important. In the United States, emergency departments (EDs) serve as the national safety net for individuals unable to find care elsewhere as well as a resource during public health emergencies and disasters through the provision of comprehensive acute care 24 hours a day and 7 days a week. Vulnerable populations who rely more heavily on the ED for services are disproportionally affected when this safety net is weakened or fails, and this needs to be addressed to ensure optimal care for all Americans. A significant portion of annual ED visits are by children younger than 18 years. Recent national data reveal that children account for approximately 20% of all ED visits, which represents more than 27 million total ED visits in the United States.[1] The vast majority of these visits take place outside of pediatric medical centers and children's hospitals.[2]

The American Academy of Pediatrics (AAP), American College of Emergency Physicians (ACEP), and Emergency Nurses Association (ENA) have previously endorsed policy statements advocating for improved access to emergency care.[3–5] Despite these statements and calls for action by other groups,[6] access to optimal emergency care remains limited for many children in the United States. The 2014 ACEP "Report Card on Emergency Medicine" examined access to emergency care for patients of

all ages on a state-by-state basis, and it found that few states have adequate policies and resources to deliver an acceptable level of emergency care access. The overall nationwide grade of D− was unchanged since the last report card was issued in 2009, reflecting a lack of improvement in emergency care access, despite recent efforts at health care reform.[7]

PROBLEMS THAT RESTRICT ACCESS TO CARE

Children and their families face barriers to optimal emergency care at many key points of access. These include the following.

1. Public and Professional Awareness of Available Resources and Systems of Care

Deficits remain in the awareness and perceptions of the public and health care professionals regarding the emergency care system and how best to access emergency care when needed. These include:

- lack of a consensus on what should drive entry into the emergency care system and appropriate points of access for patients;
- underuse of emergency medical services (EMS) in emergencies because of a misconception by some caregivers that they can reach EDs faster on their own;
- limited access to a medical home for patients and poor coordination of 2-way communication between emergency physicians, nurse practitioners or physician assistants, and the primary care provider;[8]
- misconception that urgent care centers provide comprehensive emergency services;
- lack of knowledge of the inconsistent readiness of EDs to care for children of all ages;[2]
- language and health literacy barriers to understanding the appropriate use of less emergent sources of care, such as urgent clinic appointments or urgent care centers; and
- poor access to timely primary care appointments among vulnerable patients, especially children who have public insurance, have language barriers, are members of racial and ethnic minorities, and/or live in underserved areas.[9,10]

2. Entry Into the Emergency Care System

Many factors may limit a family's ability to access the emergency care system for their child. These include:

- lack of universal access to enhanced or basic 911 services and wireless 911 service for cellular phones, with continued reliance in some areas on local 10-digit emergency telephone numbers;[11]
- language barriers that can impede the use of 911 services in many locales;
- limited transportation resources to access emergency care outside of the 911 system;
- long transportation times, especially in rural environments;[12]
- concern for financial consequences of activating the 911 system and incurring bills that may not be adequately covered by all insurance types;
- concerns on the part of families of ill or injured children regarding immigration issues, social service agency intervention, and other legal or financial concerns that might arise once care has been accessed; and
- excessive demand on the emergency care system because of inappropriate use of 911 systems by patients who do require them. This limits the availability of such services and can potentially delay a more urgent transport.

3. Availability of Optimal Pediatric Prehospital Care

The Institute of Medicine (now the National Academy of Medicine)[6] and others have outlined some of the deficiencies in pediatric prehospital care, including:

- variability in pediatric readiness between urban, suburban, and rural prehospital care systems as well as discrepancies in readiness between high-volume pediatric facilities and their low-volume (fewer than 10 pediatric patients per day) counterparts;
- lack of comprehensive pediatric training, experience, competency assessment, and ongoing quality improvement for prehospital EMS and interfacility transport professionals;
- limited scientific evidence on which to base protocols or procedures for prehospital care of children;
- limited high-quality and specific evidence-based guidelines for care efficacy and safety within all levels of EMS for children; and
- lack of validated quality metrics and paucity of quality improvement efforts in pediatric prehospital care.

4. Availability of Optimal Emergency Care for Children

- Underserved areas and populations.
  - Impact of closing hospital EDs: The closure of EDs and hospitals that disproportionately serve disadvantaged populations has impacted both rural areas and underserved urban areas, with differential impacts in each type of region.[13]
  - Critical access hospitals: The federal government has historically supported rural hospitals. In 1997, the Centers for Medicare and Medicaid Services created the Critical Access Hospital Program, through which Congress, through the Balanced Budget Act of 1997, designated several small rural hospitals as critical access facilities, recognizing that

their small size limited their scope of service.[14] Such hospitals received extra federal funding to focus on critical medical services. Often, these facilities have low volumes in general and in particular have low pediatric volumes, which limits experience in pediatric care and creates a challenge for skill retention. Moreover, changes in health care reimbursement models have led to struggles for rural hospitals, leading to many closures and decreased services in some instances. From 2010 to 2016, 75 rural hospitals in the United States closed or ceased operations, prompting new concerns about access to essential services in rural communities.[15,16]

  - Development of expanded medical services: Accelerated trends toward retail medical clinics, urgent care clinics, and freestanding EDs, in addition to expansion of existing facilities, disproportionately benefit areas with a higher socioeconomic status, which has the potential to create further disparities in access to care in underserved areas.[17]

- ED crowding: Long ED wait times for pediatric patients can discourage families from seeking timely care for emergency situations. In addition, crowded EDs create a challenging and rushed environment that is less child friendly and fails to address the specific needs of each pediatric patient.[18] Long wait times and crowding in EDs is particularly difficult for children with special health care needs, including those with physical and intellectual disabilities or mental and behavioral health concerns. Crowding has been associated with decreased safety, timeliness, and effectiveness of emergency care in children.[19–24]
- Readiness of EDs for pediatric patients: Data from the 2013 National Pediatric Readiness Project (NPRP) noted that pediatric preparedness had improved since 2003, with the national median assessment score increasing from 55 to 69 of 100 points.[2] Despite this improvement, many gaps in pediatric readiness remain, particularly in EDs with a low volume of pediatric patients. In the 2013 assessment, at least 15% of EDs lacked at least 1 specific piece of recommended equipment, 81% reported barriers to implementing guidelines for pediatric emergency care, only 47% included pediatric-specific components to their disaster plans, and fewer than one-half included children in disaster drills.[2] Further study of 1 state (California) determined that the presence of a pediatric emergency care coordinator and the inclusion of pediatric-specific elements in the ED quality improvement plan were associated with improved scores on the NPRP. However, in the same state, only about one-half of the hospitals had a person designated as a pediatric emergency care coordinator, and fewer than one-half had a quality improvement plan that included at least 1 pediatric-specific metric.[25]
- Quality of care (evidence-based practice and quality improvement): Despite significant growth in high-quality pediatric emergency care research, a relative paucity of data to support evidence-based care for childhood emergencies remains. In addition, a significant delay between the creation of evidence and its translation into practice in the ED further challenges knowledge translation and dissemination.[26,27]
- Access to pediatric medical subspecialists, pediatric surgical specialists, and mental health professionals: Significant geographic variation exists in access to pediatric subspecialty care, with children in rural areas disproportionately affected by poor access to subspecialists and longer transport times to centers that provide specialty care, including care for behavioral and mental health emergencies.[28,29] This lack of access limits the ability to provide emergency and ongoing care for children closer to their homes and places a larger burden on families requiring specialty care in addressing complications from ongoing disease processes and treatments.[30–32] Moreover, regardless of their insurance, patients may experience challenges with accessing specialty care and navigating networks of care.[33] Telemedicine has been proposed as a potential solution to this problem and has received significant attention because of coronavirus disease 2019, with improvement in access and a reduction in previously described implementation barriers.[34]

5. Financial Considerations

Limited and often inadequate payment for primary care for many children decreases both the availability of primary care and the ability to provide unscheduled visits in the primary care office setting. Children covered by Medicaid or the Children's Health Insurance Program visit the ED more frequently than both those with private insurance and those who are uninsured. However, reasons for the visit differed among population groups. When asked about their child's last visit to the ED, respondents for children who had Medicaid or Children's Health Insurance Program were more likely

than those with private coverage to report that their usual medical home was not open or they did not have another place to obtain care. In contrast, respondents for certain categories of privately insured children were more likely to report they last visited the ED because the family's primary care provider told them to go or they perceived that the condition was too serious to be treated by primary care.[35] In a recent study, researchers demonstrated that office-based primary care pediatricians increased their Medicaid participation after the payment increases, in large part by increasing their Medicaid panel percentage.[36]

Other financial concerns include:

- A failure by payers to use the "prudent-layperson" standard for definition of emergency care, which creates financial hardships after a care episode and can discourage future timely emergency visits.
- An increased number of insurance plans with high deductibles may discourage families from seeking emergency care when needed. Increasing regulatory and managed care initiatives related to emergency access for children that often require complex and time-consuming telephone calls and documentation to ensure appropriate payment for care.
- Managed care protocols designed to reduce the use of emergency facilities provide variable levels of appropriate alternatives for care.
- Increasing numbers of "narrow networks" (in which, in exchange for paying lower insurance premiums, the plan restricts the number and type of physicians, nurse practitioners, or physician assistants whose services are covered) can limit access to EDs in children's hospitals and to subspecialty services, which delays access to timely care and can result in poor health outcomes.

Improving Access to Emergency Care for Children

The emergency care environment remains challenging for pediatric patients, as outlined in this report, but efforts have been ongoing in recent years to improve access to optimal pediatric emergency care. Professional organizations such as the ACEP, the AAP, and the ENA, along with government agencies such as the Emergency Medical Services for Children (EMSC) program of the Health Resources and Services Administration, have worked to increase the information available to lay people as well as medical professionals. Enhanced and next-generation 911 systems are steadily improving the ease and reliability of calls for help and enable prehospital professionals to respond appropriately and efficiently. An increased focus on prehospital care and pediatric readiness in the ED setting through EMSC programs, the NPRP, and state-based pediatric readiness recognition programs in hospitals has increased both awareness and the ability to address pediatric emergencies at all stages of care.

Although inherent challenges remain, an increased focus on pediatric emergency research through networks, such as the Pediatric Emergency Care Applied Research Network, has helped to advance the evidence base, increase awareness, and promote efforts to address the need for more information.[37–39] In addition, pediatric emergency medical education continues to expand through increasing numbers of fellowships, residency training that includes dedicated pediatric emergency education, and ongoing targeted continuing medical education training. Pediatric nursing residency training programs and certification in pediatric emergency nursing contribute positively to patient satisfaction and nurse retention.[40]

Despite these recent efforts to improve access to emergency care, access to optimal emergency care for children can and should be improved. The ACEP, the AAP, and the ENA believe that every child in need should have access to quality pediatric emergency health care in the appropriate setting. Efforts must be made at local, state, and federal levels to improve prompt and appropriate access to pediatric emergency health care, including dental, behavioral, and mental health emergencies for all children, regardless of socioeconomic status, ethnic origin, language, immigration status, type of insurance, geographic location, or health status.

RECOMMENDATIONS

I. Improving Entry Into the Emergency Care System

The ACEP, the AAP, and the ENA recommend the following.

A. Pediatricians, emergency physicians, emergency nurses, health care systems and their professional organizations should work with stakeholders within their communities to improve public and health care professional's awareness of available resources and systems of care by:
   1. improving transparency of pediatric systems of care within communities, including educating families and caregivers about the urgent and emergency care resources in their community;
   2. developing and disseminating knowledge and resources to increase public, health professional, and government awareness about the magnitude of the problem of access to emergency medical care for children;
   3. improving awareness, use, and dissemination of

comprehensive resources available through the EMSC program;

4. encouraging collaborative efforts by emergency physicians, nurse practitioners and physician assistants, and primary care providers to identify an appropriate medical home for every child;
5. increasing access to a medical home by expansion of after-hours and/or improved coordination with after-hours or urgent care clinics with the medical home for ambulatory sensitive conditions to improve timely and appropriate care;[8]
6. encouraging the use of the emergency information form published by the AAP and ACEP[41] (this form is particularly helpful for children with medical complexity);[42] and
7. developing electronic versions of the emergency information form with health information exchange for easy access.

B. Federal governmental agencies should provide ongoing funding support for future resource development, education, research, and quality outcomes measurement by the EMSC program, as recommended in the 2006 Institute of Medicine report.

C. State and federal governmental agencies should work with EMS systems and health care organizations to improve entry into the emergency care system by:

1. improving all 911 systems to facilitate communication with non–English speaking families;
2. continuing to broaden enhanced and next-generation 911 systems to more locations in the United States to allow wireless services via cellular phones as well as voice-over Internet protocols, text messaging, and video transfer; and
3. improving collaboration and connectivity between schools, child care facilities, mental health professionals, medical homes, and local EMS systems to facilitate easy access into the EMS system.

II. Improving Pediatric Prehospital Care

The ACEP, the AAP, and the ENA recommend the following:

A. State and federal governmental agencies should work with EMS systems to ensure optimal prehospital care for children by:

1. funding, supporting, and promoting the further development and improvement of EMS for children at the federal, state, and local levels;
2. insuring the inclusion of children's needs in all funded efforts to improve prehospital care (eg, EMS education, EMS quality metrics [National EMS Quality Alliance (NEMSQA)], prehospital evidence-based guideline consortium); and
3. encouraging state EMS systems, local EMS agencies, and hospitals to incorporate children in disaster planning and response.[43]

B. EMS physicians and agency leaders should work with pediatricians, emergency physicians, emergency nurses, their professional organizations, and other stakeholders within their communities to ensure availability of optimal prehospital care for children by promoting improved readiness for pediatric patients, as outlined in the joint policy statement "Pediatric Readiness in Emergency Medical Services Systems."[44]

III. Improving Emergency Department Care for Children and Adolescents

The ACEP, the AAP, and the ENA recommend the following:

A. Pediatricians, emergency physicians, emergency nurses, health care systems, and professional organizations should work with stakeholders within their communities to ensure availability of optimal emergency care for children by

1. promoting improved readiness and a minimal standard for readiness in all EDs, as outlined in the joint policy statement "Pediatric Readiness in the Emergency Department;"[45]
2. developing quality metrics and quality improvement efforts for ED care of pediatric patients;
3. encouraging the availability of and access to existing pediatric medical subspecialists, pediatric surgical specialists, and mental health professionals who have special skills and expertise that are required for optimal care of critically ill and injured children;
4. encouraging the expansion of training programs to ensure future availability of adequate numbers of pediatric surgical and medical subspecialists necessary to provide specialized pediatric emergency care;
5. supporting the development of nurse practitioners and physician assistants with particular training and expertise in pediatric emergency care, with the goal to expand access to emergency care, with appropriate levels of supervision based on jurisdictional regulations;
6. promoting the development, dissemination, and

implementation of evidence-based guidelines and other strategies to improve diagnostic accuracy, therapeutic effectiveness, and minimization of unwanted variation in care;

7. continuing to explore new and innovative methods of pediatric medical subspecialist care, such as telemedicine, to aid medical professionals in settings of limited resources; and
8. promoting the development of guidelines and education to the approach of children with behavioral and emotional difficulties (intellectual disabilities, autism spectrum disorder, and mental health disorders) for both prehospital and emergency care.[46]

B. State and federal governmental agencies, health care systems, and professional organizations should work with stakeholders within their communities to ensure the availability of optimal emergency care for children by

1. promoting maintenance of ED facilities and work to prevent the closing of hospitals that provide critical services in underserved communities;
2. encouraging all EDs and facilities that provide urgent care for children to establish transfer agreements and protocols with facilities with higher levels of pediatric care resources to promote timely access to specialty pediatric emergency care and subspecialty tertiary care for critically ill and injured children;[47]
3. developing state or regional programs to recognize facilities that have demonstrated pediatric readiness;[48,49]
4. developing funding sources, multidisciplinary support, and enhanced research efforts directed at all aspects of pediatric emergency care, including health equity, to provide the evidence for standards for effective and safe patient care; and
5. promoting the inclusion of pediatric expertise into comprehensive psychiatric emergency programs, when these are available in a community.

C. State and federal governmental agencies, health care systems, and professional organizations should work with payers to overcome financial barriers to the provision of optimal emergency care for children by:

1. encouraging managed care organizations to accept the prudent-layperson definition of an emergency and provide payment for services mandated by the Emergency Medical Treatment and Active Labor Act (42 USC §1395dd);
2. improving payment for pediatric care, by using a value-based model that encourages the achievement of a pediatric-relevant cost to benefit ratio, especially valuing efforts that lead to prevention or better control of long-standing problems, recognizing that the most effective intervention may not be the one with the lowest cost but still represents the optimal choice;
3. providing appropriate payment levels at all episodes of care to facilitate unscheduled primary care visits and reduce the burden on the emergency care system;
4. providing payment for telemedicine to optimize the delivery of care for services that can be delivered via telemedicine;
5. expanding coverage for the expanse of language-translation services required to provide emergency care;
6. expanding networks of care to allow patient access to specialty care and children's hospitals when indicated for patients and reducing barriers to care for patients within networks of care; and
7. improving transparency of coverage for emergency care and eliminate the retrospective denial of payments for any reasons, including for chronic conditions or out-of-network emergency care.

LEAD AUTHORS

Kathleen M. Brown, MD, FAAP, FACEP
Alice D. Ackerman, MD, MBA, FAAP
Timothy K. Ruttan, MD, FAAP
Sally K. Snow, RN, BSN, CPEN, FAEN

AMERICAN ACADEMY OF PEDIATRICS

COMMITTEE ON PEDIATRIC EMERGENCY MEDICINE, 2020–2021

Gregory P. Conners, MD, MPH, MBA, FAAP, Chairperson
James Callahan, MD, FAAP
Toni Gross, MD, MPH, FAAP
Madeline Joseph, MD, FAAP
Lois Lee, MD, MPH, FAAP
Elizabeth Mack, MD, MS, FAAP
Jennifer Marin, MD, MSc, FAAP
Suzan Mazor, MD, FAAP
Ronald Paul, MD, FAAP
Nathan Timm, MD, FAAP

LIAISONS

Mark Cicero, MD, FAAP – *National Association of EMS Physicians*
Ann Dietrich, MD, FACEP – *American College of Emergency Physicians*
Andrew Eisenberg, MD, MHA – *American Academy of Family Physicians*
Mary Fallat, MD, FAAP – *American College of Surgeons*

Cynthia Wright Johnson, MSN, RN – *National Association of State EMS Officials*
Sara Kinsman, MD, PhD, FAAP – *Maternal and Child Health Bureau*
Cynthiana Lightfoot, BFA, NRP – *AAP Family Partnerships Network*
Charles Macias, MD, MPH, FAAP – *EMSC Innovation and Improvement Center*
Diane Pilkey, RN, MPH – *Maternal and Child Health Bureau*
Katherine Remick, MD, FAAP – *National Association of Emergency Medical Technicians*
Sam Shahid, MBBS, MPH – *American College of Emergency Physicians*
Elizabeth Stone, RN, PhD, CPEN – *Emergency Nurses Association*

FORMER COMMITTEE MEMBERS, 2018–2020

Joseph Wright, MD, MPH, FAAP, Chairperson (2016–2020)
Javier Gonzalez del Rey, MD, MEd, FAAP

FORMER LIAISONS, 2018–2020

Brian Moore, MD, FAAP – *National Association of EMS Physicians*
Mohsen Saidinejad, MD, MBA, FAAP, FACEP – *American College of Emergency Physicians*
Sally Snow, RN, BSN, CPEN, FAEN – *Emergency Nurses Association*

STAFF

Sue Tellez

AMERICAN COLLEGE OF EMERGENCY PHYSICIANS, PEDIATRIC EMERGENCY MEDICINE COMMITTEE, 2020–2021

Ann M. Dietrich, MD, Chairperson
Kiyetta H. Alade, MD
Christopher S. Amato, MD,
Zaza Atanelov, MD
Marc Auerbach, MD
Isabel A. Barata, MD, FACEP
Lee S. Benjamin, MD, FACEP
Kathleen T. Berg, MD
Kathleen Brown, MD, FACEP
Cindy Chang, MD
Jessica Chow, MD
Corrie E. Chumpitazi, MD, MS, FACEP
Ilene A. Claudius, MD, FACEP
Joshua Easter, MD
Ashley Foster, MD
Sean M. Fox, MD, FACEP
Marianne Gausche-Hill, MD, FACEP
Michael J. Gerardi, MD, FACEP
Jeffrey M. Goodloe, MD, FACEP (Board Liaison)
Melanie Heniff, MD, JD, FAAP, FACEP
James (Jim) L Homme, MD, FACEP
Paul T. Ishimine, MD, FACEP
Susan D. John, MD
Madeline M. Joseph, MD, FACEP
Samuel Hiu-Fung Lam, MD, MPH, RDMS, FACEP
Simone L. Lawson, MD
Moon O. Lee, MD, FACEP
Joyce Li, MD
Sophia D. Lin, MD
Dyllon Ivy Martini, MD
Larry Bruce Mellick, MD, FACEP
Donna Mendez, MD
Emory M. Petrack, MD, FACEP
Lauren Rice, MD
Emily A. Rose, MD, FACEP
Timothy Ruttan, MD, FACEP
Mohsen Saidinejad, MD, MBA, FACEP
Genevieve Santillanes, MD, FACEP
Joelle N. Simpson, MD, MPH, FACEP
Shyam M. Sivasankar, MD
Daniel Slubowski, MD
Annalise Sorrentino, MD, FACEP
Michael J. Stoner, MD, FACEP
Carmen D. Sulton, MD, FACEP
Jonathan H. Valente, MD, FACEP
Samreen Vora, MD, FACEP
Jessica J. Wall, MD
Dina Wallin, MD, FACEP
Theresa A. Walls, MD, MPH
Muhammad Waseem, MD, MS,
Dale P. Woolridge, MD, PhD, FACEP

STAFF

Sam Shahid, MBBS, MPH

CONSULTANT

Marianne Gausche-Hill, MD, FACEP, FAAP, FAEMS

EMERGENCY NURSES ASSOCIATION, PEDIATRIC COMMITTEE, 2018-2019

2018 PEDIATRIC COMMITTEE MEMBERS

Cam Brandt, MS, RN, CEN, CPEN, Chairperson
Krisi M. Kult, BSN, RN, CPEN, CPN
Justin J. Milici, MSN, RN, CEN, CPEN, CCRN, TCRN FAEN
Nicholas A. Nelson, MS, RN, CEN, CPEN, CTRN, CCRN, NRP, TCRN
Michele A. Redlo, MSN, MPA, RN, CPEN
Maureen R. Curtis Cooper, BSN, RN, CEN, CPEN, FAEN, Board Liaison

2019 PEDIATRIC COMMITTEE MEMBERS

Michele Redlo, MSN, MPA, BSN, RN, CPEN, Chairperson
Krisi Kult, BSN, RN, CPEN, CPN
Katherine Logee, MSN, RN, NP, CEN, CPEN, CFRN, CNE, FNP-BC, PNP-BC
Dixie Elizabeth Bryant, MSN, RN, CEN, CPEN, NE-BC
Maureen Curtis Cooper, BSN, RN, CEN, CPEN, FAEN
Kristen Cline, BSN, RN, CEN, CPEN, CFRN, CTRN, TCRN, Board Liaison

STAFF

Catherine Olson, MSN, RN

ABBREVIATIONS

AAP: American Academy of Pediatrics
ACEP: American College of Emergency Physicians
ED: emergency department
EMS: emergency medical services
EMSC: Emergency Medical Services for Children
ENA: Emergency Nurses Association
NPRP: National Pediatric Readiness Project

Address correspondence to Kathleen Brown, MD. Email: Kbrown@cnmc.org

PEDIATRICS (ISSN Numbers: Print, 0031-4005; Online, 1098-4275).

FINANCIAL DISCLOSURE: The authors have indicated they have no financial relationships relevant to this article to disclose.

FUNDING: No external funding.

POTENTIAL CONFLICT OF INTEREST: The authors have indicated they have no potential conflicts of interest to disclose.

REFERENCES

1. Wier LM, Hao Y, Owens PL, Washington R. *Overview of Children in the Emergency Department, 2010*. Rockville, MD: Agency for Healthcare Research and Quality; 2013. Available at: www.hcup-us.ahrq.gov/reports/statbriefs/sb157.pdf. Accessed September 18, 2019
2. Gausche-Hill M, Ely M, Schmuhl P, et al. A national assessment of pediatric readiness of emergency departments [published correction appears in *JAMA Pediatr*. 2015;169(8):791]. *JAMA Pediatr*. 2015;169(6):527–534
3. Yamamoto LG; American Academy of Pediatrics Committee on Pediatric Emergency Medicine. Access to optimal emergency care for children. *Pediatrics*. 2007;119(1):161–164
4. American College of Emergency Physicians. Access to emergency medicine. Available at: https://www.acep.org/federal-advocacy/access-to-emergency-medicine/. Accessed September 18, 2019
5. Emergency Nurses Association. Position statement: access to quality healthcare. Available at: https://www.ena.org/docs/default-source/resource-library/practice-resources/position-statements/accessqualityhealthcare.pdf?sfvrsn=c26b8f33_14. Accessed September 18, 2019
6. Institute of Medicine; Board on Health Care Services; Committee on the Future of Emergency Care Emergency Care in the United States Health System. *Emergency Care for Children: Growing Pains*. Washington, DC: National Academies Press; 2007. Available at: https://www.nap.edu/catalog/11655/emergency-care-for-children-growing-pains. Accessed September 18, 2019
7. Report Card Task Force Members; ACEP Staff. America's emergency care environment, a state-by-state report card: 2014 edition. *Ann Emerg Med*. 2014;63(2):97–242
8. American College of Emergency Physicians. The patient-centered medical home model. Available at: https://www.acep.org/patient-care/policy-statements/the-patient-centered-medical-home-model/. Accessed September 18, 2019
9. Shipman SA, Lan J, Chang C-H, Goodman DC. Geographic maldistribution of primary care for children. *Pediatrics*. 2011;127(1):19–27
10. Cheung PT, Wiler JL, Lowe RA, Ginde AA. National study of barriers to timely primary care and emergency department utilization among Medicaid beneficiaries. *Ann Emerg Med*. 2012;60(1):4–10.e2
11. FCC. Inquiry concerning 911 access, routing, and location in enterprise communications systems: notice of inquiry - PS docket No. 17-239. Available at: https://docs.fcc.gov/public/attachments/DOC-346580A1.pdf. Accessed September 18, 2019
12. Ray KN, Olson LM, Edgerton EA, et al. Access to high pediatric-readiness emergency care in the United States. *J Pediatr*. 2018;194:225–232.e1
13. Buchmueller TC, Jacobson M, Wold C. How far to the hospital? The effect of hospital closures on access to care. *J Health Econ*. 2006;25(4):740–761
14. Centers for Medicare and Medicaid Services; Medicare Learning Network. Critical access hospital. Available at: https://www.cms.gov/outreach-and-education/medicare-learning-network-mln/mlnproducts/downloads/critaccesshospfctsht.pdf. Accessed September 18, 2019
15. Cecil G. Sheps Center for Health Services Research. 180 rural hospital closures: January 2005 – present. 136 closures since 2010. Available at: www.shepscenter.unc.edu/programs-projects/rural-health/rural-hospital-closures/. Accessed September 18, 2019
16. Williams D Jr, Thomas SR, Howard HA, Pink GH. *Rural Hospital Mergers from 2005 through 2016*. Chapel Hill, NC: North Carolina Rural Health Research Program. The Cecil G. Sheps Center for Health Services Research. The University of North Carolina at Chapel Hill; 2018. Available at: https://www.shepscenter.unc.edu/wp-content/uploads/dlm_uploads/2018/08/Rural-Hospital-Mergers.pdf
17. Schuur JD, Baker O, Freshman J, Wilson M, Cutler DM. Where do freestanding emergency departments choose to locate? A national inventory and geographic analysis in three states. *Ann Emerg Med*. 2017;69(4):383–392.e5
18. American Academy of Pediatrics Committee on Pediatric Emergency Medicine. Overcrowding crisis in our nation's emergency departments: is our safety net unraveling? *Pediatrics*. 2004;114(3):878–888
19. Barata I, Brown KM, Fitzmaurice L, Griffin ES, Snow SK; American Academy of Pediatrics Committee on Pediatric Emergency Medicine; American College of Emergency Physicians Pediatric Emergency Medicine Committee; Emergency Nurses Association Pediatric Committee. Best practices for improving flow and care of pediatric patients in the emergency department. *Pediatrics*. 2015;135(1). Available at: www.pediatrics.org/cgi/content/full/135/1/e273
20. Depinet HE, Iyer SB, Hornung R, Timm NL, Byczkowski TL. The effect of emergency department crowding on reassessment of children with critically abnormal vital signs. *Acad Emerg Med*. 2014;21(10):1116–1120
21. Light JK, Hoelle RM, Herndon JB, et al. Emergency department crowding and time to antibiotic administration in febrile infants. *West J Emerg Med*. 2013;14(5):518–524
22. Bekmezian A, Fee C, Bekmezian S, Maselli JH, Weber E. Emergency department crowding and younger age are associated with delayed corticosteroid administration to children with acute asthma. *Pediatr Emerg Care*. 2013;29(10):1075–1081
23. Sills MR, Fairclough D, Ranade D, Kahn MG. Emergency department crowding is associated with decreased quality of care for children with acute asthma. *Ann Emerg Med*. 2011;57(3):191–200–e7
24. Timm NL, Ho ML, Luria JW. Pediatric emergency department overcrowding and impact on patient flow outcomes. *Acad Emerg Med*. 2008;15(9):832–837
25. Remick K, Kaji AH, Olson L, et al. Pediatric readiness and facility verification. *Ann Emerg Med*. 2016;67(3):320–328.e1
26. Auerbach M, Whitfill T, Gawel M, et al. Differences in the quality of pediatric resuscitative care across a spectrum of

emergency departments. *JAMA Pediatr*. 2016;170(10):987–994

27. Kessler DO, Walsh B, Whitfill T, et al.; INSPIRE ImPACTS Investigators. Disparities in adherence to pediatric sepsis guidelines across a spectrum of emergency departments: a multicenter, cross-sectional observational in situ simulation study [published correction appears in J Emerg Med. 2016;51(2): 223]. *J Emerg Med*. 2016;50(3): 403–415–e3
28. Dolan MA, Fein JA; Committee on Pediatric Emergency Medicine. Pediatric and adolescent mental health emergencies in the emergency medical services system. *Pediatrics*. 2011; 127(5):e1356–e1366
29. Mace SE; American Academy of Pediatrics, Committee on Pediatric Emergency Medicine; American College of Emergency Physicians and Pediatric Emergency Medicine Committee. Pediatric mental health emergencies in the emergency medical services system. *Pediatrics*. 2006;118(4): 1764–1767
30. Mayer ML. Disparities in geographic access to pediatric subspecialty care. *Matern Child Health J*. 2008;12(5): 624–632
31. Mayer ML, Beil HA, von Allmen D. Distance to care and relative supply among pediatric surgical subspecialties. *J Pediatr Surg*. 2009; 44(3):483–495
32. Lu H, Holt JB, Cheng YJ, Zhang X, Onufrak S, Croft JB. Population-based geographic access to endocrinologists in the United States, 2012. *BMC Health Serv Res*. 2015;15:541
33. Kreider AR, French B, Aysola J, Saloner B, Noonan KG, Rubin DM. Quality of health insurance coverage and access to care for children in low-income families. *JAMA Pediatr*. 2016;170(1): 43–51
34. Ray KN, Felmet KA, Hamilton MF, et al. Clinician attitudes toward adoption of pediatric emergency telemedicine in rural hospitals. *Pediatr Emerg Care*. 2017;33(4):250–257
35. MACPAC. Medicaid Access in Brief: Children's Difficulties in Obtaining Medical Care. Available at: https://www.macpac.gov/wp-content/uploads/2016/06/Childrens-Difficulties-in-Obtaining-Medical-Care.pdf. Accessed March 19, 2021
36. Tang SFS, Hudak ML, Cooley DM, Shenkin BN, Racine AD. Increased Medicaid payment and participation by office-based primary care pediatricians. *Pediatrics*. 2018;141(1): e20172570
37. Pediatric Emergency Care Applied Research Network. The Pediatric Emergency Care Applied Research Network (PECARN): rationale, development, and first steps. *Acad Emerg Med*. 2003;10(6):661–668
38. Corneli HM, Zorc JJ, Mahajan P, et al.; Bronchiolitis Study Group of the Pediatric Emergency Care Applied Research Network (PECARN). A multicenter, randomized, controlled trial of dexamethasone for bronchiolitis [published correction appears in N Engl J Med. 2008;359(18):1972]. *N Engl J Med*. 2007;357(4):331–339
39. Kuppermann N, Holmes JF, Dayan PS, et al.; Pediatric Emergency Care Applied Research Network (PECARN). Identification of children at very low risk of clinically-important brain injuries after head trauma: a prospective cohort study [published correction appears in *Lancet*. 2014; 383(9914):308]. *Lancet*. 2009;374(9696): 1160–1170
40. Straka KL, Ambrose HL, Burkett M, et al. The impact and perception of nursing certification in pediatric nursing. *J Pediatr Nurs*. 2014;29(3):205–211
41. American College of Emergency Physicians. Emergency information form for children with special health care needs. Available at: https://www.acep.org/by-medical-focus/pediatrics/medical-forms/emergency-information-form-for-children-with-special-health-care-needs/. Accessed September 18, 2019
42. Abraham G, Fehr J, Ahmad F, et al. Emergency information forms for children with medical complexity: a simulation study. *Pediatrics*. 2016; 138(2):e20160847
43. Disaster Preparedness Advisory Council; Committee on Pediatric Emergency Medicine. Ensuring the care of children in disasters. *Pediatrics*. 2015;136(5). Available at: www.pediatrics.org/cgi/content/full/136/5/e1407
44. Moore B, Shah MI, Owusu-Ansah S, et al.; American Academy of Pediatrics, Committee on Pediatric Emergency Medicine and Section on Emergency Medicine EMS Subcommittee; American College of Emergency Physicians, Emergency Medical Services Committee; Emergency Nurses Association, Pediatric Committee; National Association Of Emergency Medical Services Physicians, Standards and Clinical Practice Committee; National Association Of Emergency Medical Technicians, Emergency Pediatric Care Committee; Pediatric Readiness in Emergency Medical Services Systems; Policy Statement; Organizational Principles to Guide and Define the Child Health Care System and/or Improve the Health of All Children. Pediatric readiness in emergency medical services systems. *Ann Emerg Med*. 2020;75(1):e1–e6
45. Remick K, Gausche-Hill M, Joseph MM, Brown K, Snow SK, Wright JL; American Academy of Pediatrics Committee on Pediatric Emergency Medicine and Section on Surgery; American College of Emergency Physicians Pediatric Emergency Medicine Committee; Emergency Nurses Association Pediatric Committee. Pediatric readiness in the emergency department [published correction appears in Pediatrics. 2019; 143(3):e20183894]. *Pediatrics*. 2018; 142(5):e20182459
46. McGonigle JJ, Migyanka JM, Glor-Scheib SJ, et al. Development and evaluation of educational materials for pre-hospital and emergency department personnel on the care of patients with autism spectrum disorder. *J Autism Dev Disord*. 2014;44(5):1252–1259
47. Saidinejad M, Paul A, Gausche-Hill M, et al. Consensus statement on urgent care centers and retail clinics in acute care of children. *Pediatr Emerg Care*. 2019;35(2):138–142
48. Sacchetti A. Is it still an emergency department if it can't treat children? *Ann Emerg Med*. 2016;67(3):329–331
49. Emergency Medical Services for Children Innovation and Improvement Center. Facility categorization toolkit. Available at: https://emscimprovement.center/resources/toolboxes/facility-categorization-toolbox/. Accessed September 18, 2019

Ambient Air Pollution: Health Hazards to Children

- *Policy Statement*

POLICY STATEMENT Organizational Principles to Guide and Define the Child Health Care System and/or Improve the Health of all Children

American Academy of Pediatrics

DEDICATED TO THE HEALTH OF ALL CHILDREN®

Ambient Air Pollution: Health Hazards to Children

Heather L. Brumberg, MD, MPH, FAAP,[a] Catherine J. Karr, MD, PhD, FAAP,[b] COUNCIL ON ENVIRONMENTAL HEALTH

Ambient air pollution is produced by sources including vehicular traffic, coal-fired power plants, hydraulic fracturing, agricultural production, and forest fires. It consists of primary pollutants generated by combustion and secondary pollutants formed in the atmosphere from precursor gases. Air pollution causes and exacerbates climate change, and climate change worsens health effects of air pollution. Infants and children are uniquely sensitive to air pollution, because their organs are developing and they have higher air per body weight intake. Health effects linked to air pollution include not only exacerbations of respiratory diseases but also reduced lung function development and increased asthma incidence. Additional outcomes of concern include preterm birth, low birth weight, neurodevelopmental disorders, IQ loss, pediatric cancers, and increased risks for adult chronic diseases. These effects are mediated by oxidative stress, chronic inflammation, endocrine disruption, and genetic and epigenetic mechanisms across the life span. Natural experiments demonstrate that with initiatives such as increased use of public transportation, both air quality and community health improve. Similarly, the Clean Air Act has improved air quality, although exposure inequities persist. Other effective strategies for reducing air pollution include ending reliance on coal, oil, and gas; regulating industrial emissions; reducing exposure with attention to proximity of residences, schools, and child care facilities to traffic; and a greater awareness of the Air Quality Index. This policy reviews both short- and long-term health consequences of ambient air pollution, especially in relation to developmental exposures. It examines individual, community, and legislative strategies to mitigate air pollution.

INTRODUCTION

Air pollution exposures are widespread, and children are uniquely vulnerable. Since publication of the 2004 American Academy of Pediatrics policy statement on ambient air pollutants,[1] the evidence for child health impacts has expanded considerably. Current levels of air pollutants are associated with many of the most important pediatric morbidities, including asthma incidence and prevalence, adverse birth outcomes,

abstract

[a]*Division of Neonatology, Maria Fareri Children's Hospital, Westchester Medical Center and Departments of Pediatrics and Public Health, New York Medical College, Valhalla, New York; and* [b]*Departments of Pediatrics and Environmental and Occupational Health Sciences and Northwest Pediatric Environmental Health Specialty Unit, University of Washington, Seattle, Washington*

Drs Brumberg and Karr contributed equally to the literature review, writing, and editing of the manuscript; and all authors approved the final manuscript as submitted.

DOI: https://doi.org/10.1542/peds.2021-051484

Address correspondence to Catherine J. Karr, MD, PhD. E-mail: ckarr@uw.edu

PEDIATRICS (ISSN Numbers: Print, 0031-4005; Online, 1098-4275).

FINANCIAL DISCLOSURE: The authors have indicated they have no financial relationships relevant to this article to disclose.

To cite: Brumberg HL, Karr CJ, AAP COUNCIL ON ENVIRONMENTAL HEALTH. Ambient Air Pollution: Health Hazards to Children. *Pediatrics.* 2021;147(6):e2021051484

behavioral and cognitive development, and pediatric cancers, as well as with increased risk for a range of chronic diseases in adult life.[2–6]

Common sources of air pollution include emissions from traffic, coal-fired power plants, poorly ventilated wood-burning stoves or boilers, and forest fires. Toxicants in these emissions can influence the morphologic and functional development of organ systems from the fetal period to early, middle, and late childhood.[7] In addition, children receive higher doses because of their faster breathing rate and proportionately greater air intake per kilogram of body weight compared with adults.[8]

This policy statement focuses on short- and long-term health effects of key air pollutants that originate outdoors. These pollutants may enter buildings (and vehicles) through open doors and windows, ventilation systems, and cracks in structures, adding to the burden of indoor-derived air pollutants. Studies addressing regulated individual contaminants as well as mixtures or sources (traffic-related air pollution [TRAP], diesel particles, animal agricultural emissions, hydraulic fracking, wood burning) are included. Several other air contaminants are not included but have been addressed in other comprehensive reviews or other American Academy of Pediatrics policy statements (eg, tobacco smoke, mercury, asbestos, etc).[9–12]

EXPOSURE TO OUTDOOR AIR POLLUTANTS

The US Environmental Protection Agency (EPA) sets air quality standards for 6 criteria air pollutants (Table 1).[13] These are periodically updated and include primary standards to protect sensitive populations, including children. The EPA also monitors outdoor concentrations of 187 air toxics known or suspected to cause cancer or other serious health effects, such as birth defects; these are referred to as hazardous air pollutants. Examples include benzene, formaldehyde, polycyclic aromatic hydrocarbons (PAHs), and metals, such as chromium.[14]

States (or local agencies delegated by the state) have the primary authority to ensure compliance. These state and local air agencies, as well as the local public health agencies, are knowledgeable and can provide information about local and regional concerns.

Regulatory monitoring of criteria air pollutants indicates overall improvement in ambient air concentrations (Fig 1).[14] National mean levels of the 6 criteria air pollutants have fallen by 70% across the United States since passage of the Clean Air Act in 1970.[15] However, in 2016, 62% of children resided in a county with exceedance of at least 1 standard.[14] Despite these overall improvements, important socioeconomic and racial disparities in exposure continue to be observed in the trend data. Compared with non-Hispanic white individuals, Asian American or Pacific Islander, Black non-Hispanic, and Hispanic individuals were more likely to reside in counties unable to meet the air quality standards for particulate matter 2.5 μm or less in diameter ($PM_{2.5}$) and ozone.[14] Children living in poverty were more likely to reside in census tract areas above the benchmark for 1 in 10 000 cancer risk from hazardous air pollutants compared with those living in households at or above the poverty level.[14] Irrespective of poverty status, a higher percentage of children who identify as Black or Asian American live in census tracts where noncancer health-based benchmarks are exceeded.[14] Of note, the trend in levels of $PM_{2.5}$ shows a slight increase in the United States since 2015, the first recorded deterioration in national air quality in nearly a half century.[16]

Community air quality may reflect mobile (eg, on- and off-road vehicles) and point sources, including industrial facilities (such as coal-fired power plants and electricity-generating plants), dry-cleaning shops, restaurants (especially those using wood-fire ovens), metal plating facilities, residential wood burning, barbeques, etc, as well as seasonal variability and meteorology. Combustion contributes many primary pollutants (carbon monoxide [CO], nitrogen oxide [NO_x], particulate matter [PM], and volatile organic compounds [VOCs]). Combustion processes may also lead to secondary pollutants (ozone, nitrate, or sulfate aerosols) formed in the atmosphere from precursor gases.

TRAP is ubiquitous. These emissions include primary particles representing particulate matter 10

TABLE 1 Six EPA Criteria Pollutants With National Ambient Air Quality Standards

Pollutants	Standard
CO	9 ppm over 8 h, 35 ppm over 1 h
Lead	0.15 μg/m^3 over 3 mo
NO_2	100 ppb over 1 h; 53 ppb annual average
PM, including $PM_{2.5}$ and PM_{10}	$PM_{2.5}$: 35 μg/m^3 over 24 h; 12 μg/m^3 annual average PM_{10}: 150 μg/m^3 over 24 h
SO_2	75 ppb over 1 h
Ozone	0.070 ppm over 8 h

Permissible levels of the 6 criteria air pollutants (primary standards based on public health protection). These enforceable standards are reevaluated periodically by the EPA. Standards noted are based on information from the EPA National Ambient Air Quality Standards Table. (Available at: https://www.epa.gov/criteria-air-pollutants/naaqs-table. Accessed February 4, 2019.)

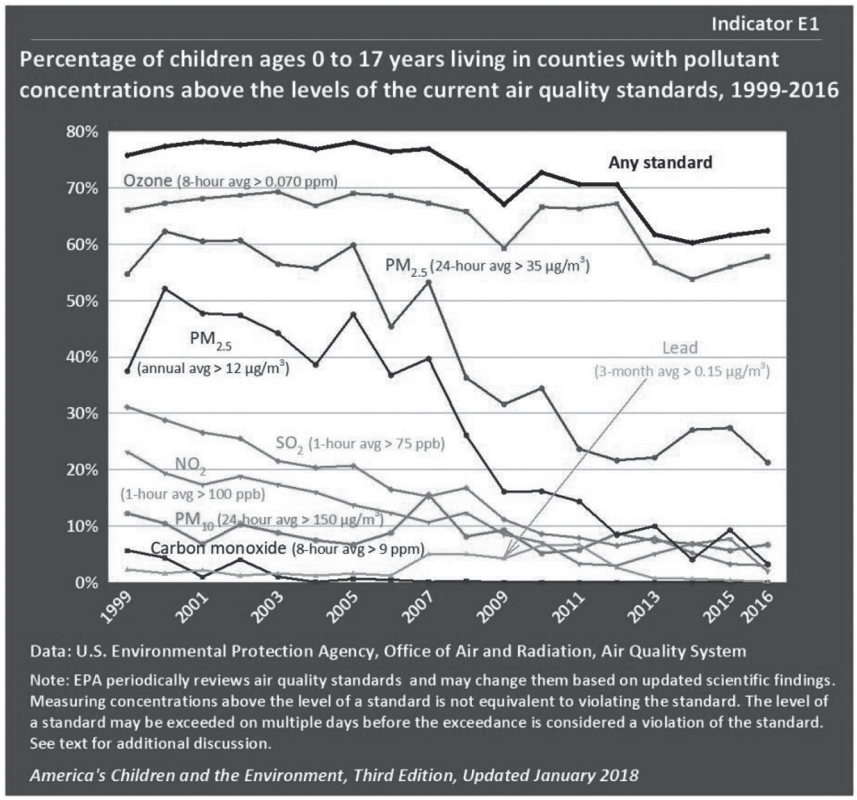


FIGURE 1
Percentage of children aged 0 to 17 years living in counties with pollutant concentrations above the levels of the current air quality standards, 1999–2016. avg, average. (Reprinted with permission from US Environmental Protection Agency. ACE: environments and contaminants - criteria air pollutants. Available at: https://www.epa.gov/ace/ace-environments-and-contaminants-criteria-air-pollutants. Accessed February 4, 2019.)

μm or less in diameter (PM_{10}), $PM_{2.5}$, and ultrafine PM (<100 nm), which are formed during combustion of fuels and comprise insoluble carbonaceous material (referred to as elemental carbon or black carbon), along with other toxic components, such as metals and PAHs. Diesel particles contain mostly ultrafine PM enriched in black carbon and PAHs as well as VOCs, such as formaldehyde. Resuspended road dust, tire wear, and brake wear represent noncombustion sources of traffic-related PM. In addition, secondary particles may be formed in the atmosphere post emission and include PM in the nanoparticle size range.[17]

An emerging source of concern is fossil fuel extraction by hydraulic fracturing, or "fracking." Water containing proprietary chemicals under high pressure is forced underground to crack deep shale layers and release trapped gas.[18,19] The volume of natural gas derived from fracking doubled in the United States from 2000 to 2011 and continues to increase.[19] The wellhead, controlled burns (flaring), water storage pits and tanks, sand operations, and diesel-powered equipment and trucks contribute VOCs, PAHs, and criteria air pollutants, such as NO_x and $PM_{2.5}$.[20,21]

Biomass combustion is an important source of air pollutants, such as PM. Globally, cooking- and heating-related emissions from solid fuel use are significant (eg, wood, charcoal, dung, crop waste). Large health initiatives for alternative fuels and improved cook stoves are targeting high pollution observed in middle- and low-income countries.[22] In some communities in North America, wood burning for heat and intentional burning of agricultural waste are important regional contributors to regional air quality.[23]

In agricultural communities, significant emissions from industrial-scale animal operations, such as poultry, swine, dairy, or beef, may result from the decomposition of animal waste or application of waste in liquid form as fertilizer. This includes gases and odorous vapors, including ammonia, hydrogen sulfide, and PM, that may contain endotoxin and other bioaerosols.[24]

Air pollution and climate change are closely linked, and the contribution of climate change to air quality is of concern. Climate change has increased the size and frequency of wildfires in North America, and ground-level ozone formation from precursor gases is enhanced in the presence of increasing temperatures.[25] Climate change influences the distribution, quantity, and quality of aeroallergens as well as ozone levels. Among those with allergic disease and asthma, global climate change is estimated to worsen disease, lead to more symptom days, and reduce quality of life.[26]

Air pollution is experienced by populations as a mixture containing components with various toxicological properties. Several common pathophysiological pathways have been identified as important mechanisms of how air pollution may affect health, including oxidative stress, inflammation, endocrine disruption, genetics, and epigenetics (Fig 2). The effects of air pollution occur at each stage of the life course and may cross generations via epigenetic and genetic factors. The delineation of mechanisms is complicated by the fact that different

pathways may trigger one another, such as oxidative stress causing inflammation or DNA damage.[27,28] PM and PAHs have been associated with increased histone acetylation and DNA methylation, respectively.[29,30] Supporting the role of environmental exposures on epigenetic modifications is the association of exposure to air pollution and increased methylation of the *FOXP3* locus from T regulatory lymphocytes, changes known to increase asthma morbidity.[30,31]

The subsequent morbidities arising from these pathways in childhood are reviewed in the following sections. The emphasis is on human epidemiological data, much of which are observational. Observational studies of air pollution and regulation of air pollutants are based on causal inferences from observational data with consideration of confounders and application of epidemiological criteria for causality (eg, dose response, biological plausibility, and consistency of evidence).

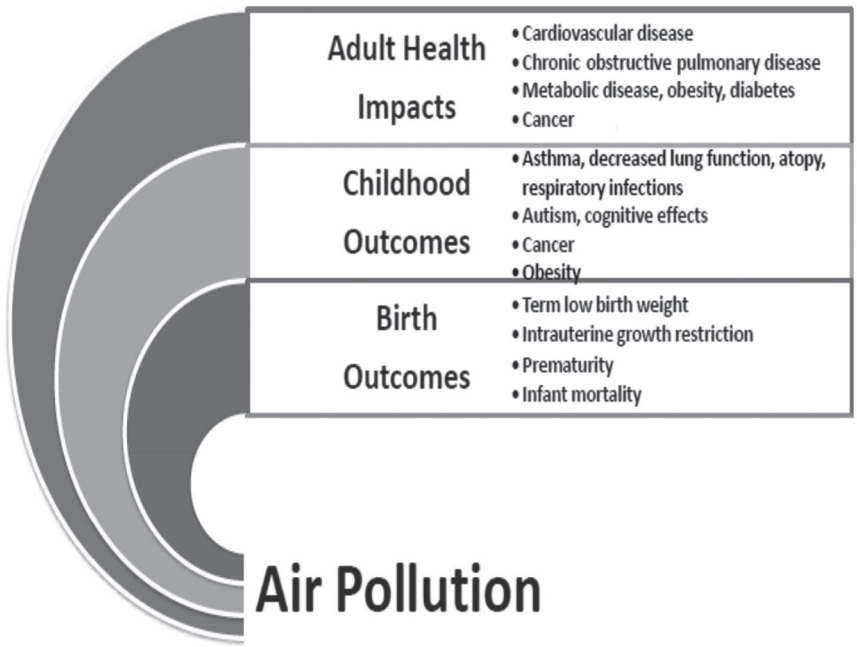


FIGURE 2
Mechanisms and key morbidities of concern for air pollution exposure across the life course and subsequent generations. Key mechanistic pathways include the following: Systemic or pulmonary inflammation, oxidative stress, immune modulation, endocrine disruption, genetic, and epigenetic effects.

BIRTH OUTCOMES

Multiple studies, many systematic reviews, and a few pooled analyses are available and have supported associations between ambient air pollution exposure during pregnancy and adverse birth outcomes. In most studies, researchers have examined effects on fetal growth (as term low birth weight or small for gestational age) and preterm birth.[2,32–36] In a pooled analysis comprising multiple studies and examination of multiple pollutants, birth weight decrements of approximately 10 to 30 g and odds ratios of 1.05 to 1.10 for low birth weight and of 1.04 to 1.06 for preterm birth were observed in relation to representative concentrations of higher CO, nitrogen dioxide (NO_2), PM_{10}, and $PM_{2.5}$.[2]

For context, van der Zee et al[37] sought to translate ambient air pollution effect sizes to a more familiar air contaminant sharing many constituents, environmental tobacco smoke. The risk of low birth weight associated with a 10 μg/m^3 increase in NO_2 or $PM_{2.5}$ was estimated to be equivalent to the effect of maternal passive smoking of 1.3 ± 0.7 or 3.8 ± 2.3 cigarettes, respectively. The public health impact is significant, with an estimated 3.3% of 2010 preterm births in the United States attributable to airborne PM exposure at a cost of more than $5 billion dollars in medical care and lost economic productivity.[38]

Limitations to this evidence base include an inadequate understanding of specific windows of vulnerability (eg, trimester or more refined time points) during pregnancy. Current findings are heterogeneous regarding specific trimester effects.[39,40] Methodologic challenges include accuracy of gestational age measurements, which may be measured by last menstrual period rather than by early ultrasonography.[39]

Data on other pregnancy and birth outcomes are fewer but accumulating. Maternal air pollution exposure and hypertensive disorders in pregnancy have been systematically reviewed, and most studies support an association.[41,42] This association provides a mechanistic link to intrauterine growth restriction, perinatal and neonatal mortality, preterm birth, and associated prematurity-related neonatal diseases, all highly associated with maternal hypertensive disorders. In addition, several studies report associations between airborne particulate exposures and increased risk of postneonatal death from respiratory causes.[33,43–47] Exposures to airborne sulfur dioxide (SO_2)[43] and CO[42] have also been associated with postneonatal mortality. There are conflicting data on associations between ambient air pollution and sudden infant death

syndrome.[43,45,46,48] There have also been mixed results regarding a possible association between ambient air pollution and risk of stillbirth.[49–55]

Thus, the evidence reveals that components of air pollution and proximity to traffic reduce birth weight and increase the risk for low birth weight at term, being small for gestational age, and preterm birth. Firm conclusions about congenital anomalies and air pollution are hampered by fewer available studies and inconsistent findings. Increased risk of congenital heart anomalies has been noted most consistently.[56–58] Emerging data suggest that exposures to fracking may increase risk of certain adverse birth outcomes, including congenital anomalies, preterm birth, and being small for gestational age.[59–61] Additional evidence needs to be amassed to understand the role of air pollution in infant mortality, stillbirth, sudden infant death syndrome, and congenital anomalies.

NEURODEVELOPMENT

Mechanistic data, large well-designed cohort studies, and systematic reviews of multiple studies support mounting concern for effects of air pollution, largely TRAP, on the developing central nervous system.[3,62–66] Recent systematic reviews of the epidemiological studies suggest evidence is currently strongest for pre- or postnatal PAH exposure to decrease neurocognitive function and for $PM_{2.5}$ to increase the risk of autism spectrum disorder.[63,65,67] There are also several studies revealing associations of autism spectrum disorder with NO_2.[62,67] Studies in which researchers examine the association of air pollutant exposures with attention-deficit/hyperactivity disorder risk are fewer and have inconsistent results.[62,63]

Interestingly, reduction in PAH pollution after the closure of a coal-fired power plant in China was reported to resolve previously observed decrements in motor and overall developmental quotients in area children, thus suggesting positive public health effects may be possible with improved community air quality.[68]

Studies of possible associations between neurocognitive development and postnatal exposures to air pollution include a focus on school-based exposures. These studies demonstrate adverse effects of pollution on measures of academic success and neurobehavioral development.[69–71] Growth in cognitive development assessed by repeat assessments has also been shown to be adversely affected by traffic-related air contaminant exposures at school.[71]

Overall, despite heterogeneity in exposure assessments and outcome metrics, the current literature suggests that exposure to ambient air pollutants and TRAP in early life, particularly during pregnancy, likely plays a role in the genesis of neurodevelopmental disorders in children. Exposures postnatally may also affect the trajectory of normal neurodevelopment. Continued attention to robust characterization of exposures across the pediatric life course and assessment of neurodevelopmental health and functional growth throughout childhood are needed to more adequately assess risks and protective factors.

CHILDHOOD AND ADULT RESPIRATORY ILLNESS

The primary exposure pathway for air pollutants is inhalation, and thus, the respiratory tract represents a sensitive and key target for health effects. The adverse consequences of air pollution on the respiratory system have been recognized for decades, and the particular vulnerability of children is well established.

PM, NO_x, ozone, and measures of traffic are most frequently implicated in studies of respiratory compromise. Traffic is a primary source of NO_x in most settings. For children living in urban areas, TRAP is often the most significant air pollution exposure source. For children residing in areas with significant animal agriculture, emerging data suggest emissions from large animal-feeding operations (eg, ammonia, hydrogen sulfide, and PM) may influence respiratory health, including pediatric asthma.[72–74]

Children with asthma are highly vulnerable to the respiratory effects of air pollutants. Ozone, NO_x, PM, and TRAP have been consistently associated with reduced asthma control manifested as increased symptoms, such as wheezing, rescue medication use, and decreased lung function, as well as increased use of medical services and school absences.[17,75] In addition, 2 of the most common infectious disease problems of early childhood, bronchiolitis and otitis media, have been linked with ambient air pollution.[76,77] Air pollution may adversely affect individuals with cystic fibrosis by increasing the risk of pulmonary exacerbations and related antibiotic use as well as by increasing the risk for a decline in lung function.[78,79]

There is a rapidly developing evidence base supporting the role of early-life exposures (including exposures in utero) in the development of asthma and allergic disease in childhood and in reduced lung function. In multiple large cohort studies in a variety of locations in Europe and North America, authors have investigated early-life exposure to NO_x, PM, and/or measures of traffic and found consistent associations with increased risk of development and exacerbation of

asthma.[4] This reflects exposure based on home residence as well as exposure based on school proximity to roads with a high density of traffic.[80,81] Similarly, several studies have reported associations between measures of air pollution exposure and lung function impairment in children.[82,83] Long-term decrements in lung function growth have been demonstrated for pediatric cohorts both with and without asthma. In a systematic review of this body of evidence, the authors concluded that there is strong support for adverse effects on lung function growth in childhood and adolescence.[84] The evidence base includes natural experimental studies that reveal improvements in lung function growth associated with relocation of children to less polluted residential settings or secular trends in air quality improvement, highlighting the potential public health impact of interventions to improve air quality.[85]

In addition to asthma, other atopic conditions (eczema, allergic rhinitis) have been associated with exposure to TRAP.[86] In addition to epidemiological studies, experimental data from studies of animals, in vitro systems, and human volunteers provide evidence of diesel exhaust particle induction of airway inflammatory reaction and enhancement of immunologic response to allergens.[87] In the Canadian Healthy Infant Longitudinal Development (CHILD) prospective birth cohort study, exposure to NO_2 during the first year of life (derived from a traffic-focused land use model) was positively associated with atopy at 1 year of age; exposure during pregnancy was not significantly associated.[88] A recent meta-analysis revealed no association of TRAP with sensitization to indoor allergens; however, PM was associated with sensitization to outdoor allergens, such as pollen and grass.[89]

In summary, ambient air pollution is responsible for a significant public health burden of respiratory disorders in children, including not only asthma and cystic fibrosis exacerbations but also the development of asthma and allergic disease as well as impaired lung functional development. These consistent findings support ongoing efforts and targeted interventions to reduce air pollution exposures among pregnant women and children in various locations (eg, home, school, and while commuting).

LONG-TERM HEALTH EFFECTS

Cancer

Ambient air pollution and some of its constituents have been identified as human carcinogens that are specifically associated with increased risk of childhood leukemia. In 2013, the International Agency for Research on Cancer separately classified (1) outdoor air pollution and (2) PM, an important component of outdoor air pollution, as known human carcinogens,[90] in addition to diesel and gasoline engine exhausts and some nitroarenes, which were designated in 2014.[91] Authors of recent meta-analyses found a significant increase in risk of childhood leukemia associated with proximity of traffic and petrol stations to residence in the postnatal period. Increased risk of leukemia was not, however, associated with the same exposures in the prenatal period.[5,92] The specific pollutants NO_2 and benzene have been associated with childhood leukemia.[92] Links between air pollution and other childhood cancers have been difficult to assess in meta-analyses because of the paucity of studies.[5] Given emerging evidence regarding the association between postnatal exposure to TRAP and childhood cancers, ongoing research is merited to confirm these findings and examine other types of childhood cancers in relation to traffic proximity and specific pollutants.

Obesity

The relationship between childhood obesity and environment is multifactorial and complex. The effects of air pollution may be direct, through toxicological properties of particulate pollutants, or indirect, through, for example, avoidance of physical activity in areas of high traffic density because of safety concerns.[93–95] Although the body of literature is small, several well-designed prospective studies have begun to describe this multidimensional relationship between TRAP and childhood obesity and emphasize the need for further studies to help clarify this relationship.

Antecedents of Adult Cardiovascular Disease

PM is a well-established risk factor for cardiovascular disease and mortality in adults,[6,96] but data on childhood exposure to ambient air pollution and subsequent cardiovascular disease risk in adulthood are few. Prehypertension (3 measurements above the 90th percentile for age) in youth and adolescents is associated with PM, noise pollution, and secondhand tobacco smoke exposure.[97] There is also a small emerging literature suggesting a potential link between childhood exposure to PM and development of short-term elevated blood pressure.[98,99] Future longitudinal studies are needed to identify critical windows of exposure and whether elevated blood pressure attributed to air pollution in childhood persists into adulthood.

Modifiers of Health Effects

The ultimate toxicity of air pollution on individual children and populations is modified by developmental processes (timing of exposure during sensitive windows of development) and cofactors,

including other toxicant exposures and genetic polymorphisms. An ongoing emphasis of air pollution research in the area of developmental origins of health and disease will be useful in understanding the early life-course vulnerabilities and potential effects into adulthood[100] (Fig 2). In addition, many studies are identifying potentiating effects of coexposure to social stressors.[101–104] Genetic polymorphisms in several oxidative stress genes (*GSTM1*, *GSTP1*, and *NQO1*) and inflammation genes (*TNF*) have been associated with differences in toxic effects of ozone and PM.[105,106] Future genome-wide association studies and whole-genome sequencing may be more helpful in understanding the mechanisms of health outcomes related to air pollution exposure.[29]

There is emerging literature examining antioxidant properties of vitamins C, D, and E mitigating air pollution oxidative effects, but human data are few.[107] In a clinical trial of children in Mexico City, investigators observed that genetically vulnerable children (those with severe asthma with the *GSTM1* deletion in the area coding for glutathione transferase enzyme, which protects against oxidative stress) revealed less severe ozone-related decreases in forced expiratory flow when supplemented with antioxidant vitamins C and E.[108]

PREVENTION OF EXPOSURE AND EFFECTS

Several natural experiments have demonstrated that reducing community air contaminants can lead to improved health outcomes. In the landmark study of 6 US cities, longitudinal decreases in $PM_{2.5}$ resulted in significant decreases in mortality.[109] Childhood asthma exacerbations were significantly reduced during the 1996 Olympics in Atlanta, Georgia, when initiatives surrounding the games included increased public transportation and telecommuting, which resulted in significantly less air pollution.[110] In Beijing, China, when reduced air pollution measures for the 2008 Olympics occurred, birth weights averaged 23 g higher.[111]

Regulatory protections under the Clean Air Act and the National Ambient Air Quality Standards have helped reduce the percentages of children living in areas with concentrations above the annual standard of $PM_{2.5}$ (from 37.5% to 3.3%), the 8-hour ozone standard (from 66.1% to 57.8%), the 1-hour SO_2 standard (from 31.1% to 3.0%), and the 1-hour NO_2 standard (from 23.2% to 2%) from 1999 to 2016.[14] Major ongoing contributors to air pollution, besides power plants and industrial fossil fuel combustion, include increasing urban populations and motor vehicles on the roads and deforestation that decreases plant use of CO_2.[17,25] Some strategies to address the growing motor vehicle fleet includes maintaining emissions standards, anticipation and planning of transportation efficiencies to match needs, availability of clean fuels (including electric), and requirements for inspections and vehicle maintenance.[17] Furthermore, catalytic converter use has reduced ambient air pollution (ie, ozone, mobile air toxics, and $PM_{2.5}$).[17] Interestingly, when school buses in select Washington State communities used clear air technologies, participating elementary school students had both better lung function and less school absenteeism.[112]

Other ways to decrease exposure would be to adjust behavior on the basis of degree of ambient air pollution. The Air Quality Index (AQI), calculated by the EPA on the basis of daily ambient concentrations of National Ambient Air Quality Standards and then grouped and color coded to 6 categories ranging from good (green) to hazardous (maroon), provides a tool for this.[113] On the basis of local air quality at any particular time, individuals may make decisions to reduce time spent in exertional activities outside or elect to do indoor activities. Although much of the general public may not recognize the AQI implications, the AQI would be a powerful tool for physicians to help patients alter behavior as needed if better awareness could be achieved.[114,115] In addition to the AQI, policies limiting proximity of schools, child care facilities, and residences to traffic corridors, as well as anti-idling policies at schools, could reduce exposure in vulnerable populations in areas where they spend significant time.[115] These strategies are important because many US children attend schools in high-traffic areas or encounter diesel school buses with exposure to traffic-related pollutants.[17,112,116]

The EPA has reviewed costs and benefits of air quality regulation since 1997, and their first retrospective assessment demonstrated a mean benefit savings of $22.2 trillion, including health, quality of life, and agricultural benefits, versus a cost of regulation and compliance of $523 billion.[117] Most recently, in 2011 an EPA prospective analysis of the years 1990–2020, a $2 trillion benefit and $65 billion in costs were calculated.[117]

CONCLUSIONS

Ambient air pollution is increasingly recognized as a preventable risk factor for a spectrum of pediatric health concerns. Not only do health effects manifest as exacerbations of chronic diseases (eg, asthma) but air pollution also appears to be associated with the development of major pediatric diseases, including adverse birth outcomes, abnormal lung and neurodevelopment, and pediatric cancer, as well as obesity and cardiovascular disease risk.

Proposed mechanisms involve immune, inflammatory, and oxidative pathways as well as gene-environment interactions and epigenetic changes combined with sociodemographic cofactors. Exposure and resultant health effects may be ameliorated most effectively through policy changes to reduce exposure across the life course. In addition, education around modifiable behaviors may contribute to exposure and toxicity reduction. Evidence demonstrates that children and adults are exposed to potential environmental toxicants from distant as well as proximal sources. This mandates preventive action at the level of state, national, and international policy development, regulation, and enforcement. Although inequalities of exposure to children in certain neighborhoods from local sources of pollution occur, children everywhere experience heightened risk. Continued efforts to unravel the complexity of combined exposures, exposure timing, moderators of effect, and key sources will serve to further focus the most effective policies and approaches for exposure prevention.

RECOMMENDATIONS

1. Pediatric Practice

a. Recognize air quality concerns and resources in your practice area and for individual patients.

b. Serve as a role model and practice model in reducing contributions to poor air quality by using and promoting active transport (eg, walking, cycling) and alternative transportation to gasoline-powered motor vehicles.

c. Use the AQI as a tool in helping educate families of potential protective behaviors. The AQI may be the most useful in especially vulnerable patients with medical risk factors, such as preexisting asthma. Additional information, clinical scenarios, and patient education tools may be found through the EPA Web site at https://www.epa.gov/pmcourse/learn-about-particle-pollution-and-your-patients-health-course.

d. Serve as a source of expertise in your community on the vulnerability of children to air pollution and the importance of primary prevention.

2. Research

a. Evaluate programs and policies designed to reduce exposure to ambient and infiltrated air pollution for effectiveness and health economic analyses.

b. Increase monitoring and health impact assessment in areas with historically less emphasis or enhanced vulnerability (areas with animal agricultural production, child care facilities, and low-income communities).

c. Develop reliable biomarkers of exposure to key traffic constituents and biomass sources.

d. Enhance understanding of genetic and nongenetic modifiers of air pollution effects.

e. Elucidate effects of exposure to mixtures of air pollutants and modifying influences of nonchemical stressors, genetic factors, and nutrition.

3. Regulation and Policy

a. Continue to uphold and strengthen the Clean Air Act, which has demonstrated success in reducing air pollution from mobile and stationary sources.

b. Advocate for reversing rollbacks of emission limits for coal, gas, and oil industries.

c. Ensure consideration of pediatric and fetal stages of the life course in all program and regulatory standard reviews related to ambient air contaminants.

d. Promote school and child care facility siting policies that reduce exposure to traffic-derived air contaminants or other influential proximal sources.

e. Incorporate active transport and air pollution exposure reduction considerations into land use planning.

f. Promote lower-emission technology and approaches for transit.

g. Review regulatory approaches for addressing increasing evidence of community health effects from air contaminants derived from animal-feeding operations.

h. Advocate for 100% renewable energy.

i. Require all states to have emissions standards and vehicle inspections to enforce these standards.

j. Ensure adequate federal and state governmental allocation of resources:

   i. To optimize effective enforcement of current and future regulations of air pollutants.

   ii. To incentivize curtailing of polluting industries.

   iii. To facilitate adoption of lower-emission technology.

LEAD AUTHORS

Heather L. Brumberg, MD, MPH, FAAP
Catherine J. Karr, MD, PhD, FAAP

COUNCIL ON ENVIRONMENTAL HEALTH EXECUTIVE COMMITTEE, 2019–2020

Aparna Bole, MD, FAAP, Chairperson
Samantha Ahdoot, MD, FAAP
Sophie J. Balk, MD, FAAP
Aaron S. Bernstein, MD, MPH, FAAP
Lori G. Byron, MD, FAAP
Philip J. Landrigan, MD, FAAP
Steven M. Marcus, MD, FAAP
Abby L. Nerlinger, MD, FAAP
Susan E. Pacheco, MD, FAAP
Alan D. Woolf, MD, MPH, FAAP
Lauren Zajac, MD, MHP, FAAP

FORMER EXECUTIVE COMMITTEE MEMBERS

Carl R. Baum, MD, FACMT, FAAP
Carla C. Campbell, MD, MS, FAAP

Jennifer A. Sample, MD, FAAP
Adam J. Spanier, MD, PhD, MPH, FAAP
Leonardo Trasande, MD, MPP, FAAP

CONTRIBUTOR

Kembra L. Howdeshell, PhD

LIAISONS

John M. Balbus, MD, MPH – *National Institute of Environmental Health Sciences*
Jeanne Briskin – *US Environmental Protection Agency*
Nathaniel G. DeNicola, MD, MSc – *American College of Obstetricians and Gynecologists*
Mateusz P. Karwowski, MD, MPH, FAAP – *Centers for Disease Control and Prevention National Center for Environmental Health and Agency for Toxic Substances and Disease Registry*
Natalie M. Villafranco, MD, FAAP – *Section on Pediatric Trainees*
Mary H. Ward, PhD – *National Cancer Institute*

STAFF

Paul Spire

ACKNOWLEDGMENTS

The Council on Environmental Health extends thanks to Kembra L. Howdeshell, PhD (National Institute of Environmental Health Sciences), for providing technical assistance and critical review of the draft scientific report.

ABBREVIATIONS

AQI: Air Quality Index
CO: carbon monoxide
EPA: US Environmental Protection Agency
NO_2: nitrogen dioxide
NO_x: nitrogen oxide
PAH: polycyclic aromatic hydrocarbon
PM: particulate matter
$PM_{2.5}$: particulate matter $\leq$2.5 μm in diameter
PM_{10}: particulate matter $\leq$10 μm in diameter
SO_2: sulfur dioxide
TRAP: traffic-related air pollution
VOC: volatile organic compound

FUNDING: No external funding.

POTENTIAL CONFLICT OF INTEREST: The authors have indicated they have no potential conflicts of interest to disclose.

REFERENCES

1. Kim JJ; American Academy of Pediatrics Committee on Environmental Health. Ambient air pollution: health hazards to children. *Pediatrics*. 2004;114(6):1699–1707. Reaffirmed April 2009
2. Stieb DM, Chen L, Eshoul M, Judek S. Ambient air pollution, birth weight and preterm birth: a systematic review and meta-analysis. *Environ Res*. 2012; 117:100–111
3. Volk HE, Lurmann F, Penfold B, Hertz-Picciotto I, McConnell R. Traffic-related air pollution, particulate matter, and autism. *JAMA Psychiatry*. 2013;70(1): 71–77
4. Guarnieri M, Balmes JR. Outdoor air pollution and asthma. *Lancet*. 2014; 383(9928):1581–1592
5. Boothe VL, Boehmer TK, Wendel AM, Yip FY. Residential traffic exposure and childhood leukemia: a systematic review and meta-analysis. *Am J Prev Med*. 2014;46(4):413–422
6. Pope CA III, Turner MC, Burnett RT, et al. Relationships between fine particulate air pollution, cardiometabolic disorders, and cardiovascular mortality. *Circ Res*. 2015;116(1):108–115
7. Miller MD, Marty MA. Impact of environmental chemicals on lung development. *Environ Health Perspect*. 2010;118(8):1155–1164
8. US Environmental Protection Agency. Exposure Factors Handbook: 2011 Edition (Final Report). Washington, DC: US Environmental Protection Agency; 2011. Available at: https://www.epa.gov/expobox/about-exposure-factors-handbook. Accessed June 9, 2019
9. American Academy of Pediatrics, Council on Environmental Health. In: Etzel RA, Balk SJ, eds. *Pediatric Environmental Health*, 4th ed. Itasca, IL: American Academy of Pediatrics; 2019
10. Farber HJ, Groner J, Walley S, Nelson K; Section on Tobacco Control. Protecting children from tobacco, nicotine, and tobacco smoke. *Pediatrics*. 2015;136(5). Available at: www.pediatrics.org/cgi/content/full/136/5/e1439
11. Farber HJ, Walley SC, Groner JA, Nelson KE; Section on Tobacco Control. Clinical practice policy to protect children from tobacco, nicotine, and tobacco smoke. *Pediatrics*. 2015;136(5):1008–1017
12. Farber HJ, Nelson KE, Groner JA, Walley SC; Section on Tobacco Control. Public policy to protect children from tobacco, nicotine, and tobacco smoke. *Pediatrics*. 2015;136(5):998–1007
13. US Environmental Protection Agency. Reviewing National Ambient Air Quality Standards (NAAQS): scientific and technical information. Available at: https://www.epa.gov/naaqs. Accessed February 4, 2019
14. US Environmental Protection Agency. America's children and the environment (ACE): ACE environments and contaminants. Available at: https://www.epa.gov/ace/ace-environments-and-contaminants. Accessed February 4, 2019
15. Samet JM, Burke TA, Goldstein BD. The Trump administration and the environment - heed the science. *N Engl J Med*. 2017;376(12):1182–1188
16. Clay K, Muller NZ. Recent increases in air pollution: evidence and implications for mortality. 2019. Available at: https://www.nber.org/system/files/working_

papers/w26381/w26381.pdf. Accessed February 10, 2021

17. Health Effects Institute Panel on the Health Effects of Traffic Related Air Pollution. *Traffic-Related Air Pollution: A Critical Review of the Literature on Emissions, Exposure, and Health Effects*. Boston, MA: Health Effects Institute; 2010. Available at: https://www.healtheffects.org/publication/traffic-related-air-pollution-critical-review-literature-emissions-exposure-and-health. Accessed February 10, 2021
18. US Environmental Protection Agency. The process of unconventional natural gas production: hydraulic fracturing. Available at: https://www.epa.gov/hydraulicfracturing/process-hydraulic-fracturing. Accessed June 1, 2017
19. Moore CW, Zielinska B, Pétron G, Jackson RB. Air impacts of increased natural gas acquisition, processing, and use: a critical review. *Environ Sci Technol*. 2014;48(15):8349–8359
20. Macey GP, Breech R, Chernaik M, et al. Air concentrations of volatile compounds near oil and gas production: a community-based exploratory study. *Environ Health*. 2014; 13:82
21. Walters K, Jacobson J, Kroening Z, Pierce C. $PM_{2.5}$ airborne particulates near frac sand operations. *J Environ Health*. 2015;78(4):8–12
22. Lewis JJ, Pattanayak SK. Who adopts improved fuels and cookstoves? A systematic review. *Environ Health Perspect*. 2012;120(5):637–645
23. Naeher LP, Brauer M, Lipsett M, et al. Woodsmoke health effects: a review. *Inhal Toxicol*. 2007;19(1):67–106
24. Heederik D, Sigsgaard T, Thorne PS, et al. Health effects of airborne exposures from concentrated animal feeding operations. *Environ Health Perspect*. 2007;115(2):298–302
25. Ahdoot S, Pacheco SE; Council on Environmental Health. Global climate change and children's health. *Pediatrics*. 2015;136(5). Available at: www.pediatrics.org/cgi/content/full/136/5/e1468
26. Shea KM, Truckner RT, Weber RW, Peden DB. Climate change and allergic disease. *J Allergy Clin Immunol*. 2008; 122(3):443–453–455
27. Kannan S, Misra DP, Dvonch JT, Krishnakumar A. Exposures to airborne particulate matter and adverse perinatal outcomes: a biologically plausible mechanistic framework for exploring potential effect modification by nutrition. *Environ Health Perspect*. 2006;114(11):1636–1642
28. Ferrari L, Carugno M, Bollati V. Particulate matter exposure shapes DNA methylation through the lifespan. *Clin Epigenetics*. 2019;11(1):129
29. Holloway JW, Savarimuthu Francis S, Fong KM, Yang IA. Genomics and the respiratory effects of air pollution exposure. *Respirology*. 2012;17(4): 590–600
30. Ji H, Khurana Hershey GK. Genetic and epigenetic influence on the response to environmental particulate matter. *J Allergy Clin Immunol*. 2012;129(1):33–41
31. Carlsten C, Melén E. Air pollution, genetics, and allergy: an update. *Curr Opin Allergy Clin Immunol*. 2012;12(5): 455–460
32. Srám RJ, Binková B, Dejmek J, Bobak M. Ambient air pollution and pregnancy outcomes: a review of the literature. *Environ Health Perspect*. 2005;113(4): 375–382
33. Glinianaia SV, Rankin J, Bell R, Pless-Mulloli T, Howel D. Particulate air pollution and fetal health: a systematic review of the epidemiologic evidence. *Epidemiology*. 2004;15(1):36–45
34. Malley CS, Kuylenstierna JCI, Vallack HW, Henze DK, Blencowe H, Ashmore MR. Preterm birth associated with maternal fine particulate matter exposure: a global, regional and national assessment. *Environ Int*. 2017; 101:173–182
35. Song J, Chen Y, Wei L, et al. Early-life exposure to air pollutants and adverse pregnancy outcomes: protocol for a prospective cohort study in Beijing. *BMJ Open*. 2017;7(9):e015895
36. Dadvand P, Parker J, Bell ML, et al. Maternal exposure to particulate air pollution and term birth weight: a multi-country evaluation of effect and heterogeneity. *Environ Health Perspect*. 2013;121(3):267–373
37. van der Zee SC, Fischer PH, Hoek G. Air pollution in perspective: health risks of air pollution expressed in equivalent numbers of passively smoked cigarettes. *Environ Res*. 2016;148: 475–483
38. Trasande L, Malecha P, Attina TM. Particulate matter exposure and preterm birth: estimates of U.S. attributable burden and economic costs. *Environ Health Perspect*. 2016; 124(12):1913–1918
39. Woodruff TJ, Parker JD, Darrow LA, et al. Methodological issues in studies of air pollution and reproductive health. *Environ Res*. 2009;109(3):311–320
40. Lamichhane DK, Leem JH, Lee JY, Kim HC. A meta-analysis of exposure to particulate matter and adverse birth outcomes. *Environ Health Toxicol*. 2015; 30:e2015011
41. Hu H, Ha S, Roth J, Kearney G, Talbott EO, Xu X. Ambient air pollution and hypertensive disorders of pregnancy: a systematic review and meta-analysis. *Atmos Environ (1994)*. 2014;97:336–345
42. Pedersen M, Stayner L, Slama R, et al. Ambient air pollution and pregnancy-induced hypertensive disorders: a systematic review and meta-analysis. *Hypertension*. 2014;64(3):494–500
43. Scheers H, Mwalili SM, Faes C, Fierens F, Nemery B, Nawrot TS. Does air pollution trigger infant mortality in Western Europe? A case-crossover study. *Environ Health Perspect*. 2011;119(7):1017–1022
44. Woodruff TJ, Parker JD, Schoendorf KC. Fine particulate matter ($PM_{2.5}$) air pollution and selected causes of postneonatal infant mortality in California. *Environ Health Perspect*. 2006;114(5):786–790
45. Woodruff TJ, Darrow LA, Parker JD. Air pollution and postneonatal infant mortality in the United States, 1999-2002. *Environ Health Perspect*. 2008; 116(1):110–115
46. Ritz B, Wilhelm M, Zhao Y. Air pollution and infant death in southern California, 1989-2000. *Pediatrics*. 2006;118(2): 493–502
47. Hajat S, Armstrong B, Wilkinson P, Busby A, Dolk H. Outdoor air pollution and infant mortality: analysis of daily time-series data in 10 English cities. *J Epidemiol Community Health*. 2007; 61(8):719–722

48. Dales R, Burnett RT, Smith-Doiron M, Stieb DM, Brook JR. Air pollution and sudden infant death syndrome. *Pediatrics*. 2004;113(6). Available at: www.pediatrics.org/cgi/content/full/113/6/e628

49. Green R, Sarovar V, Malig B, Basu R. Association of stillbirth with ambient air pollution in a California cohort study. *Am J Epidemiol*. 2015;181(11):874–882

50. Faiz AS, Rhoads GG, Demissie K, Kruse L, Lin Y, Rich DQ. Ambient air pollution and the risk of stillbirth. *Am J Epidemiol*. 2012;176(4):308–316

51. Faiz AS, Rhoads GG, Demissie K, Lin Y, Kruse L, Rich DQ. Does ambient air pollution trigger stillbirth? *Epidemiology*. 2013;24(4):538–544

52. DeFranco E, Hall E, Hossain M, et al. Air pollution and stillbirth risk: exposure to airborne particulate matter during pregnancy is associated with fetal death. *PLoS One*. 2015;10(3):e0120594

53. de Medeiros APP, Gouveia N, Machado RPP, et al. Traffic-related air pollution and perinatal mortality: a case-control study. *Environ Health Perspect*. 2009;117(1):127–132

54. Hwang BF, Lee YL, Jaakkola JJK. Air pollution and stillbirth: a population-based case-control study in Taiwan. *Environ Health Perspect*. 2011;119(9):1345–1349

55. Pearce MS, Glinianaia SV, Rankin J, et al. No association between ambient particulate matter exposure during pregnancy and stillbirth risk in the north of England, 1962-1992. *Environ Res*. 2010;110(1):118–122

56. Agay-Shay K, Friger M, Linn S, Peled A, Amitai Y, Peretz C. Air pollution and congenital heart defects. *Environ Res*. 2013;124:28–34

57. Vrijheid M, Martinez D, Manzanares S, et al. Ambient air pollution and risk of congenital anomalies: a systematic review and meta-analysis. *Environ Health Perspect*. 2011;119(5):598–606

58. Padula AM, Tager IB, Carmichael SL, et al. Ambient air pollution and traffic exposures and congenital heart defects in the San Joaquin Valley of California. *Paediatr Perinat Epidemiol*. 2013;27(4):329–339

59. McKenzie LM, Guo R, Witter RZ, Savitz DA, Newman LS, Adgate JL. Birth outcomes and maternal residential proximity to natural gas development in rural Colorado. *Environ Health Perspect*. 2014;122(4):412–417

60. Casey JA, Savitz DA, Rasmussen SG, et al. Unconventional natural gas development and birth outcomes in Pennsylvania, USA. *Epidemiology*. 2016;27(2):163–172

61. Stacy SL, Brink LL, Larkin JC, et al. Perinatal outcomes and unconventional natural gas operations in Southwest Pennsylvania. *PLoS One*. 2015;10(6):e0126425

62. Xu X, Ha SU, Basnet R. A review of epidemiological research on adverse neurological effects of exposure to ambient air pollution. *Front Public Health*. 2016;4:157

63. Suades-González E, Gascon M, Guxens M, Sunyer J. Air pollution and neuropsychological development: a review of the latest evidence. *Endocrinology*. 2015;156(10):3473–3482

64. Guxens M, Garcia-Esteban R, Giorgis-Allemand L, et al. Air pollution during pregnancy and childhood cognitive and psychomotor development: six European birth cohorts. *Epidemiology*. 2014;25(5):636–647

65. Lam J, Sutton P, Kalkbrenner A, et al. A systematic review and meta-analysis of multiple airborne pollutants and autism spectrum disorder. *PLoS One*. 2016;11(9):e0161851

66. Newman NC, Ryan P, Lemasters G, et al. Traffic-related air pollution exposure in the first year of life and behavioral scores at 7 years of age. *Environ Health Perspect*. 2013;121(6):731–736

67. Flores-Pajot MC, Ofner M, Do MT, Lavigne E, Villeneuve PJ. Childhood autism spectrum disorders and exposure to nitrogen dioxide, and particulate matter air pollution: a review and meta-analysis. *Environ Res*. 2016;151:763–776

68. Perera F, Li TY, Zhou ZJ, et al. Benefits of reducing prenatal exposure to coal-burning pollutants to children's neurodevelopment in China. *Environ Health Perspect*. 2008;116(10):1396–1400

69. Wang S, Zhang J, Zeng X, Zeng Y, Wang S, Chen S. Association of traffic-related air pollution with children's neurobehavioral functions in Quanzhou, China. *Environ Health Perspect*. 2009;117(10):1612–1618

70. Mohai P, Kweon BS, Lee S, Ard K. Air pollution around schools is linked to poorer student health and academic performance. *Health Aff (Millwood)*. 2011;30(5):852–862

71. Sunyer J, Esnaola M, Alvarez-Pedrerol M, et al. Association between traffic-related air pollution in schools and cognitive development in primary school children: a prospective cohort study. *PLoS Med*. 2015;12(3):e1001792

72. Loftus C, Yost M, Sampson P, et al. Ambient ammonia exposures in an agricultural community and pediatric asthma morbidity. *Epidemiology*. 2015;26(6):794–801

73. Pavilonis BT, Sanderson WT, Merchant JA. Relative exposure to swine animal feeding operations and childhood asthma prevalence in an agricultural cohort. *Environ Res*. 2013;122:74–80

74. Mirabelli MC, Wing S, Marshall SW, Wilcosky TC. Asthma symptoms among adolescents who attend public schools that are located near confined swine feeding operations. *Pediatrics*. 2006;118(1):e66–e75

75. Gilliland FD. Outdoor air pollution, genetic susceptibility, and asthma management: opportunities for intervention to reduce the burden of asthma. *Pediatrics*. 2009;123(suppl 3):S168–S173

76. Karr CJ, Demers PA, Koehoorn MW, Lencar CC, Tamburic L, Brauer M. Influence of ambient air pollutant sources on clinical encounters for infant bronchiolitis. *Am J Respir Crit Care Med*. 2009;180(10):995–1001

77. MacIntyre EA, Karr CJ, Koehoorn M, et al. Residential air pollution and otitis media during the first two years of life. *Epidemiology*. 2011;22(1):81–89

78. Goss CH, Newsom SA, Schildcrout JS, Sheppard L, Kaufman JD. Effect of ambient air pollution on pulmonary exacerbations and lung function in cystic fibrosis. *Am J Respir Crit Care Med*. 2004;169(7):816–821

79. Goeminne PC, Kiciński M, Vermeulen F, et al. Impact of air pollution on cystic fibrosis pulmonary exacerbations: a case-crossover analysis. *Chest*. 2013; 143(4):946–954

80. Gasana J, Dillikar D, Mendy A, Forno E, Ramos Vieira E. Motor vehicle air pollution and asthma in children: a meta-analysis. *Environ Res*. 2012;117: 36–45

81. Dick S, Friend A, Dynes K, et al. A systematic review of associations between environmental exposures and development of asthma in children aged up to 9 years. *BMJ Open*. 2014; 4(11):e006554

82. Schultz ES, Gruzieva O, Bellander T, et al. Traffic-related air pollution and lung function in children at 8 years of age: a birth cohort study. *Am J Respir Crit Care Med*. 2012;186(12):1286–1291

83. Rice MB, Rifas-Shiman SL, Litonjua AA, et al. Lifetime exposure to ambient pollution and lung function in children. *Am J Respir Crit Care Med*. 2016;193(8): 881–888

84. Götschi T, Heinrich J, Sunyer J, Künzli N. Long-term effects of ambient air pollution on lung function: a review. *Epidemiology*. 2008;19(5):690–701

85. Gauderman WJ, Urman R, Avol E, et al. Association of improved air quality with lung development in children. *N Engl J Med*. 2015;372(10):905–913

86. Brandt EB, Myers JMB, Ryan PH, Hershey GKK. Air pollution and allergic diseases. *Curr Opin Pediatr*. 2015;27(6): 724–735

87. Riedl MA. The effect of air pollution on asthma and allergy. *Curr Allergy Asthma Rep*. 2008;8(2):139–146

88. Sbihi H, Allen RW, Becker A, et al. Perinatal exposure to traffic-related air pollution and atopy at 1 year of age in a multi-center Canadian birth cohort study. *Environ Health Perspect*. 2015; 123(9):902–908

89. Bowatte G, Lodge C, Lowe AJ, et al. The influence of childhood traffic-related air pollution exposure on asthma, allergy and sensitization: a systematic review and a meta-analysis of birth cohort studies. *Allergy*. 2015;70(3):245–256

90. Straif K, Cohen A, Samet J, eds. Air Pollution and Cancer. IARC Scientific Publication No. 161. Lyon, France: International Agency for Research on Cancer; 2013

91. IARC Working Group on the Evaluation of Carcinogenic Risks to Humans. Diesel and gasoline engine exhausts and some nitroarenes. *IARC Monogr Eval Carcinog Risks Hum*. 2014;105:9–699

92. Filippini T, Heck JE, Malagoli C, Del Giovane C, Vinceti M. A review and meta-analysis of outdoor air pollution and risk of childhood leukemia. *J Environ Sci Health C Environ Carcinog Ecotoxicol Rev*. 2015;33(1):36–66

93. Rundle A, Hoepner L, Hassoun A, et al. Association of childhood obesity with maternal exposure to ambient air polycyclic aromatic hydrocarbons during pregnancy. *Am J Epidemiol*. 2012;175(11):1163–1172

94. Jerrett M, McConnell R, Wolch J, et al. Traffic-related air pollution and obesity formation in children: a longitudinal, multilevel analysis. *Environ Health*. 2014;13:49

95. McConnell R, Shen E, Gilliland FD, et al. A longitudinal cohort study of body mass index and childhood exposure to secondhand tobacco smoke and air pollution: the Southern California Children's Health Study. [published correction appears in *Environ Health Perspect*. 2015;123(4):A81]. *Environ Health Perspect*. 2015;123(4):360–366

96. Brook RD, Rajagopalan S, Pope CA III, et al.; American Heart Association Council on Epidemiology and Prevention, Council on the Kidney in Cardiovascular Disease, and Council on Nutrition, Physical Activity and Metabolism. Particulate matter air pollution and cardiovascular disease: an update to the scientific statement from the American Heart Association. *Circulation*. 2010;121(21):2331–2378

97. Kelishadi R, Poursafa P, Keramatian K. Overweight, air and noise pollution: universal risk factors for pediatric pre-hypertension. *J Res Med Sci*. 2011;16(9): 1234–1250

98. Pieters N, Koppen G, Van Poppel M, et al. Blood pressure and same-day exposure to air pollution at school: association with nano-sized to coarse PM in children. *Environ Health Perspect*. 2015; 123(7):737–742

99. Poursafa P, Kelishadi R, Lahijanzadeh A, et al. The relationship of air pollution and surrogate markers of endothelial dysfunction in a population-based sample of children. *BMC Public Health*. 2011;11:115

100. Haugen AC, Schug TT, Collman G, Heindel JJ. Evolution of DOHaD: the impact of environmental health sciences. *J Dev Orig Health Dis*. 2015; 6(2):55–64

101. Chen E, Schreier HMC, Strunk RC, Brauer M. Chronic traffic-related air pollution and stress interact to predict biologic and clinical outcomes in asthma. *Environ Health Perspect*. 2008; 116(7):970–975

102. Clougherty JE, Levy JI, Kubzansky LD, et al. Synergistic effects of traffic-related air pollution and exposure to violence on urban asthma etiology. *Environ Health Perspect*. 2007;115(8): 1140–1146

103. Clougherty JE, Kubzansky LD. A framework for examining social stress and susceptibility to air pollution in respiratory health. *Environ Health Perspect*. 2009;117(9):1351–1358

104. Bandoli G, von Ehrenstein O, Ghosh JK, Ritz B. Synergistic effects of air pollution and psychosocial stressors on adolescent lung function. *J Allergy Clin Immunol*. 2016;138(3):918–920.e4

105. Sacks JD, Stanek LW, Luben TJ, et al. Particulate matter-induced health effects: who is susceptible? *Environ Health Perspect*. 2011;119(4):446–454

106. Yang IA, Fong KM, Zimmerman PV, Holgate ST, Holloway JW. Genetic susceptibility to the respiratory effects of air pollution. *Thorax*. 2008;63(6): 555–563

107. Whyand T, Hurst JR, Beckles M, Caplin ME. Pollution and respiratory disease: can diet or supplements help? A review. *Respir Res*. 2018;19(1):79

108. Romieu I, Sienra-Monge JJ, Ramírez-Aguilar M, et al. Genetic polymorphism of GSTM1 and antioxidant supplementation influence lung function in relation to ozone exposure in asthmatic children in Mexico City. *Thorax*. 2004;59(1):8–10

109. Laden F, Schwartz J, Speizer FE, Dockery DW. Reduction in fine particulate air pollution and mortality: extended

follow-up of the Harvard Six Cities study. *Am J Respir Crit Care Med*. 2006; 173(6):667–672

110. Friedman MS, Powell KE, Hutwagner L, Graham LM, Teague WG. Impact of changes in transportation and commuting behaviors during the 1996 Summer Olympic Games in Atlanta on air quality and childhood asthma. *JAMA*. 2001;285(7):897–905
111. Rich DQ, Liu K, Zhang J, et al. Differences in birth weight associated with the 2008 Beijing Olympics air pollution reduction: results from a natural experiment. *Environ Health Perspect*. 2015;123(9):880–887
112. Adar SD, D'Souza J, Sheppard L, et al. Adopting clean fuels and technologies on school buses. Pollution and health impacts in children. *Am J Respir Crit Care Med*. 2015;191(12):1413–1421
113. AirNow.gov. Air Quality Index (AQI) basics. Available at: www.airnow.gov/index.cfm?action=aqibasics.aqi. Accessed June 7, 2017
114. Laumbach R, Meng Q, Kipen H. What can individuals do to reduce personal health risks from air pollution? *J Thorac Dis*. 2015;7(1):96–107
115. Abelsohn A, Stieb DM. Health effects of outdoor air pollution: approach to counseling patients using the Air Quality Health Index. *Can Fam Physician*. 2011;57(8):881–887, e280–e287
116. Tester JM; Committee on Environmental Health. The built environment: designing communities to promote physical activity in children. *Pediatrics*. 2009;123(6):1591–1598. Reaffirmed January 2013
117. US Environmental Protection Agency. Benefits and costs of the Clean Air Act. Available at: https://www.epa.gov/clean-air-act-overview/benefits-and-costs-clean-air-act. Accessed June 7, 2017

Antibiotic Stewardship in Pediatrics

- *Policy Statement*

POLICY STATEMENT Organizational Principles to Guide and Define the Child Health Care System and/or Improve the Health of all Children

American Academy of Pediatrics
DEDICATED TO THE HEALTH OF ALL CHILDREN®

Antibiotic Stewardship in Pediatrics

Jeffrey S. Gerber, MD, PhD, FAAP,[a] Mary Anne Jackson, MD, FAAP,[b] Pranita D. Tamma, MD, MHS,[c] Theoklis E. Zaoutis, MD, FAAP,[a]
COMMITTEE ON INFECTIOUS DISEASES, PEDIATRIC INFECTIOUS DISEASES SOCIETY

Antibiotic overuse contributes to antibiotic resistance, which is a threat to public health. Antibiotic stewardship is a practice dedicated to prescribing antibiotics only when necessary and, when antibiotics are considered necessary, promoting use of the appropriate agent(s), dose, duration, and route of therapy to optimize clinical outcomes while minimizing the unintended consequences of antibiotic use. Because there are differences in common infectious conditions, drug-specific considerations, and the evidence surrounding treatment recommendations (eg, first-line therapy, duration of therapy) between children and adults, this statement provides specific guidance for the pediatric population. This policy statement discusses the rationale for inpatient and outpatient antibiotic stewardship programs; essential personnel, infrastructure, and activities required; approaches to evaluating their effectiveness; and gaps in knowledge that require further investigation. Key guidance for both inpatient and outpatient antibiotic stewardship programs are provided.

REVIEW OF EVIDENCE

Overview

Antibiotics are the most common class of medications prescribed to children.[1] Although antibiotic therapy has saved countless lives, their overuse can cause harm. Antibiotic exposure can lead to antibiotic resistance, *Clostridioides difficile* infections (CDIs), and other drug-related adverse events, such as end-organ toxicities, diarrhea, rashes, cytopenia, and anaphylaxis. The Centers for Disease Control and Prevention (CDC) estimates that antibiotic-resistant microbes cause nearly 3 million infections and 35 000 deaths each year in the United States.[2] Antibiotics are frequently used in both pediatric inpatient and outpatient settings, with a significant proportion of antibiotic use considered unnecessary.[3] Antibiotic stewardship is a practice dedicated to using antibiotics only when necessary and, when antibiotics are deemed necessary, to targeting the spectrum of activity and using the appropriate dose, route, and duration of therapy to optimize clinical outcomes while minimizing the

abstract

[a]Department of Pediatrics, Perelman School of Medicine, University of Pennsylvania and Division of Infectious Diseases, Children's Hospital of Philadelphia, Philadelphia, Pennsylvania; [b]Section of Infectious Disease, Department of Pediatrics, Children's Mercy Hospital and School of Medicine, University of Missouri–Kansas City, Kansas City, Missouri; and [c]Division of Pediatric Infectious Diseases, Department of Pediatrics, School of Medicine, Johns Hopkins University, Baltimore, Maryland

Drs Gerber, Jackson, Tamma, and Zaoutis were equally responsible for all aspects of revising and writing the policy statement with input from reviewers and the Board of Directors; and all authors approved the final manuscript as submitted.

Policy statements from the American Academy of Pediatrics benefit from expertise and resources of liaisons and internal (AAP) and external reviewers. However, policy statements from the American Academy of Pediatrics may not reflect the views of the liaisons or the organizations or government agencies that they represent.

The guidance in this statement does not indicate an exclusive course of treatment or serve as a standard of medical care. Variations, taking into account individual circumstances, may be appropriate.

All policy statements from the American Academy of Pediatrics automatically expire 5 years after publication unless reaffirmed, revised, or retired at or before that time.

Published simultaneously in the Journal of Pediatric Infectious Diseases.

DOI: https://doi.org/10.1542/peds.2020-040295

Address correspondence to Jeffrey S. Gerber, MD, PhD.
E-mail: GERBERJ@email.chop.edu

To cite: Gerber JS, Jackson MA, Tamma PD, et al.; AAP COMMITTEE ON INFECTIOUS DISEASES, PEDIATRIC INFECTIOUS DISEASES SOCIETY. Antibiotic Stewardship in Pediatrics. *Pediatrics.* 2021;147(1):e2020040295

undesirable consequences of antibiotic use.[4] A growing body of evidence demonstrates that antibiotic stewardship programs (ASPs) reduce antibiotic overuse while improving patient outcomes. Consistent with the CDC, the Infectious Diseases Society of America, the Society for Healthcare Epidemiology of America, and the Pediatric Infectious Diseases Society, the American Academy of Pediatrics endorse the development and implementation of ASPs across pediatric health care settings.

This policy statement discusses the rationale for inpatient and outpatient ASPs; essential personnel, infrastructure, and activities required; approaches to evaluating their effectiveness; and gaps in knowledge that require further investigation.

The Role of ASPs

Strategies to address antimicrobial use and the emergence of antimicrobial-resistant pathogens, including formulary management and restriction, have been used for more than 4 decades, but results of such interventions were variable. Briceland et al[5] published the first evidence showing the positive effects from the use of a formal program with an infectious disease physician and pharmacist audit and feedback in 1988, and thereafter, there have been increasing efforts to customize and apply such stewardship strategies at hospitals throughout the United States. In a consensus statement by the Infectious Diseases Society of America, the Society for Healthcare Epidemiology of America, and the Pediatric Infectious Diseases Society, antibiotic stewardship has been defined as "coordinated interventions designed to improve and measure the appropriate use of [antibiotic] agents by promoting the selection of the optimal [antibiotic] drug regimen including dosing, duration of therapy, and route of administration."[6] Although most of the evidence base for antibiotic stewardship has focused on the acute care setting, the CDC has published core elements of antibiotic stewardship for acute care (including small and critical access hospitals), long-term care, and ambulatory care settings.[7]

Unintended Consequences of Antibiotic Use in Children

Although numerous antibiotics have been developed since the discovery of penicillin, they have been closely followed by the development of increasingly complex mechanisms of antibiotic resistance by bacterial pathogens as these agents have been introduced into clinical practice.[8] The increase in multidrug-resistant infections has outpaced the development of novel antibiotics capable of treating them.[9] Although not addressed in this document, the use of antibiotics in animal agriculture also contributes to antibiotic resistance.[10]

Adverse consequences associated with antibiotic use extend beyond the development of resistance in targeted organisms. As seen from evaluation of pediatric data from the National Electronic Injury Surveillance System in the United States between 2011 and 2015, antibiotic-associated adverse drug events accounted for almost 50% of emergency department visits for adverse events from systemic medications.[11] CDI is another potential consequence of antibiotic use. In a large surveillance study, 71% of CDI cases in children were community associated and generally developed after exposure to antibiotics prescribed during ambulatory encounters for otitis media, sinus infections, or acute respiratory tract infections (ARTIs).[12] Researchers in more recent investigations have explored the effect of antibiotic exposure on the intestinal microbiome. Data suggest the potential for antibiotic exposures, especially when frequent and occurring early in life, to promote intestinal dysbiosis and possible effects on the development of conditions such as juvenile idiopathic arthritis, inflammatory bowel disease, asthma, and diabetes.[13–15]

Inpatient ASPs

Stewardship programs dedicated to a variety of pediatric patient populations are becoming increasingly prevalent in the United States. A 2011 survey of 38 freestanding children's hospitals reported that 42% had established ASPs and an additional 37% were in the process of implementing programs.[16] In 2014, the CDC compiled a checklist of "Core Elements of Hospital Antibiotic Stewardship Programs" that included the following: support from leadership for the ASP, including appropriate financial support; an identified physician leader for the ASP; a pharmacist coleader; support from other relevant stakeholders (ie, microbiology laboratory personnel, infection prevention team members, information technology staff, and nursing and other allied health professionals, among others); specific interventions to improve antibiotic use (eg, prior approval, postprescription review with feedback, etc); pharmacy-driven interventions (eg, dose optimization, therapeutic drug monitoring, automatic conversion of intravenous to oral antibiotic therapy, etc); recommendations for the diagnosis and treatment of specific syndromes (eg, community-acquired pneumonia, urinary tract infections, etc); monitoring antibiotic prescribing and resistance patterns and regularly reporting findings to health care workers; and educating health care workers about resistance and optimal prescribing.[16] In January 2017, The Joint Commission (TJC) Antimicrobial Stewardship Standard went into effect, further emphasizing the need for all acute care facilities to have ASPs.[17] The Pediatric Antibiotic Stewardship Program Toolkit

developed by the American Academy of Pediatrics and the Pediatric Infectious Diseases Society offers guidance more specific to the pediatric population.[18] For hospitals with both adult and pediatric patients, inclusion of a pediatric infectious diseases physician and/or pharmacist as members of the ASP is recommended.

The core team members of ASPs include physician and pharmacist leaders, according to both the CDC Core Elements[16] and TJC Antimicrobial Stewardship Standard.[17] Dedicated financial support to these leaders is critical to enable the success of stewardship programs.[19] Ideally, both physicians and pharmacists will have an infectious diseases fellowship or postgraduate year 2 infectious diseases residency training, respectively, to ensure comprehensive knowledge of the diagnosis and management of infectious diseases.[20] In resource-limited settings, ASPs may be led by physicians and/or pharmacists without formal infectious diseases training; however, an ASP team member with pediatric expertise is required. Although team members are encouraged to develop program goals together, unique roles for the physician leader include underscoring to other clinicians how the overarching goals of the ASP are to optimize patient outcomes and prevent unnecessary harm to patients and to function as a bridge to hospital executive leadership. Pharmacists typically conduct the majority of routine interventions and often lead efforts to compile and validate antibiotic use data. The pharmacist also functions as a liaison between providers and both the department of pharmacy and the therapeutic standards committee to encourage agreement between stewardship and pharmacy goals.

Close relationships between stewardship leaders and hospital leaders can further the goals of the stewardship program.[16,17] Along with financial resources, executives can facilitate the involvement of stewardship leaders in strategic high-level meetings and connect the stewardship team to institution-wide stakeholders who can help further disseminate concepts of stewardship.

Both the CDC Core Elements and TJC Antimicrobial Stewardship Standard highlight the importance of monitoring antibiotic use and antibiotic resistance.[16,17] A data analyst can support the stewardship program by compiling relevant antibiotic use and microbiological data that can periodically be fed back to hospital administration and clinicians and identify necessary interventions led by the ASP. Moreover, the data analyst can lead efforts to report institutional data to the CDC National Healthcare Safety Network Antimicrobial Use and Resistance Module.[16]

Nurses are valuable partners in antibiotic stewardship efforts and can be actively integrated into stewardship interventions.[21] Bedside nurses provide continuity of care to patients and can be vital in ensuring that goals of care are carried over and readdressed on a daily basis.[22] Furthermore, nurses can assist with alleviating patient and guardian concerns about antibiotic use (or a perceived but appropriate "lack" of antibiotic use). Additional guidance on specific examples of how valuable nurses can be to stewardship efforts are available.[21,23] Additionally, the stewardship team may consider working closely with the clinical microbiology laboratory to assist with antibiogram development (ie, a periodic report summarizing the susceptibility activity of a bacteria to a variety of antibiotics), help inform selective reporting of antibiotic susceptibility results, and improve the selection and implementation of rapid diagnostic tests. The stewardship team can also function as a conduit between the microbiology laboratory and clinician by educating providers about appropriate culture specimen collection and testing criteria as well as interpretation of the antibiogram and rapid diagnostic test results.[24] Finally, stewardship teams can work with the infection prevention team as the infection prevention team compiles data on hospital-wide resistant organism trends and *C difficile* laboratory-infectious disease events (a metric standardly collected by many US hospitals on a quarterly basis and reported to the CDC) that can be informative in guiding stewardship interventions.

Stewardship Strategies in the Inpatient Setting

Local Guidelines

The development and dissemination of institutional guidelines for diagnosing and treating common infectious syndromes is a key function of stewardship programs. Guidelines provide evidence-based and standardized diagnostic and treatment recommendations based on local data and promote adherence to the use of formulary drugs. Inpatient antibiotic guidelines can be developed to target common indications for antibiotic use, such as community-acquired pneumonia, urinary tract infections, hospital- and ventilator-associated pneumonia, skin and soft tissue infections, intraabdominal infections, and neonatal and pediatric sepsis. These indications represent the majority of antibiotic use in most institutions.[25] Inpatient guidelines can discuss appropriate clinical criteria suggestive of bacterial infections, diagnostic testing (including imaging studies when needed), specific empirical and targeted therapy (including dosing and options for severe drug allergies), and appropriate durations of therapy. Each guideline can be developed with input from each of the relevant

specialties and include medical, pharmacy, and nursing representatives. Ensuring guidelines are available at the point of care (eg, intranet, patient unit handbooks, pocket cards, apps, etc) increases the likelihood that clinicians will easily access them when necessary. Finally, periodic reviews and updates of local guidelines by the stewardship team will maintain their relevance as new evidence emerges.

Prior Approval Versus Postprescription Review With Feedback

Stewardship programs should determine their approach to interventions on the basis of available resources.[26] Direct, face-to-face interactions such as "handshake stewardship" is always favored when possible, because they foster a collaborative relationship between the stewardship team and clinicians, but they can be labor intensive.[27] Although telephone calls or notes in the medical record will never be substitutes for human interactions, they can play an important role in promoting evidence-based antibiotic use and may be more feasible for many programs. Stewardship programs may want to consider prior approval, postprescription review with feedback, or a combination of the 2 approaches to encourage judicious antibiotic use.[26] Prior approval generally consists of a phone call to the stewardship team for select anti-infectives justifying the use of the agent before it is dispensed by pharmacy. This approach can reduce unnecessary antibiotic initiation, optimize the selection of empirical antibiotics, provide information on optimal culture techniques, and encourage infectious diseases consultations when necessary. Drawbacks of this approach include its focus on specific restricted agents, potential to disrupt front-line clinician workflow, potential delays in antibiotic administration for sepsis, and an inability to address downstream antibiotic use, such as intravenous to oral conversion or duration of therapy.

Postprescription review with feedback generally occurs 48 to 72 hours after antibiotics are initiated, when more clinical data are available to make recommendations. Advantages to this approach include greater flexibility in the timing of interventions and the ability to address targeted therapy decisions. An important limitation with this approach is that recommendations are generally optional because most stewardship programs are not able to enforce mandatory discontinuation of antibiotics. Additionally, postprescription review generally does not affect the first 2 to 3 days of antibiotic therapy, which often constitute a large portion of inpatient antibiotic use. A hybrid approach including a component of prior approval and postprescription review is often the most effective.[28]

Syndrome-Specific Stewardship

Syndrome-specific interventions target specific disease processes such as community-acquired pneumonia[29] or skin and soft tissue infections.[30] It also includes perioperative prophylaxis recommendations or surgical conditions such as the management of appendicitis.[31–33] Perioperative prophylaxis remains an important target because approximately 40% of all antibiotics in the inpatient setting are administered to surgical patients.[34] Syndrome-specific stewardship is generally operationalized through the development of local guidelines and targeted educational interventions around the syndrome.[29] Benefits include engagement of front-line clinicians and facilitation of sustained practices. Additionally, syndrome-specific stewardship can address both empirical and targeted prescribing and is generally viewed as a measure toward optimizing "patient safety" or "quality improvement," rather than as an approach involving less-attractive restrictive interventions. Disadvantages include incomplete capture of all cases of a specific condition, particularly if a culture result is not the usual trigger (eg, community-acquired pneumonia); challenges obtaining consensus approaches among various stakeholders; and the inability to target antibiotic use that occurs without clear indications. When developing specific treatment recommendations in local guidelines for specific syndromes, clear criteria for determination of penicillin allergies and when penicillin allergy testing might be necessary can be helpful.

Rapid Diagnostic Tests

Diagnostic test implementation provides a unique opportunity for stewardship teams to educate providers in real time and to inform prescribing practices.[24] Rapid diagnostics can facilitate antibiotic de-escalation (eg, switching from vancomycin to oxacillin for methicillin-susceptible *Staphylococcus aureus* bacteremia), broadening therapy when necessary (eg, switching from vancomycin to daptomycin for vancomycin-resistant *Enterococcus faecium* bacteremia), stopping therapy (eg, discontinuing vancomycin for a single positive culture for coagulase-negative *Staphylococcus* bacteremia), or in some cases, identifying a viral etiology that may reduce the likelihood of a bacterial pathogen. Before implementing a new test, the stewardship team may want to develop and disseminate a guidance document for prescribers on how to interpret results of the new test. Moreover, the team can develop language to include in the electronic health record that is concise, relevant, and understandable to clinicians. The main disadvantage of interventions around implementation of rapid diagnostic tests is that the impact is generally limited to a small number of

patients (eg, patients with bloodstream or respiratory tract infections). Furthermore, these tests can be costly and sometimes resource intensive. Stewardship programs may also struggle with ensuring prescriber "buy-in" if the test does not have negative or positive predictive values approaching 100%.

Outpatient ASPs

The vast majority of antibiotic prescribing occurs in the outpatient setting.[35] One in 5 pediatric ambulatory visits result in an antibiotic prescription, accounting for nearly 50 million antibiotic prescriptions annually in the United States, at least half of which are considered inappropriate.[36] ARTIs account for more than two-thirds of antibiotic prescriptions for children, at least one-third of which are unnecessary.[37] Although most outpatient pediatric antibiotic prescriptions come from primary care encounters, subspecialty practices, emergency departments, urgent care clinics, retail clinics, and dentists' offices are also important settings for outpatient antibiotic stewardship.

As with inpatient stewardship, effective outpatient stewardship requires strong leadership. Ideally, a single clinician leader with expertise in antibiotic use in the outpatient setting is identified. If the practice is part of a larger organization (eg, health care network), commitment from administrators, such as salary support and providing the authority to implement change, is important. Last, the ability to track and report antibiotic prescribing and, ideally, clinical outcomes data is critical for measuring the impact of interventions (and potentially as a tool for influencing appropriate antibiotic use). The Antimicrobial Stewardship Standard of TJC for the outpatient setting went into effect in January 2020.[38]

Stewardship Strategies in the Outpatient Setting

Standard antibiotic stewardship approaches recommended for the hospital setting, such as prior approval and real time, postprescription review with feedback, are not practical in the ambulatory setting. However, a variety of stewardship strategies have been successfully implemented in outpatient practices, and their effects on antibiotic prescribing and clinical outcomes have been reviewed.[39,40] These include, but are not limited to, clinical decision support, clinician and/or patient education (eg, watchful waiting for acute otitis media, when appropriate), and audit with feedback of antibiotic prescribing. Implementation of a systematic approach to follow up negative culture results and discontinue antibiotics that were initiated on the basis of initial signs and symptoms can also reduce exposure to antibiotics. It is common for there to be a system to notify the patient and families of positive results in cases in which an antibiotic was not prescribed; however, it is important to also have a comparable process for discontinuing antibiotics when final results are negative. Because communication between the clinician and patient and/or caregiver can influence the decision to prescribe an antibiotic, communication training is another potential strategy.[41] Consideration of the sociobehavioral aspects and context of the encounter during which antibiotic prescribing might occur have also been shown to be important levers for improving practice.[42,43] Furthermore, educating parents about the natural course of viral and bacterial infections can foster an understanding of expectations (eg, prolonged cough for viral pharyngitis). The emergency department remains a hybrid in which elements of both inpatient and outpatient stewardship generally need to be merged to optimize antibiotic prescribing for both patients discharged from the hospital and for those who will ultimately be hospitalized.

Unnecessary Prescribing

Clinical encounters in which antibiotics could be avoided altogether can be a primary target for outpatient stewardship. Examples include antibiotic prescribing for nonspecific upper respiratory infection, bronchiolitis, acute bronchitis, asthma exacerbation, or conjunctivitis. When considering the epidemiology of bacterial infections presenting in the ambulatory setting requiring antibiotics, it has been conservatively estimated that antibiotic prescribing could be safely reduced by 30%.[37]

Diagnosis Stewardship

Just as antibiotic prescribing rates vary across providers and practices, rates of diagnosis of the most common childhood infections have been shown to vary substantially.[44] Thus, "diagnostic stewardship" can be considered as a means to reduce prescribing. Examples include reserving antibiotic treatment of pharyngitis for children with a positive group A streptococcal test result and only testing children with a suggestive clinical syndrome, requiring characteristic findings identified by pneumatic otoscopy and clinical signs of middle ear infection to confirm and treat acute otitis media, demonstrating pyuria in conjunction with signs and symptoms suggestive of a urinary tract infection and to distinguish asymptomatic bacteriuria from true infection, and confirming severe, progressive, or prolonged and unrelenting symptoms for the diagnosis and treatment of acute bacterial sinusitis.

Antibiotic Choice

Even when antibiotics are indicated, outpatient stewardship interventions can improve patient care. Broad-spectrum second-line antibiotics are prescribed as often as first-line

recommended narrow-spectrum agents for ARTIs.[36] This practice can lead to avoidable adverse drug events and antibiotic resistance and can increase overall health care costs without clinical benefit over narrow-spectrum agents.[45] In some cases, these nonrecommended antibiotics are less likely to cover the most likely offending pathogen, such as oral cephalosporins or azithromycin for pneumococcus, the prime target for acute otitis media, sinusitis, and pneumonia.

Duration and Route of Therapy

Even when the right drug and dose are prescribed, the duration of therapy is an important stewardship target. Many infections treated for 10 or 14 days will respond to shorter antibiotic courses, including most uncomplicated skin and soft tissue infections, pneumonia, and urinary tract infections.[46] The use of outpatient parenteral antibiotic therapy can be limited to conditions for which oral therapy is known to be less effective.[47,48] A large proportion of outpatient parenteral antibiotic therapy for children is unnecessary, and use of peripherally inserted central catheters is associated with a high rate of adverse events in children.[49–51]

Challenges to implementing antibiotic stewardship in the outpatient setting include finding resources to support a program, identifying a clinician leader who has the time and interest to commit to engaging outpatient clinicians in a quality improvement initiative, obtaining data to identify high-impact targets and track process improvement and clinical outcomes, and sustaining improvement over time.

Measuring the Success of ASPs

Process Measures

When evaluating ASPs, outcomes are frequently categorized into those that are related to process outcomes (eg, antibiotic use) or to clinical outcomes (eg, length of hospital stay). This distinction is debatable, because process outcomes, with all of their downstream effects, are themselves arguably a clinically relevant outcome. Antibiotic usage outcomes generally examine changes in antibiotic use practices after the implementation of stewardship interventions. It is always preferred to use data reporting antibiotics dispensed from the pharmacy or administered to patients rather than purchasing data when measuring antibiotic use because the former more accurately assesses antibiotic exposure. Published data from pediatric ASPs have consistently demonstrated that these programs can effectively decrease antibiotic use.[52–57] These findings were summarized in a systematic review including 9 studies reporting outcomes from US pediatric ASPs.[58]

In the past, defined daily doses per 1000 patient-days was widely accepted as an antibiotic stewardship process outcome in the inpatient setting but has largely been replaced in the United States by days of therapy (DOTs) per 1000 patient-days. As opposed to defined daily doses, DOTs have the advantage of not being affected by variations in dosing and, therefore, are more representative of pediatric prescribing practices in which dosing can vary greatly between age groups. DOTs account for the number of different antibiotics (but not doses) administered each day. For example, if a child receives cefepime, gentamicin, and vancomycin on a hospital day, this would contribute 3 DOTs. Limitations of this metric include the lack of accounting for antibiotics prescribed at the time of hospital discharge, which make it sensitive to changes in the mean hospital length of stay,[59,60] and its inability to discriminate between antibiotic spectrum of activity (eg, a day of ceftriaxone and metronidazole would count as 2 DOTs, whereas a day of meropenem would count as 1 DOT).

Metrics that can be considered in outpatient settings include the number of antibiotic prescriptions per monthly patient-visits, proportions of all visits or sick visits leading to antibiotics, and proportions of visits for particular diagnoses leading to antibiotics. However, because of inherent differences in the acuity of patients visiting urgent care centers versus primary care clinics and challenges with providing close follow-up of patients in urgent care settings, comparisons between antibiotic use across these practices can be problematic.

In the current medical landscape, in which payment requirements are becoming increasingly stringent, cost-saving strategies are of particular interest to health care administrators. Several investigators have found implementation of pediatric ASPs to be associated with reduced antibiotic-related expenditures.[52,61] This is particularly true in the initial years after implementation but has also been shown to be sustainable.[53] Although cost savings are appealing to administrators and regulatory bodies and therefore improve resource allocation and "buy-in," focusing on clinical outcomes is more likely to influence clinician antibiotic prescribing behavior.

Clinical Outcomes Measures

Clinical outcomes are more challenging to measure than antibiotic use, because they are more resource intensive to collect; may be rare (eg, death), so may not provide sufficient statistical power when evaluated in the context of ASP interventions; and are potentially attributable to multiple other non–stewardship-related interventions. Although improvement in clinical outcomes after optimization of antibiotic therapy is ideal, a reduction in antibiotic use without worsening clinical outcomes is also acceptable. Examples of clinical outcomes to consider include CDI, antibiotic resistance, antibiotic-

associated adverse drug events, length of stay, hospital readmission, and mortality.

CDI is a common adverse event associated with antibiotic use that has been well-studied in the adult population but less so in children. The most common standardized CDI metric is CDI cases per 10 000 hospitalizations. Reductions in rates of CDI with stewardship programs have been identified in adult populations[38,62–64] but have not been observed in children, in part because the incidence of CDI is lower in children compared with adults, and *C difficile* has a high likelihood of being a colonizer (rather than a pathogen) in young children, making it challenging to adequately power a study to demonstrate a difference in CDI rates.

Decreasing rates of antibiotic resistance is an important goal of a stewardship program; however, similar to CDI rates, they are difficult to demonstrate, mostly because there are numerous alternate pathways by which the development and spread of antibiotic resistance occur, including lapses in infection prevention practices, outpatient antibiotic use, and mixing of patient populations from outside institutions. In addition, resistance is a dynamic process and may take months to years to emerge. A reduction in antibiotic resistance attributable to pediatric stewardship programs has not been the subject of extensive evaluation, and when it has been assessed, results have been conflicting.[57,65–67] These findings are similar to what has been observed with adult ASPs.[68–70]

Hospital length of stay is frequently studied as a metric in health care interventions, although less often for ASPs. In one children's hospital in which postprescription review and feedback was used, hospital length of stay was reduced by approximately 1 day, and 30-day readmission was reduced by 3%.[71] Although decreasing length of stay is an important goal of health care institutions, it is inherently multifactorial and, thus, not ideal as a primary outcome of ASPs.

Decreased mortality is difficult to associate with ASP interventions, because it is a relatively rare outcome in children in general and because excessive antibiotic use is unlikely to meaningfully affect survival. Mortality has not been shown to be a feasible outcome of stewardship programs in either children or adults, and its use as a primary outcome is discouraged.

Gaps in Knowledge

Although the field of antibiotic stewardship has made considerable advancements over the past decade, notable knowledge gaps remain.[21] Some gaps in knowledge for antibiotic stewardship to highlight include (1) effective adaptation of the organizational structure and interventions established for the acute care setting to ambulatory and long-term care settings, (2) understanding the cultural and adaptive influences of antibiotic prescribing, (3) understanding how best to incorporate nursing into stewardship efforts and fostering an environment in which nursing contribution is actively encouraged, (4) defining the optimal treatment of common bacterial infections specific to the pediatric population (eg, comparisons of different drug regimens, durations of therapy, parenteral versus oral therapy, and optimal dosing strategies) to improve the evidence base for stewardship recommendations, (5) developing and validating metrics that consider the potential harm of antibiotics and weigh the risks versus the benefits (ie, an antibiotic-associated harm score), (6) establishment of risk-adjusted antibiotic use benchmarking approaches, (7) approaches to effectively teaching clinicians to become "self-stewards," and (8) incorporating the patient and family perspective and shared decision-making into stewardship.

RECOMMENDATIONS

1. The American Academy of Pediatrics and the Pediatric Infectious Diseases Society recommend establishing ASPs to improve antibiotic prescribing.
2. ASPs governing antibiotic use for children should include specialists with pediatric expertise.
3. Inpatient ASPs are ideally composed of a medical director and a clinical pharmacist(s), both with expertise in pediatric infectious diseases and/or antibiotic stewardship.
4. Inpatient ASPs can use clinical guidelines, prior approval, and postprescription review and feedback as core interventions.
5. Inpatient ASPs can include pharmacy-driven interventions such as dose optimization, therapeutic drug monitoring, automatic conversion of intravenous to oral antibiotic therapy, or dose adjustments in cases of organ dysfunction.
6. Inpatient ASPs can consider auditing, analyzing, and reporting local unit-specific antibiotic prescribing data periodically to relevant stakeholders.
7. Outpatient primary care practices, urgent care clinics, and emergency departments could consider establishing standardized approaches for antibiotic prescribing including clinical guidelines and/or decision support.
8. Outpatient stewardship can focus on judicious use of antibiotics for ARTIs, including avoidance of antibiotic prescribing for undifferentiated upper respiratory tract infection, bronchiolitis, acute bronchitis, and nonstreptococcal pharyngitis; refraining from prescribing antibiotics for urinary

tract infections in the absence of a urinalysis and urine culture; and judicious diagnosis of acute otitis media, acute sinusitis, and group A streptococcal pharyngitis.

9. Outpatient stewardship efforts can emphasize use of the narrowest-spectrum antibiotics for the shortest duration of therapy that will adequately treat bacterial infections.

LEAD AUTHORS

Jeffrey S. Gerber, MD, PhD, FAAP
Mary Anne Jackson, MD, FAAP
Pranita D. Tamma, MD, MHS
Theoklis E. Zaoutis, MD, FAAP

COMMITTEE ON INFECTIOUS DISEASES, 2019–2020

Yvonne A. Maldonado, MD, FAAP, Chairperson
Sean T. O'Leary, MD, MPH, FAAP, Vice Chairperson
Ritu Banerjee, MD, PhD, FAAP
Elizabeth D. Barnett MD, FAAP
James D. Campbell, MD, MS, FAAP
Mary T. Caserta, MD, FAAP
Jeffrey S. Gerber, MD, PhD, FAAP
Athena P. Kourtis, MD, PhD, MPH, FAAP
Ruth Lynfield, MD, FAAP
Flor M. Munoz, MD, MSc, FAAP
Dawn Nolt, MD, MPH, FAAP
Ann-Christine Nyquist, MD, MSPH, FAAP
William J. Steinbach, MD, FAAP
Ken Zangwill, MD, FAAP
Theoklis E. Zaoutis, MD, MSCE, FAAP

EX OFFICIO

David W. Kimberlin, MD, FAAP – *Red Book Editor*
Mark H. Sawyer, MD, FAAP – *Red Book Associate Editor*
Henry H. Bernstein, DO, MHCM, FAAP – *Red Book Online Associate Editor*
H. Cody Meissner, MD, FAAP – *Visual Red Book Associate Editor*

LIAISONS

Amanda C. Cohn, MD, FAAP – *Centers for Disease Control and Prevention*
Karen M. Farizo, MD – *US Food and Drug Administration*
Marc Fischer, MD, FAAP – *Centers for Disease Control and Prevention*
Natasha B. Halasa, MD, MPH, FAAP – *Pediatric Infectious Diseases Society*
Nicole Le Saux, MD, FRCP(C) – *Canadian Paediatric Society*
Eduardo Lopez, MD – *Sociedad Latinoamericana de Infectología Pediátrica*
Scot B. Moore, MD, FAAP – *Committee on Practice Ambulatory Medicine*
Neil S. Silverman, MD – *American College of Obstetricians and Gynecologists*
Judith Steinberg, MD – *US Department of Health and Human Services Office of Infectious Disease and HIV/AIDS Policy*
Jeffrey R. Starke, MD, FAAP – *American Thoracic Society*
James J. Stevermer, MD, MSPH, FAAFP – *American Academy of Family Physicians*
Kay M. Tomashek, MD, MPH, DTM – *National Institutes of Health*

STAFF

Jennifer M. Frantz, MPH

PEDIATRIC INFECTIOUS DISEASES SOCIETY

Jason Newland, MD
Rana Hamdy, MD, MPH
Mayssa Abuali, MD
Daniel Adams, MD
Ritu Banerjee, MD, PhD
Fernando Bula-Rudas, MD
Dhanya Dharmapalan, MD
Daniel Dulek, MD
Dustin Flannery, DO
Bishara Freij, MD
Andrew Gainey, PharmD
Jeffrey S. Gerber, MD, PhD, FAAP
Carol Glaser, MD
Lori Handy, MD
Benjamin Hanisch, MD
Sara Healy, MD, MPH
Adam Hersh, MD, PhD
David Hyun, MD
Candace Johnson, MD
Sophie Katz, MD
Matthew Kronman, MD
John Manaloor, MD
Holly Maples, PharmD
Lee Morris, DTM&H, MD, MSPH
Ben Onankpa, MBBS, MPH
Ronda Oram, MD
Debra Palazzi, MD
Hayden Schwenk, MD
Craig Shapiro, MD
Prachi Singh, DO
Kevin Spicer, MD
Pranita Tamma, MD, MHS
Michael TeKippe, MD, PhD
Emily Thorell, MD
Alison Tribble, MD
Zachary Willis, MD, MPH
Jon Woods, MD
Tracy Zembles, PharmD, BCPS-AQ ID

STAFF

Terri Christene Phillips, MSA

ABBREVIATIONS

ARTI: acute respiratory tract infection
ASP: antibiotic stewardship program
CDC: Centers for Disease Control and Prevention
CDI: *Clostridioides difficile* infection
DOT: day of therapy
TJC: The Joint Commission

PEDIATRICS (ISSN Numbers: Print, 0031-4005; Online, 1098-4275).

FINANCIAL DISCLOSURE: The authors have indicated they have no financial relationships relevant to this article to disclose.

FUNDING: No external funding.

POTENTIAL CONFLICT OF INTEREST: The authors have indicated they have no potential conflicts of interest to disclose.

REFERENCES

1. Chai G, Governale L, McMahon AW, Trinidad JP, Staffa J, Murphy D. Trends of outpatient prescription drug use in US children, 2002-2010. *Pediatrics*. 2012; 130(1):23–31
2. The Centers for Disease Control and Prevention. Antibiotic / antimicrobial resistance (AR / AMR): biggest threats and data. Available at: www.cdc.gov/DrugResistance/Biggest-Threats.html. Accessed December 7, 2019
3. Soyka LF, Robinson DS, Lachant N, Monaco J. The misuse of antibiotics for treatment of upper respiratory tract infections in children. *Pediatrics*. 1975; 55(4):552–556
4. American Academy of Pediatrics. Antimicrobial Resistance and Antimicrobial Stewardship: Appropriate and Judicious Use of Antimicrobial Agents. In: Kimberlin DW, Brady MT, Jackson MA, Long SS, eds. *Red Book: 2018 Report of the Committee on Infectious Diseases*. Elk Grove Village, IL: American Academy of Pediatrics; 2018: 906–910
5. Briceland LL, Nightingale CH, Quintiliani R, Cooper BW, Smith KS. Antibiotic streamlining from combination therapy to monotherapy utilizing an interdisciplinary approach. *Arch Intern Med*. 1988;148(9):2019–2022
6. Society for Healthcare Epidemiology of America; Infectious Diseases Society of America; Pediatric Infectious Diseases Society. Policy statement on antimicrobial stewardship by the Society for Healthcare Epidemiology of America (SHEA), the Infectious Diseases Society of America (IDSA), and the Pediatric Infectious Diseases Society (PIDS). *Infect Control Hosp Epidemiol*. 2012;33(4):322–327
7. Mansour ME, Rose B, Toole K, Luzader CP, Atherton HD. Pursuing perfection: an asthma quality improvement initiative in school-based health centers with community partners. *Public Health Rep*. 2008;123(6):717–730
8. Medernach RL, Logan LK. The growing threat of antibiotic resistance in children. *Infect Dis Clin North Am*. 2018; 32(1):1–17
9. Tamma PD, Hsu AJ. Defining the role of novel β-lactam agents that target carbapenem-resistant gram-negative organisms. *J Pediatric Infect Dis Soc*. 2019;8(3):251–260
10. Paulson JA, Zaoutis TE; Council on Environmental Health; Committee on Infectious Diseases. Nontherapeutic use of antimicrobial agents in animal agriculture: implications for pediatrics. *Pediatrics*. 2015;136(6). Available at: www.pediatrics.org/cgi/content/full/136/6/e1670
11. Lovegrove MC, Geller AI, Fleming-Dutra KE, Shehab N, Sapiano MRP, Budnitz DS. US emergency department visits for adverse drug events from antibiotics in children, 2011-2015. *J Pediatric Infect Dis Soc*. 2019;8(5):384–391
12. Wendt JM, Cohen JA, Mu Y, et al. *Clostridium difficile* infection among children across diverse US geographic locations. *Pediatrics*. 2014;133(4): 651–658
13. Horton DB, Scott FI, Haynes K, et al. Antibiotic exposure, infection, and the development of pediatric psoriasis: a nested case-control study. *JAMA Dermatol*. 2016;152(2):191–199
14. Vangay P, Ward T, Gerber JS, Knights D. Antibiotics, pediatric dysbiosis, and disease. *Cell Host Microbe*. 2015;17(5): 553–564
15. Hildebrand H, Malmborg P, Askling J, Ekbom A, Montgomery SM. Early-life exposures associated with antibiotic use and risk of subsequent Crohn's disease. *Scand J Gastroenterol*. 2008; 43(8):961–966
16. Newland JG, Gerber JS, Weissman SJ, et al. Prevalence and characteristics of antimicrobial stewardship programs at freestanding children's hospitals in the United States. *Infect Control Hosp Epidemiol*. 2014;35(3):265–271
17. The Joint Commission Antimicrobial Stewardship Standard. Approved: new antimicrobial stewardship standard. Available at: https://www.jointcommission.org/assets/1/6/New_Antimicrobial_Stewardship_Standard.pdf. Accessed December 5, 2019
18. Pediatric Infectious Diseases Society. Pediatric antibiotic stewardship program toolkit. Available at: www.pids.org/asp-toolkit.html. Accessed June 22, 2020
19. Doernberg SB, Abbo LM, Burdette SD, et al. Essential resources and strategies for antibiotic stewardship programs in the acute care setting. *Clin Infect Dis*. 2018;67(8):1168–1174
20. Nichols K, Stoffella S, Meyers R, Girotto J; Advocacy Committee for the Pediatric Pharmacy Advocacy Group. Pediatric antimicrobial stewardship programs. *J Pediatr Pharmacol Ther*. 2017;22(1): 77–80
21. Olans RN, Olans RD, DeMaria A Jr.. The critical role of the staff nurse in antimicrobial stewardship–unrecognized, but already there. *Clin Infect Dis*. 2016;62(1):84–89
22. Monsees E, Popejoy L, Jackson MA, Lee B, Goldman J. Integrating staff nurses in antibiotic stewardship: opportunities and barriers. *Am J Infect Control*. 2018; 46(7):737–742
23. Monsees EA, Tamma PD, Cosgrove SE, Miller MA, Fabre V. Integrating bedside nurses into antibiotic stewardship: a practical approach. *Infect Control Hosp Epidemiol*. 2019;40(5):579–584
24. Avdic E, Carroll KC. The role of the microbiology laboratory in antimicrobial stewardship programs. *Infect Dis Clin North Am*. 2014;28(2): 215–235
25. Magill SS, Edwards JR, Beldavs ZG, et al.; Emerging Infections Program Healthcare-Associated Infections and Antimicrobial Use Prevalence Survey Team. Prevalence of antimicrobial use in US acute care hospitals, May-September 2011. *JAMA*. 2014;312(14): 1438–1446
26. Barlam TF, Cosgrove SE, Abbo LM, et al. Executive summary: implementing an antibiotic stewardship program: guidelines by the Infectious Diseases Society of America and the Society for Healthcare Epidemiology of America. *Clin Infect Dis*. 2016;62(10):1197–1202
27. Messacar K, Campbell K, Pearce K, et al. A handshake from antimicrobial stewardship opens doors for infectious disease consultations. *Clin Infect Dis*. 2017;64(10):1449–1452
28. Tamma PD, Avdic E, Keenan JF, et al. What is the more effective antibiotic stewardship intervention: preprescription authorization or

postprescription review with feedback? *Clin Infect Dis*. 2017;64(5):537–543

29. Avdic E, Cushinotto LA, Hughes AH, et al. Impact of an antimicrobial stewardship intervention on shortening the duration of therapy for community-acquired pneumonia. *Clin Infect Dis*. 2012;54(11): 1581–1587
30. Pasquale TR, Trienski TL, Olexia DE, et al. Impact of an antimicrobial stewardship program on patients with acute bacterial skin and skin structure infections. [published correction appears in Am J Health Syst Pharm. 2014;71(15):1243]. *Am J Health Syst Pharm*. 2014;71(13):1136–1139
31. Kronman MP, Hersh AL, Gerber JS, et al. Identifying antimicrobial stewardship targets for pediatric surgical patients. *J Pediatric Infect Dis Soc*. 2015;4(4): e100–e108
32. Sandora TJ, Fung M, Melvin P, Graham DA, Rangel SJ. National variability and appropriateness of surgical antibiotic prophylaxis in US children's hospitals. *JAMA Pediatr*. 2016;170(6):570–576
33. Bratzler DW, Ma A, Nsa W. Surgical care improvement project adherence and postoperative infections. *JAMA*. 2010; 304(15):1670; author reply 1671–1672
34. Gerber JS, Kronman MP, Ross RK, et al. Identifying targets for antimicrobial stewardship in children's hospitals. *Infect Control Hosp Epidemiol*. 2013; 34(12):1252–1258
35. Suda KJ, Hicks LA, Roberts RM, Hunkler RJ, Danziger LH. A national evaluation of antibiotic expenditures by healthcare setting in the United States, 2009. *J Antimicrob Chemother*. 2013;68(3): 715–718
36. Hersh AL, Shapiro DJ, Pavia AT, Shah SS. Antibiotic prescribing in ambulatory pediatrics in the United States. *Pediatrics*. 2011;128(6):1053–1061
37. Fleming-Dutra KE, Hersh AL, Shapiro DJ, et al. Prevalence of inappropriate antibiotic prescriptions among US ambulatory care visits, 2010-2011. *JAMA*. 2016;315(17):1864–1873
38. Feazel LM, Malhotra A, Perencevich EN, Kaboli P, Diekema DJ, Schweizer ML. Effect of antibiotic stewardship programmes on *Clostridium difficile* incidence: a systematic review and meta-analysis. *J Antimicrob Chemother*. 2014;69(7):1748–1754
39. McDonagh M, Peterson K, Winthrop K, Cantor A, Holzhammer B, Buckley DI. *Improving Antibiotic Prescribing for Uncomplicated Acute Respiratory Tract Infections*. Rockville, MD: Agency for Healthcare Research and Quality (US); 2016
40. Drekonja DM, Filice GA, Greer N, et al. Antimicrobial stewardship in outpatient settings: a systematic review. *Infect Control Hosp Epidemiol*. 2015;36(2): 142–152
41. Mangione-Smith R, Zhou C, Robinson JD, Taylor JA, Elliott MN, Heritage J. Communication practices and antibiotic use for acute respiratory tract infections in children. *Ann Fam Med*. 2015;13(3):221–227
42. Meeker D, Knight TK, Friedberg MW, et al. Nudging guideline-concordant antibiotic prescribing: a randomized clinical trial. *JAMA Intern Med*. 2014; 174(3):425–431
43. Meeker D, Linder JA, Fox CR, et al. Effect of behavioral interventions on inappropriate antibiotic prescribing among primary care practices: a randomized clinical trial. *JAMA*. 2016; 315(6):562–570
44. Gerber JS, Prasad PA, Russell Localio A, et al. Variation in antibiotic prescribing across a pediatric primary care network. *J Pediatric Infect Dis Soc*. 2015;4(4):297–304
45. Gerber JS, Ross RK, Bryan M, et al. Association of broad- vs narrow-spectrum antibiotics with treatment failure, adverse events, and quality of life in children with acute respiratory tract infections. *JAMA*. 2017;318(23): 2325–2336
46. Spellberg B, Rice LB. Duration of antibiotic therapy: shorter is better. *Ann Intern Med*. 2019;171(3):210–211
47. Hersh AL, Olson J, Stockmann C, et al. Impact of antimicrobial stewardship for pediatric outpatient parenteral antibiotic therapy. *J Pediatric Infect Dis Soc*. 2018;7(2):e34–e36
48. Olson J, Thorell EA, Hersh AL. Evaluation of discharge antibiotic prescribing at a freestanding children's hospital: opportunities for stewardship. *J Pediatric Infect Dis Soc*. 2019;8(6): 563–566
49. Ruebner R, Keren R, Coffin S, Chu J, Horn D, Zaoutis TE. Complications of central venous catheters used for the treatment of acute hematogenous osteomyelitis. *Pediatrics*. 2006;117(4): 1210–1215
50. Kovacich A, Tamma PD, Advani S, et al. Peripherally inserted central venous catheter complications in children receiving outpatient parenteral antibiotic therapy (OPAT). *Infect Control Hosp Epidemiol*. 2016;37(4):420–424
51. Norris AH, Shrestha NK, Allison GM, et al. 2018 Infectious Diseases Society of America clinical practice guideline for the management of outpatient parenteral antimicrobial therapy. *Clin Infect Dis*. 2019;68(1):e1–e35
52. Agwu AL, Lee CK, Jain SK, et al. A World Wide Web-based antimicrobial stewardship program improves efficiency, communication, and user satisfaction and reduces cost in a tertiary care pediatric medical center. *Clin Infect Dis*. 2008;47(6): 747–753
53. Sick AC, Lehmann CU, Tamma PD, Lee CK, Agwu AL. Sustained savings from a longitudinal cost analysis of an internet-based preapproval antimicrobial stewardship program. *Infect Control Hosp Epidemiol*. 2013; 34(6):573–580
54. Newland JG, Stach LM, De Lurgio SA, et al. Impact of a prospective-audit-with-feedback antimicrobial stewardship program at a children's hospital. *J Pediatric Infect Dis Soc*. 2012;1(3):179–186
55. Chan S, Hossain J, Di Pentima MC. Implications and impact of prior authorization policy on vancomycin use at a tertiary pediatric teaching hospital. *Pediatr Infect Dis J*. 2015;34(5):506–508
56. Hersh AL, De Lurgio SA, Thurm C, et al. Antimicrobial stewardship programs in freestanding children's hospitals. *Pediatrics*. 2015;135(1):33–39
57. Di Pentima MC, Chan S, Hossain J. Benefits of a pediatric antimicrobial stewardship program at a children's hospital. *Pediatrics*. 2011;128(6): 1062–1070

58. Smith MJ, Gerber JS, Hersh AL. Inpatient Antimicrobial stewardship in pediatrics: a systematic review. *J Pediatric Infect Dis Soc*. 2015;4(4): e127–e135

59. Ibrahim OM, Polk RE. Antimicrobial use metrics and benchmarking to improve stewardship outcomes: methodology, opportunities, and challenges. *Infect Dis Clin North Am*. 2014;28(2):195–214

60. Moehring RW, Dodds Ashley ES, Ren X, et al.; Centers for Disease Control and Prevention Epicenters Program. Denominator matters in estimating antimicrobial use: a comparison of days present and patient days. *Infect Control Hosp Epidemiol*. 2018;39(5): 612–615

61. Metjian TA, Prasad PA, Kogon A, Coffin SE, Zaoutis TE. Evaluation of an antimicrobial stewardship program at a pediatric teaching hospital. *Pediatr Infect Dis J*. 2008;27(2):106–111

62. Aldeyab MA, Kearney MP, Scott MG, et al. An evaluation of the impact of antibiotic stewardship on reducing the use of high-risk antibiotics and its effect on the incidence of *Clostridium difficile* infection in hospital settings. *J Antimicrob Chemother*. 2012;67(12): 2988–2996

63. Valiquette L, Cossette B, Garant MP, Diab H, Pépin J. Impact of a reduction in the use of high-risk antibiotics on the course of an epidemic of *Clostridium difficile*-associated disease caused by the hypervirulent NAP1/027 strain. *Clin Infect Dis*. 2007;45(suppl 2):S112–S121

64. Wenisch JM, Equiluz-Bruck S, Fudel M, et al. Decreasing *Clostridium difficile* infections by an antimicrobial stewardship program that reduces moxifloxacin use. *Antimicrob Agents Chemother*. 2014;58(9):5079–5083

65. Di Pentima MC, Chan S. Impact of antimicrobial stewardship program on vancomycin use in a pediatric teaching hospital. *Pediatr Infect Dis J*. 2010;29(8): 707–711

66. Toltzis P, Yamashita T, Vilt L, et al. Antibiotic restriction does not alter endemic colonization with resistant gram-negative rods in a pediatric intensive care unit. *Crit Care Med*. 1998; 26(11):1893–1899

67. Toltzis P, Dul MJ, Hoyen C, et al. The effect of antibiotic rotation on colonization with antibiotic-resistant bacilli in a neonatal intensive care unit. *Pediatrics*. 2002;110(4):707–711

68. Cook PP, Gooch M. Long-term effects of an antimicrobial stewardship programme at a tertiary-care teaching hospital. *Int J Antimicrob Agents*. 2015; 45(3):262–267

69. Dancer SJ, Kirkpatrick P, Corcoran DS, Christison F, Farmer D, Robertson C. Approaching zero: temporal effects of a restrictive antibiotic policy on hospital-acquired *Clostridium difficile*, extended-spectrum β-lactamase-producing coliforms and meticillin-resistant *Staphylococcus aureus*. *Int J Antimicrob Agents*. 2013;41(2): 137–142

70. Taggart LR, Leung E, Muller MP, Matukas LM, Daneman N. Differential outcome of an antimicrobial stewardship audit and feedback program in two intensive care units: a controlled interrupted time series study. *BMC Infect Dis*. 2015;15:480

71. Lee BR, Goldman JL, Yu D, et al. Clinical impact of an antibiotic stewardship program at a children's hospital. *Infect Dis Ther*. 2017;6(1):103–113

Biologics for Asthma and Allergic Skin Diseases in Children

- *Clinical Report*

CLINICAL REPORT Guidance for the Clinician in Rendering Pediatric Care

American Academy of Pediatrics
DEDICATED TO THE HEALTH OF ALL CHILDREN™

Biologics for Asthma and Allergic Skin Diseases in Children

Heather Hoch De Keyser, MD, MSCS, FAAP,[a] Bradley Chipps, MD, FAAP,[b] Chitra Dinakar, MD, FAAP,[c,d]
SECTION ON ALLERGY AND IMMUNOLOGY and SECTION ON PEDIATRIC PULMONOLOGY AND SLEEP MEDICINE

An estimated 7 million children in the United States have asthma, which causes a significant health care burden and affects quality of life. The minority of these children have asthma that does not respond to Global Initiative for Asthma steps 4 and 5 care, and biological medications are recommended at this level in the 2019 Global Initiative for Asthma recommendations. In addition, biologics have been introduced into the care of children with allergic skin diseases. Omalizumab and mepolizumab are approved for children as young as 6 years, and benralizumab and dupilumab are approved for people aged ≥12 years. Reslizumab is approved only for people aged ≥18 years. These monoclonal antibodies may be added for appropriate patients when asthma or allergic skin diseases are not well controlled. Pediatricians and pediatric subspecialists should work together and be aware of the benefits and risks of these medications for their patients, as well as the practical implications of providing these options for their patients. This clinical report serves as an evaluation of the current literature on these types of medications in the treatment of children with asthma and allergic skin disease.

ASTHMA

Asthma may not be controlled in 38% of affected children, and biological medications may be prescribed if appropriate, other pharmacologic treatment, treatment of comorbidities, and verification of medication adherence does not lead to an acceptable level of control.[1] The minority of these children have asthma that does not respond to Global Initiative for Asthma (GINA) steps 4 and 5 care, and biological medications are recommended at this level in the 2019 GINA recommendations.[2] It is important to first confirm the diagnosis of asthma and to verify adherence to and appropriate technique for using an inhaler before embarking on biological therapy. Limited numbers of clinical trials include children, resulting in minimal current information on biological use in the pediatric population. The exception is the oldest biological therapy, omalizumab,

abstract

[a]Department of Pediatrics, Section of Pediatric Pulmonary and Sleep Medicine, School of Medicine, University of Colorado Anschutz, Breathing Institute at Children's Hospital Colorado, Denver, Colorado; [b]Capital Allergy & Respiratory Disease Center, Sacramento, California; [c]Department of Pediatrics, School of Medicine, Stanford University, Stanford, California; [d]Deceased

Drs De Keyser, Chipps, and Dinakar were equally responsible for conceptualizing, writing, and revising the manuscript and considering input from all reviewers and the board of directors; and all authors approved the final manuscript as submitted.

DOI: https://doi.org/10.1542/peds.2021-054270

Address correspondence to Heather Hoch De Keyser, MD, MSCS. E-mail: heather.dekeyser@childrenscolorado.org

PEDIATRICS (ISSN Numbers: Print, 0031-4005; Online, 1098-4275).

To cite: De Keyser HH, Chipps B, Dinakar C, et al; AAP section on allergy and immunology and section on pediatric pulmonology and sleep medicine. *Pediatrics*. 2021;148(5): e2021054270

which has a more significant amount of data on use in children. Increasing numbers and types of biological therapies have become available to this population, however, and the niche for each product will be better defined as its role in asthma care evolves. Pediatricians and pediatric subspecialists should be aware of the current range of biological medications available to children with severe asthma. In addition, general pediatricians should monitor patients for evidence of poor response to traditional therapies and consider referring to pediatric subspecialists for evaluation of eligibility for these types of medications. Finally, those who administer this type of care for children with asthma should be aware of the potential for anaphylaxis for many biologics, especially omalizumab and reslizumab, and be prepared to treat and evaluate anaphylaxis and other potential treatment-related adverse effects. The American Academy of Pediatrics policy statement "Preparation for Emergencies in the Offices of Pediatricians and Pediatric Primary Care Providers" is a helpful reference in the preparation for such emergencies.[3] The purpose of this clinical report is to review the available literature for these types of medications in children.

ASTHMA MEDICATIONS

Anti–Immunoglobulin E Therapy

Omalizumab was approved by the US Food and Drug Administration (FDA) in 2003. It is a subcutaneously administered humanized anti–immunoglobulin E (IgE) antibody that is licensed for the treatment of patients aged >6 years with moderate to severe asthma who have a positive skin test result to a perennial allergen and whose IgE is between 30 and 1300 IU for people aged 6 to 12 years and between 30 and 700 IU for those aged ≥12 years.[1,4,5]

In 2001, Milgrom et al evaluated children aged 6 to 12 years with moderate to severe asthma in a double-blind, randomized, placebo-controlled trial.[6] The participants had asthma that was well controlled for 3 months by using inhaled corticosteroids (ICSs) (168–420 μg beclomethasone equivalent) and had a forced expiratory volume in the first second of expiration (FEV_1) of greater than 60% predicted. The primary outcome was ICS reduction. After 28 weeks of omalizumab therapy, the ICS dose was reduced, as tolerated, and the percentage of patients in whom ICS reduction occurred was 100% with omalizumab versus 66.7% of the placebo group patients. Fewer participants had asthma exacerbations during the steroid reduction phase in the omalizumab group versus placebo (18.2% versus 38.5%). The proportion of the participants who had ICS completely withdrawn in the omalizumab group was 55% and in the placebo group was 39%. Withdrawal of ICS did not compromise asthma control. Physician-rated global evaluation of treatment effectiveness was excellent or good in the omalizumab group at 44% and 32.7% in the placebo group.

Lanier et al conducted a 52-week trial in participants aged 6 to 12 years with moderate to severe, persistent asthma that was uncontrolled on greater than 200 μg of fluticasone or equivalent and who had a history of severe exacerbation within the previous 2 years of therapy.[7] Participants were randomly assigned 2:1 to receive omalizumab or placebo, and there was a 24-week, fixed inhaled-steroid phase followed by a 28-week, adjustable ICS steroid phase. From the baseline period to week 24 (fixed phase), there was a 31% reduction in exacerbations (defined as worsening of symptoms requiring doubling of baseline ICS dose and/or systemic steroids) in the omalizumab group versus placebo and a 43% reduction in exacerbations over the entire study time frame (52 weeks) with omalizumab versus placebo. The global evaluation of treatment effectiveness was also rated excellent or good by 79% in the omalizumab group and 56% in the placebo group.

Third and fourth studies were conducted by the Inner-City Asthma Consortium.[8,9] In these studies, researchers enrolled, predominantly, children from low-income families and people of color. The first of these included participants 6 to 20 years of age with persistent allergic asthma for greater than 1 year, at least 1 positive skin-prick test result for perennial allergens, weight between 20 and 150 kg, and serum IgE concentration 30 to 1300 IU/mL, per the omalizumab-insert dosing table.[8] Participants were randomly assigned to receive omalizumab or placebo, in addition to standard care during a 60-week treatment period. The mean age was approximately 11 years. The percentage of children with one or more exacerbation during the study period was 48.8% with placebo and 30.3% in the omalizumab group. In addition, seasonal analysis of exacerbations revealed that omalizumab reduced the spring and fall spikes in asthma exacerbations. The mean ICS dose in the omalizumab group was 663 μg per day versus 771 μg per day in the placebo group. This study underscored the efficacy of omalizumab in children from low-income families and people of color.

In a companion study, researchers enrolled participants aged 6 to 17 years who met package-insert criteria for omalizumab and who had uncontrolled asthma, defined as an ICS dose of greater than 200 μg

of fluticasone a day and more than 1 exacerbation in the last year.[9] Those receiving 500 μg twice a day of fluticasone or equivalent (treatment step 5 from the National Asthma Education and Prevention Program Expert Panel Report) were randomly assigned 3:1 to receive omalizumab or placebo, and participants receiving less than 500 μg per day of fluticasone or equivalent were randomly assigned 3:3:1 to receive omalizumab plus inhaled placebo, ICS boost plus injected placebo, or guideline-based care with injected placebo and inhaled placebo. The 90-day treatment period commenced 4 to 6 weeks before the start of the school year. There was a reduction in fall exacerbations with omalizumab, with 11.3% of participants in the omalizumab group having exacerbations, compared with 21% in the placebo group. The effect was even higher in those with more than 1 exacerbation during the run-in phase; the fall exacerbation rate was 6.4% for omalizumab and 36.3% for those in all placebo groups.

In a French, real-world study, researchers enrolled participants aged 6 to 18 years with severe allergic asthma who were partially or poorly controlled by GINA guidelines with a mean ICS dose of 703 μg fluticasone equivalent per day[10] and evaluated outcomes at baseline and after initiation of omalizumab add-on treatment. In week 52 versus baseline, control improved to good control (by GINA guidelines) in 67% of participants. Exacerbations were reduced by 72% and hospitalizations were reduced by 89% in the first year of therapy. FEV_1 increased by 4.9%, and there was a 30% reduction in mean ICS dose.

Omalizumab is indicated for allergic asthma and currently approved for people as young as 6 years. Injection dosing is based on IgE concentration and body weight, with injections administered either every 2 or every 4 weeks.[5] The cost is substantial. According to the 2018 Institute for Clinical and Economic Review report on biological therapies for asthma, the per-unit manufacturer net price of omalizumab is $802.64, with per-patient costs varying significantly depending on the dosage needed as well as provider and payer, with an average net adult cost per year of $28 895.[11] In addition, anaphylaxis is a risk with this medication; the patient should be under medical observation for anaphylaxis after every injection,[5] and epinephrine autoinjectors should be prescribed for use at home in the case of delayed anaphylaxis.[12] Safety outcomes were primarily studied in patients older than 12 years but have shown an incidence of postmarketing anaphylactic reactions of 0.2% in treated patients,[13,14] leading to a black box warning on anaphylaxis.[15] Initial pooled data from phase I through III clinical trials revealed a numeric imbalance in the number of malignancies in patients treated with omalizumab versus placebo; however, in further pooled analysis of 67 phase I through IV clinical trials, including 4254 patients who received omalizumab treatment, researchers found no significant association between malignancy and omalizumab treatment in the overall group, although specific conclusions in the pediatric subgroup were not possible because of small sample size.[16] The FDA recognizes the following most common adverse events for omalizumab for asthma: "[adults and adolescents >12 years] arthralgia, pain (general), leg pain, fatigue, dizziness, fracture, arm pain, pruritus, dermatitis, and earache; [pediatric patients 6 to <12 years of age] nasopharyngitis, headache, pyrexia, upper abdominal pain, pharyngitis streptococcal, otitis media, viral gastroenteritis, arthropod bites, and epistaxis." In addition, the FDA cautions not to use omalizumab for acute asthma symptoms, not to abruptly discontinue corticosteroids, and to monitor for signs of serum sickness, eosinophilia, vasculitic rashes, worsening pulmonary symptoms, cardiac complications, or neuropathy.[5]

Omalizumab has been shown to generate improved asthma control, reduce incidence and frequency of exacerbations, reduce health care use for severe exacerbations, have corticosteroid-sparing effects, and ultimately result in improved quality of life for qualifying patients with moderate and severe persistent asthma.

Anti–Interleukin 5 Therapy

Interleukin 5 (IL-5) is a cytokine involved in eosinophil activation, which makes it a key target for therapeutic intervention in eosinophil-driven diseases, including asthma. There have been multiple anti–IL-5 antibodies under development in recent years. The therapeutics described have been studied in populations of people with asthma as young as 6 years, although importantly, data on children have not been reported separately.

Mepolizumab

Mepolizumab is a fully humanized anti–IL-5 antibody, currently approved in the United States for the add-on maintenance treatment of severe asthma.[17] Mepolizumab binds to IL-5, blocking its interaction with the IL-5 receptor on the surface of eosinophils, obstructing its actions at that level.[18] The best response is observed in patients with eosinophil concentrations >300 cells/μL.

The first key study to evaluate the efficacy of mepolizumab was the DREAM study (Dose Ranging

Efficacy And Safety With Mepolizumab in Severe Asthma), a multicenter, randomized, placebo-controlled trial.[19] In this trial, researchers enrolled 621 participants with a history of recurrent severe asthma exacerbations and signs of eosinophilic inflammation. Although children aged 12 to 17 years were eligible for enrollment, demographics suggest that no pediatric participants were enrolled.[20] The investigators found the rate of clinically significant exacerbations was significantly reduced in the mepolizumab groups (2.40 per participant per year in the placebo group, 1.24 per participant per year in the low-dose mepolizumab group [75 mg, intravenous (IV)], 1.46 in the medium-dose group [250 mg, IV], and 1.15 in the high-dose group [750 mg, IV]). All mepolizumab-treated groups also had reduced circulating blood eosinophils and sputum eosinophils. One post hoc analysis of the DREAM trial data also showed that treatment response was unaffected by season or atopy.[21]

After the DREAM trial, there were 2 additional studies in which researchers evaluated the efficacy of mepolizumab in adults and adolescents. The Mepolizumab as Adjunctive Therapy in Patients with Severe Asthma (MENSA) study, in which researchers enrolled 576 participants aged 12 to 82 years (only 25 patients in age range 12–17 years[22]), revealed a 47% reduction in exacerbation rates in those receiving IV mepolizumab and a 53% reduction in those receiving subcutaneous injections.[23] In addition, there was a reduction in exacerbations necessitating an emergency department visit or hospitalization (32% in the IV mepolizumab group and 61% in the subcutaneous mepolizumab group). There was an increase in FEV_1 in both mepolizumab-treated groups, as well as improvements in markers of asthma control.

In the Steroid Reduction with Mepolizumab Study (SIRIUS) study, researchers sought to evaluate the steroid-sparing effect of mepolizumab in people with severe eosinophilic asthma (enrolling 135 participants, 16–74 years of age) and found a 50% reduction in steroids from baseline in the treatment group, with no reduction in the placebo group.[24] Along with the reduction in steroid dosing, there was a reduction in exacerbations in the mepolizumab group by 32%, and a reduction in asthma symptoms. Importantly, the SIRIUS study did not report the number of pediatric participants; however, the mean age of both the placebo and mepolizumab groups was 50 years. Both the SIRIUS and MENSA studies revealed no significant safety concerns with mepolizumab.

Secondary data analyses were conducted on the MENSA and SIRIUS trials. In one such analysis, researchers evaluated mepolizumab in subjects who had previously received omalizumab therapy. In MENSA, mepolizumab reduced exacerbations by 57% and 47% in those who had and who had not previously received omalizumab, respectively.[25] The SIRIUS trial showed reduced oral corticosteroid (OCS) rates regardless of previous omalizumab use.[25] In addition, both studies showed that asthma control and quality of life were improved regardless of omalizumab use. A secondary analysis of the DREAM and MENSA studies revealed a "close relationship between baseline blood eosinophil levels and clinical efficacy of mepolizumab," with efficacy highest in those with eosinophil concentrations of at least 150 cells/μL, with one pooled analysis showing treatment-associated exacerbation rate reductions increasing from a 26% rate reduction in those with $<$150 eosinophils/μL to a 70% rate reduction in those with $>$500 eosinophils/μL.[26] The efficacy and safety of mepolizumab in children aged 6 to 11 years have been extrapolated from the adult and adolescent trials, as well as a clinical trial (NCT no. 02377427) that showed that a dose of 40 mg, subcutaneously, every 4 weeks showed similar drug-exposure levels in children aged 6 to 11 years as the 100-mg dose used in adults and adolescents.[22]

Safety evaluations of mepolizumab have raised no significant safety concerns,[19,23,24] although long-term evaluations are ongoing. The FDA recognizes "headache, injection site reaction, back pain, and fatigue" as the most common adverse reactions, and it warns to monitor for hypersensitivity reactions, herpes zoster (consider varicella immunizations before treatment), not to use mepolizumab for the treatment of acute bronchospasm, to use caution when reducing steroids during treatment, and to treat any existing helminthic infections before therapy and monitor for further infections.[22] Mepolizumab is approved for the add-on maintenance of children and adults 6 years and older with severe asthma and an eosinophilic phenotype, but it should be noted that the most robust data are in adults.[22] The FDA-recommended dose is 100 mg, administrated subcutaneously, every 4 weeks for patients 12 years and older, and 40 mg every 4 weeks for patients aged 6 through 11 years.[22] Self-injection may be an option for patients 12 years and older.[22]

Reslizumab

Reslizumab is another anti–IL-5 agent for use in severe asthma that binds to circulating IL-5 and

downregulates the IL-5 signaling pathway.[27] In one phase III trial in 315 participants aged 12 to 75 years (15 participants aged 12–17 years), it was found to improve lung function, asthma control scores measured by the Asthma Control Questionnaire, and quality of life scores measured by the Asthma Quality of Life Questionnaire.[27] Pooled data from 2 phase III trials of reslizumab showed a reduction in asthma exacerbations compared with placebo (rate ratios 0.5 and 0.41)[28]; however, in the small group of adolescents aged 12 to 18 years studied ($N = 25$), the exacerbation rate was higher with reslizumab than with placebo.[29] Therefore, reslizumab is not currently approved for use in children younger than 18 years, and further study would be required before considering this as a treatment option in this age group. Reslizumab is dosed as an IV infusion, 3 mg/kg every 4 weeks.[29] The FDA recognizes oropharyngeal pain as the most common adverse effect,[29] although there is an anaphylaxis risk of approximately 0.3%, prompting a black box warning from the FDA and the recommendation for in-office infusions and close monitoring.[15] In addition, the FDA warns that malignancies have been seen in clinical studies, that corticosteroids should not be abruptly discontinued and should not be used for acute bronchospasm, and that patients with helminthic infections should be treated and monitored for further infection during therapy.[29]

Benralizumab

Benralizumab is the third of the anti–IL-5 monoclonal antibodies and induces a nearly complete reduction in eosinophil concentration by binding to the α chain of the IL-5 receptor on eosinophils and possibly inducing destruction by natural killer cells.[30] The first large clinical trial in which researchers evaluated benralizumab was the CALIMA study.[30] Enrolled participants were 12 to 75 years of age (total $n = 728$, with 55 participants aged 12–18 years) with severe asthma. It was found that in patients with eosinophil concentrations >300 cells/μL, benralizumab significantly reduced asthma exacerbation rate ratios relative to placebo (by 36% and 28% in the every 4-week and every 8-week dosing groups, respectively) and was well tolerated.

Similarly, in the SIROCCO study, researchers evaluated 1204 participants 12 to 75 years of age with severe asthma (53 participants aged 12–18 years) and found that in patients with eosinophil concentrations >300 cells/μL, benralizumab reduced the annual asthma exacerbation rate over 48 weeks when given every 4 or 8 weeks (by 45% and 51%, respectively) and increased prebronchodilator FEV_1 (106 mL and 159 mL, respectively).[31] The most common adverse events were worsening of asthma and nasopharyngitis and were similar between treatment groups.

Benralizumab is approved in the United States for the add-on maintenance treatment of participants with severe asthma aged 12 years and older with an eosinophilic phenotype, although long-term and pediatric-specific safety data are still needed. The FDA recognizes headache and pharyngitis as the most common adverse reactions,[32] although hypersensitivity reactions such as anaphylaxis, angioedema, and urticaria occurred in about 3% of patients.[15] The FDA warns that it should not be used for an acute exacerbation, and that providers should not abruptly stop corticosteroids and should treat preexisting helminthic infections and monitor for such infections during therapy.[32] Benralizumab is dosed as a subcutaneous injection, 30 mg every 4 weeks for the first 3 doses, followed by once every 8 weeks thereafter, but it should be noted that the most robust data are in adults.[32]

Anti–Interleukin 4 Therapies

Dupilumab

Dupilumab is an interleukin 4 (IL-4) receptor α antagonist that was recently approved in treatment of people 12 years and older who have moderate to severe asthma as add-on therapy to maintenance therapy, specifically in patients who have eosinophilic phenotype or who are OCS dependent.[33] In one key study, 210 patients with severe oral glucocorticoid-dependent asthma older than 12 years were randomly assigned to receive dupilumab or placebo.[34] Adolescent data were not reported separately; however, the average age of all participants was 51.3 years. The dupilumab group experienced a 70.1% reduction in glucocorticoid dose (compared with a 41.9% reduction in the placebo group). Despite these reductions in oral steroids, the dupilumab group had a significantly lower severe exacerbation rate (59% lower than placebo). In another recently published study, researchers enrolled 1902 people 12 years or older with uncontrolled asthma and showed an annualized exacerbation rate that was 47.7% lower with dupilumab than with placebo, and this was accompanied by a 320-mL increase in FEV_1.[35] Of note, adolescent data were not reported separately; however, the average age of study participants was 47.9 years. In participants with eosinophil concentrations >300 cells/μL, the annualized exacerbation rate was reduced even further: 65.8% lower than placebo. Injection site reactions and hypereosinophilia were more common in the dupilumab study

groups,[34,35] although long-term and pediatric-specific safety data are still needed. The FDA recognizes injection site reactions, oropharyngeal pain, and eosinophilia as the most common adverse reactions in asthma treatment,[33] although hypersensitivity reactions have been described in 0.1% to 1%, usually generalized urticaria.[15] In addition, the FDA warnings for dupilumab include not to abruptly stop corticosteroids and to treat preexisting helminthic infections and monitor for infections during treatment, to monitor for eosinophilic conditions (especially vasculitic rash, worsening pulmonary symptoms, and neuropathy), and not to use it for acute bronchospasm.[33] For asthma, the dose is 400 mg, subcutaneously, as a loading dose and then 200 mg, every 2 weeks. For OCS-dependent patients or patients with coexisting atopic dermatitis, 600 mg is the loading dose and then 300 mg every 2 weeks, and dupilumab may be self-injected.[33]

SUMMARY: BIOLOGICS IN PEDIATRIC ASTHMA

There are multiple biologics available to treat moderate to severe persistent asthma in children and adults (Table 1). Omalizumab is approved for patients 6 years and older with sensitization to at least 1 perennial allergen and serum IgE concentration between 30 and 1300 IU for patients aged 6 to 12 years and between 30 and 700 IU for those 12 years and older. Health care providers now have 18 years of experience with omalizumab. With regard to anti–IL-5 drugs, there are data for mepolizumab and benralizumab in people aged 12 to 17 years, and both drugs work indirectly on eosinophils through blocking the receptor-ligand union. These drugs are particularly helpful in participants with an eosinophilic phenotype (peripheral blood absolute eosinophil count >150 cells/μL) and are particularly helpful when the absolute eosinophil count is >300 cells/μL. These drugs are under study for the treatment of eosinophilic esophagitis, nasal polyps, and sinus disease. Dupilumab may be effective by decreasing exacerbations and improving pulmonary function tests. Dupilumab has also been approved for the treatment of chronic rhinosinusitis with nasal polyposis in adults.[33] The final answer for which biological is indicated for each individual participant type will evolve as researchers develop more information in the pediatric age range. In addition, identification of useful biomarkers and surrogate end points for use in children to predict treatment response is needed.

URTICARIA

Chronic spontaneous urticaria (chronic idiopathic urticaria) and chronic inducible urticaria (physical urticaria, such as dermatographism, or cold and/or heat-induced urticaria) are diagnosed when itchy urticarial wheals are present for more than 6 weeks.[36,37] Although more common in adults than children, chronic urticaria can be important in this age group, with a prevalence estimated at between 0.1% and 0.3% of children.[38] Chronic inducible urticaria has a specific trigger that can be identified, as opposed to chronic spontaneous urticaria, in which symptoms occur at irregular intervals. There can be multiple triggers of both syndromes. These diagnoses may lead to recalcitrant symptoms that significantly affect quality of life. Standard treatment includes second-generation, nonsedating antihistamines at up to 2 times the standard dose. Omalizumab has been shown to be effective in this disease, with response rates in all comers ranging from 52% to 90%.[39] One systematic review of 43 studies found a strong body of evidence for the efficacy of omalizumab in adults and children with treatment-refractory, chronic inducible urticaria, although they did note that there were nonresponders.[37] The adverse effect profile was similar to that observed in asthma studies. More data are needed in the treatment of children, but omalizumab appears to be a promising treatment strategy for chronic spontaneous urticaria. Omalizumab is FDA approved for chronic idiopathic urticaria in people 12 years or older who are symptomatic despite H1 antihistamine treatment.[5] When used for urticaria, omalizumab is dosed at 150 to 300 mg, subcutaneously, every 4 weeks; dosing is not based on serum IgE concentration or body weight.[25] The FDA recognizes "nausea, nasopharyngitis, sinusitis, upper respiratory tract infection, viral upper respiratory tract infection, arthralgia, headache, and cough" as the most common adverse events in the treatment of urticaria with omalizumab.[5] The other biologics previously discussed for treatment of asthma may show some promise for the treatment of chronic urticaria; however, they are still in the early stages of evaluation for efficacy[39] and have not yet been approved for use for this indication in children.

ATOPIC DERMATITIS

Atopic dermatitis is a common comorbidity in children that affects approximately 10% of the US population,[40] with onset usually before 5 years of age and with significant deleterious effects on quality of life.[41] The anti–IL-4 receptor antagonist, dupilumab, has shown promise in the treatment of atopic dermatitis in children 6 years or older. Landmark adult studies have included the SOLO1 (671 patients, 25–51 years of age) and SOLO2 (708 patients, 25–46 years of age) trials, conducted in adults 18

TABLE 1 Summary of the Biologics Currently Approved for the Treatment of Moderate to Severe Persistent Asthma With Type 2 High Phenotype

Therapy	Mechanism of Action	Indication	Dosing and Route	Adverse Effects
Omalizumab	Anti–IgE; prevents IgE from binding to its receptor on mast cells and basophils	People aged ≥6 years with moderate to severe persistent asthma, positive allergy testing, incomplete control with an ICS, and IgE 30-1300 IU/mL (United States, age 6–11 y), 30–700 IU/mL (United States, age ≥12 years), or 30–1500 IU/mL (European Union)	0.016 mg/kg per IU of IgE (in a 4-wk period) administered every 2–4 weeks subcutaneously (150–375 mg in United States; 150–600 mg in European Union)[a]	Black box warning: ∼0.1%–0.2% risk of anaphylaxis in clinical trials
Mepolizumab	Anti–IL-5; binds to IL-5 ligand; and prevents IL-5 from binding to its receptor	People aged ≥12 years with severe eosinophilic asthma unresponsive to other GINA steps 4–5 therapies. Suggested AEC ≥150–300 cells/μl	100 mg subcutaneously every 4 weeks	Rarely causes hypersensitivity reactions; can cause activation of zoster
Reslizumab	Anti–IL-5; binds to IL-5 ligand; and prevents IL-5 from binding to its receptor	People aged ≥18 years with severe eosinophilic asthma unresponsive to other GINA steps 4–5 therapies. Suggested AEC ≥400 cells/μl	Weight-based dosing of 3 mg /kg IV every 4 weeks	Black box warning: ∼0.3% risk of anaphylaxis in clinical trials
Benralizumab	Anti–IL-5; binds to IL-5 receptor α; and causes apoptosis of eosinophils and basophils	People aged ≥12 years with severe eosinophilic asthma unresponsive to other GINA steps 4–5 therapies. Suggested AEC ≥300 cells/μl	30 mg subcutaneously every 4 weeks for 3 doses; followed by every 8 weeks subsequently	Rarely causes hypersensitivity reactions
Dupilumab	Anti–IL-4R; binds to IL-4 receptor α; and blocks signaling of IL-4 and IL-13	People aged ≥12 years with severe eosinophilic asthma unresponsive to other GINA steps 4–5 therapies. Suggested AEC ≥150 cells/μl and/or FeNO level ≥25 ppb	200 or 300 mg subcutaneously every 2 weeks	Rarely causes hypersensitivity reactions; higher incidence of injection site reactions (up to 18%) and hypereosinophilia (4% to 14%)

Reprinted with permission from the American Thoracic Society. The American Journal of Respiratory and Critical Care Medicine is an official journal of the American Thoracic Society.[44] AEC, absolute blood eosinophil count; FeNO, fractional exhaled nitric oxide; IL-13, interleukin 13.
[a]Upper limits exist for the dosing of omalizumab in patients with high IgE levels and increased weight.

years or older, which showed that over the 16-week study period, dupilumab improved scores on the Investigator's Global Assessment and Eczema Area and Severity Index and improved markers including pruritis and quality of life measures.[42] A phase IIa study with phase III open-label extension in adolescents revealed efficacy with regards to Eczema Area and Severity Index improvement over the study period.[43] Adverse effects in this study included nasopharyngitis and worsening of atopic dermatitis.[43] Overall, the safety and efficacy is similar in adolescent and adult patients,[33] although long-term safety data collection is ongoing. The FDA recognizes "injection site reactions, conjunctivitis, blepharitis, oral herpes, keratitis, eye pruritus, other herpes simplex virus infection, and dry eye" as the most common adverse reactions, and it cautions that patients should alert providers of worsening eye symptoms concerning for conjunctivitis and keratitis.[33] Dupilumab for atopic dermatitis is dosed by body weight in adolescents, with patients weighing <60 kg receiving a 400-mg initial dose and 200-mg doses every other week, and patients weighing ≥60 kg receiving a 600-mg initial dose and 300-mg doses every other week; self-injection may be considered for some patients.[33] Other emerging biological therapies in atopic dermatitis include interleukin 12 and interleukin 23 inhibitors ustekinumab, interleukin 13 inhibitors lebrikizumab and tralokinumab, interleukin 22 inhibitor fezakinumab, and oral Janus kinas inhibitor baricicitinib, as well as

TABLE 2 Key Recommendations

Key Recommendations for General Pediatricians	Key Recommendations for Pediatric Subspecialists
Evaluate adherence to medications in patients with poorly controlled atopic diseases, such as asthma, urticaria, and atopic dermatitis.	Evaluate adherence to medications in patients with poorly controlled atopic diseases, such as asthma, urticaria, and atopic dermatitis.
Refer to a pediatric subspecialist (allergist, dermatologist, or pulmonologist) for determination of whether a patient is an appropriate candidate for biological therapy, as well as for determination of which therapy best fits the patient's phenotype.	Partner with general pediatricians to identify appropriate patients for biological therapy.
Be familiar with adverse effects of biological therapy, particularly the risk of anaphylaxis with omalizumab, benralizumab, dupilumab, and reslizumab (if ever approved in the pediatric population).	Monitor for adverse effects that are particular to the particular therapy.
The home administration is approved for dupilumab, mepolizumab, and omalizumab. Further opportunities for home administration are likely in the future.	Monitor for clinical improvement in symptoms with therapy.
	Continue to work to identify new biomarkers and means to identify candidates for therapy, as well as monitor response to therapy

phosphodiesterase type 4 inhibitors, interleukin 17 inhibitors, thymic stromal lymphopoietin inhibitors, and neurokinin-1 inhibitors.[41]

CONCLUSIONS

Asthma and atopic skin conditions can be difficult to treat and lead to significant morbidity and child and family stress. Pediatricians are faced with a widening array of targeted therapies; however, the question of what therapy to choose for which patient remains an area of continued study. In many studies in biological therapies for asthma and other allergic diseases, researchers have focused on the adult population; however, drugs are becoming more and more readily available for pediatrics. In ongoing studies, researchers should focus on appropriate biomarkers (including IgE and circulating eosinophils, as well as further biomarkers yet to be determined), as well as other patient-focused factors to allow the choice of the right biological for the right patient and at the right time. In addition, further study is needed regarding the use of novel methods of administration and monitoring in resource-limited settings, such as rural areas where access to specialty care may be limited, because these medications are currently prescribed in subspecialty offices. Home administration may be possible for some biological medications (dupilumab and mepolizumab); however, assessment of the appropriate patients for such therapy, as well as monitoring adherence in these patients, will be of key importance. One of the key questions that pediatricians and pediatric subspecialists are faced with remains when to start biological therapy for continued poor asthma control versus continued focus on appropriate medication adherence. In this situation, referral to a pediatric asthma specialist may be warranted to determine when to start biological therapy and which therapy to initiate. In addition, all pediatricians should be aware of the real possibility of anaphylaxis to certain biological medications, especially omalizumab and reslizumab, although others may also have hypersensitivity reactions,[15] and be prepared to respond appropriately and immediately. Continued research is required to evaluate long-term tolerability and safety of these medications in pediatric populations, although no evidence exists for aberrations in immune function. Pediatric subspecialists, including allergists, dermatologists, and pulmonologists, are necessary and key partners in the determination of not only the appropriate children for this type of therapy but also the most appropriate therapy for each individual child. With collaboration, true personalization of medical care for these complex patients can be achieved (Table 2).

Lead Authors

Heather Hoch De Keyser, MD, MSCS, FAAP
Bradley Chipps, MD, FAAP
Chitra Dinakar, MD, FAAP

Section on Allergy and Immunology Executive Committee, 2019–2020

Julie Wang, MD, FAAP, Chairperson
Theresa Bingemann, MD, FAAP
John A. Bird, MD, FAAP
Carla McGuire Davis, MD, FAAP
Vivian Pilar Hernandez-Trujillo, MD, FAAP
Elizabeth C. Matsui, MD, FAAP, Immediate Past Chairperson
Jordan S. Orange, MD, PhD, FAAP
Michael Pistiner, MD, MMSc, FAAP

Liaisons

Todd A. Mahr, MD, FAAP – *American College of Allergy, Asthma, and Immunology*
Paul V. Williams, MD, FAAP – *American Academy of Allergy, Asthma, and Immunology*

ACKNOWLEDGMENT

We thank Dr Chitra Dinakar whose contributions to this manuscript, dedication to the American Academy of Pediatrics, and steadfast commitment to improving the health of children will serve as an eternal source of inspiration.

ABBREVIATIONS

FDA: US Food and Drug Administration
FEV_1: forced expiratory volume in the first second of expiration
GINA: Global Initiative for Asthma
ICS: inhaled corticosteroid
IgE: immunoglobulin E
IL-4: interleukin 4
IL-5: interleukin 5
IV: intravenous
MENSA: Mepolizumab as Adjunctive Therapy in Patients with Severe Asthma
OCS: oral corticosteroid
SIRIUS: Steroid Reduction with Mepolizumab Study

FINANCIAL DISCLOSURE: The authors have indicated they do not have a financial relationship relevant to this article to disclose.

FUNDING: No external funding.

POTENTIAL CONFLICT OF INTEREST: Dr Chipps serves on speakers' bureaus for AstraZeneca, Boeringer Ingelhein, Novartis, Regeneron, and Sanofi Genzyme. He also serves as a consultant with GlaxoSmithKline. Dr De Keyser serves as a consultant with Astra Zeneca and received donated devices from Propeller Health/Resmed. Dr Dinikar has indicated she has no potential conflicts of interest to disclose.

REFERENCES

1. Chipps BE, Bacharier LB, Farrar JR, et al. The pediatric asthma yardstick: practical recommendations for a sustained step-up in asthma therapy for children with inadequately controlled asthma. *Ann Allergy Asthma Immunol*. 2018;120(6):559–579.e511
2. Global Initiative for Asthma. Global strategy for asthma management and prevention. 2019. Available at: https://ginasthma.org/wp-content/uploads/2019/06/GINA-2019-main-report-June-2019-wms.pdf. Accessed November 11, 2019
3. Frush K; American Academy of Pediatrics Committee on Pediatric Emergency Medicine. Preparation for emergencies in the offices of pediatricians and pediatric primary care providers. *Pediatrics*. 2007;120(1):200–212
4. Chipps BE, Lanier B, Milgrom H, et al. Omalizumab in children with uncontrolled allergic asthma: review of clinical trial and real-world experience. *J Allergy Clin Immunol*. 2017;139(5):1431–1444
5. US Food and Drug Administration. Xolair FDA prescribing information. 2016. Available at: https://www.accessdata.fda.gov/drugsatfda_docs/label/2016/103976s5225lbl.pdf. Accessed October 21, 2019
6. Milgrom H, Berger W, Nayak A, et al. Treatment of childhood asthma with anti-immunoglobulin E antibody (omalizumab). *Pediatrics*. 2001;108(2):E36
7. Lanier B, Bridges T, Kulus M, Taylor AF, Berhane I, Vidaurre CF. Omalizumab for the treatment of exacerbations in children with inadequately controlled allergic (IgE-mediated) asthma. *J Allergy Clin Immunol*. 2009;124(6):1210–1216
8. Busse WW, Morgan WJ, Gergen PJ, et al. Randomized trial of omalizumab (anti-IgE) for asthma in inner-city children. *N Engl J Med*. 2011;364(11):1005–1015
9. Teach SJ, Gill MA, Togias A, et al. Preseasonal treatment with either omalizumab or an inhaled corticosteroid boost to prevent fall asthma exacerbations. *J Allergy Clin Immunol*. 2015;136(6):1476–1485
10. Deschildre A, Marguet C, Salleron J, et al. Add-on omalizumab in children with severe allergic asthma: a 1-year real

life survey. *Eur Respir J.* 2013; 42(5):1224–1233

11. Institute for Clinical and Economic Review. Biologic therapies for treatment of asthma associated with type 2 inflammation: effectiveness, value, and value-based price benchmarks: final evidence report. 2018. Available at: https://icer-review.org/material/asthma-final-evidence-report/. Accessed October 21, 2019
12. Cox L, Lieberman P, Wallace D, et al. American Academy of Allergy, Asthma & Immunology/American College of Allergy, Asthma & Immunology Omalizumab-Associated Anaphylaxis Joint Task Force follow-up report. *J Allergy Clin Immunol.* 2011;128(1):210–212
13. Adachi M, Kozawa M, Yoshisue H, et al. Real-world safety and efficacy of omalizumab in patients with severe allergic asthma: a long-term post-marketing study in Japan. *Respir Med.* 2018;141:56–63
14. Corren J, Casale TB, Lanier B, Buhl R, Holgate S, Jimenez P. Safety and tolerability of omalizumab. *Clin Exp Allergy.* 2009;39(6):788–797
15. Jackson K, Bahna SL. Hypersensitivity and adverse reactions to biologics for asthma and allergic diseases. *Expert Rev Clin Immunol.* 2020;16(3):311–319
16. Busse W, Buhl R, Fernandez Vidaurre C, et al. Omalizumab and the risk of malignancy: results from a pooled analysis. *J Allergy Clin Immunol.* 2012;129(4):983–9.e6
17. Keating GM. Mepolizumab: first global approval. *Drugs.* 2015;75(18):2163–2169
18. Smith DA, Minthorn EA, Beerahee M. Pharmacokinetics and pharmacodynamics of mepolizumab, an anti-interleukin-5 monoclonal antibody. *Clin Pharmacokinet.* 2011;50(4): 215–227
19. Pavord ID, Korn S, Howarth P, et al. Mepolizumab for severe eosinophilic asthma (DREAM): a multicentre, double-blind, placebo-controlled trial. *Lancet.* 2012;380(9842):651–659
20. Robinson PD, Van Asperen P. Newer treatments in the management of pediatric asthma. *Paediatr Drugs.* 2013;15(4):291–302
21. Ortega H, Chupp G, Bardin P, et al. The role of mepolizumab in atopic and non-atopic severe asthma with persistent eosinophilia. *Eur Respir J.* 2014;44(1):239–241
22. US Food and Drug Administration. Nucala FDA prescribing information. Available at: https://www.accessdata.fda.gov/drugsatfda_docs/label/2019/125526s012,761122s002s003lbl.pdf. Accessed March 2, 2020
23. Ortega HG, Liu MC, Pavord ID, et al; MENSA Investigators. Mepolizumab treatment in patients with severe eosinophilic asthma. *N Engl J Med.* 2014;371(13):1198–1207
24. Bel EH, Wenzel SE, Thompson PJ, et al; SIRIUS Investigators. Oral glucocorticoid-sparing effect of mepolizumab in eosinophilic asthma. *N Engl J Med.* 2014;371(13):1189–1197
25. Magnan A, Bourdin A, Prazma CM, et al. Treatment response with mepolizumab in severe eosinophilic asthma patients with previous omalizumab treatment. *Allergy.* 2016;71(9):1335–1344
26. Ortega HG, Yancey SW, Mayer B, et al. Severe eosinophilic asthma treated with mepolizumab stratified by baseline eosinophil thresholds: a secondary analysis of the DREAM and MENSA studies. *Lancet Respir Med.* 2016;4(7):549–556
27. Bjermer L, Lemiere C, Maspero J, Weiss S, Zangrilli J, Germinaro M. Reslizumab for inadequately controlled asthma with elevated blood eosinophil levels: a randomized phase 3 Study. *Chest.* 2016;150(4):789–798
28. Castro M, Zangrilli J, Wechsler ME, et al. Reslizumab for inadequately controlled asthma with elevated blood eosinophil counts: results from two multicentre, parallel, double-blind, randomised, placebo-controlled, phase 3 trials. *Lancet Respir Med.* 2015;3(5):355–366
29. US Food and Drug Administration. Cinqair FDA prescribing information. Available at: https://www.accessdata.fda.gov/drugsatfda_docs/label/2016/761033lbl.pdf. Accessed August 6, 2018
30. FitzGerald JM, Bleecker ER, Nair P, et al; CALIMA study investigators. Benralizumab, an anti-interleukin-5 receptor α monoclonal antibody, as add-on treatment for patients with severe, uncontrolled, eosinophilic asthma (CALIMA): a randomised, double-blind, placebo-controlled phase 3 trial. *Lancet.* 2016;388(10056):2128–2141
31. Bleecker ER, FitzGerald JM, Chanez P, et al; SIROCCO study investigators. Efficacy and safety of benralizumab for patients with severe asthma uncontrolled with high-dosage inhaled corticosteroids and long-acting β_2-agonists (SIROCCO): a randomised, multicentre, placebo-controlled phase 3 trial. *Lancet.* 2016;388(10056):2115–2127
32. US Food and Drug Administration. Fasenra FDA prescribing information. Available at: https://www.accessdata.fda.gov/drugsatfda_docs/label/2017/761070s000lbl.pdf. Accessed August 6, 2018
33. US Food and Drug Administration. Dupixent FDA prescribing information. Available at: https://www.accessdata.fda.gov/drugsatfda_docs/label/2019/761055s014lbl.pdf. Accessed March 2, 2020
34. Rabe KF, Nair P, Brusselle G, et al. Efficacy and safety of dupilumab in glucocorticoid-dependent severe asthma. *N Engl J Med.* 2018;378(26):2475–2485
35. Castro M, Corren J, Pavord ID, et al. Dupilumab efficacy and safety in moderate-to-severe uncontrolled asthma. *N Engl J Med.* 2018;378(26):2486–2496
36. Ghaffari J, Shahmohammadi S, Ashrafi H, Ranjbar AR, Ghaffari N. Omalizumab (Xolair) in children above 12 years with chronic urticaria: a review of literature. *Journal of Pediatrics Review.* 2015;3(1)
37. Maurer M, Metz M, Brehler R, et al. Omalizumab treatment in patients with chronic inducible urticaria: A systematic review of published evidence. *J Allergy Clin Immunol.* 2018;141(2):638–649
38. Church MK, Weller K, Stock P, Maurer M. Chronic spontaneous urticaria in children: itching for insight. *Pediatr Allergy Immunol.* 2011;22(1 Pt 1):1–8
39. Kocatürk E, Zuberbier T. New biologics in the treatment of urticaria. *Curr Opin Allergy Clin Immunol.* 2018;18(5):425–431
40. Shaw TE, Currie GP, Koudelka CW, Simpson EL. Eczema prevalence in the United States: data from the 2003 National Survey of Children's Health. *J Invest Dermatol.* 2011;131(1):67–73

41. Yang EJ, Sekhon S, Sanchez IM, Beck KM, Bhutani T. Recent developments in atopic dermatitis. *Pediatrics*. 2018;142(4):e20181102

42. Simpson EL, Bieber T, Guttman-Yassky E, et al; SOLO 1 and SOLO 2 Investigators. Two phase 3 trials of dupilumab versus placebo in atopic dermatitis. *N Engl J Med*. 2016; 375(24):2335–2348

43. Cork MJ, Thaci D, Eichenfield LF, et al. Dupilumab in adolescents with uncontrolled moderate-to-severe atopic dermatitis: results from a phase IIa open-label trial and subsequent phase III open-label extension. *Br J Dermatol*. 2020;182(1):85–96

44. McGregor MC, Krings JG, Nair P, Castro M. Role of biologics in asthma. *Am J Respir Crit Care Med*. 2019;199(4): 433–445

Care of Adolescent Parents and Their Children

- *Clinical Report*

CLINICAL REPORT Guidance for the Clinician in Rendering Pediatric Care

American Academy of Pediatrics
DEDICATED TO THE HEALTH OF ALL CHILDREN®

Care of Adolescent Parents and Their Children

Makia E. Powers, MD, MPH, FAAP,[a] Jennifer Takagishi, MD, FAAP,[b] COMMITTEE ON ADOLESCENCE, COUNCIL ON EARLY CHILDHOOD

Teen pregnancy and parenting remain important public health issues in the United States and around the world. A significant proportion of teen parents reside with their families of origin, which may positively or negatively affect the family structure. Teen parents, defined as those 15 to 19 years of age, are at high risk for repeat births. Pediatricians can play an important role in the care of adolescent parents and their children. This clinical report updates a previous report on the care of adolescent parents and their children and addresses clinical management specific to this population, including updates on breastfeeding, prenatal management, and adjustments to parenthood. Challenges unique to teen parents and their children are reviewed, along with suggestions for the pediatrician on models for intervention and care.

INTRODUCTION

Adolescent parents and their children represent populations at increased risk for medical, psychological, developmental, and social problems. Pediatricians can play an integral role as the primary care provider for both adolescent parents and their children. This clinical report updates an American Academy of Pediatrics (AAP) clinical report published in 2012.[1] Although the most recent birth rate data from 2017 indicate historically low birth rates for 15- to 19-year-old adolescents and young women in the United States, the rate remains higher than in many other resource-abundant countries.[2–5]

BACKGROUND INFORMATION

Epidemiology

Birth rates among adolescents and young women 15 to 19 years of age have declined overall and for each race and ethnicity group in 2017, the year of the most recent available data.[3,4] Overall teen birth rates were 18.8 per 1000 live births and have declined 51% since 2007 and 67% since 1991, with the greatest decline among 15- to 17-year-olds.[5] American Indian or Alaskan native teenagers had the highest birth rates (32.9 per

[a]*Children's Healthcare of Atlanta and Morehouse School of Medicine, Atlanta, Georgia; and* [b]*Department of Pediatrics, University of South Florida, Tampa, Florida*

Both authors wrote all sections, reviewed all drafts, provided edits of all drafts, and approved the final manuscript as submitted.

The guidance in this report does not indicate an exclusive course of treatment or serve as a standard of medical care. Variations, taking into account individual circumstances, may be appropriate.

All clinical reports from the American Academy of Pediatrics automatically expire 5 years after publication unless reaffirmed, revised, or retired at or before that time.

DOI: https://doi.org/10.1542/peds.2021-050919

Address correspondence to Makia Powers, MD. Email: makiapowers@gmail.com

PEDIATRICS (ISSN Numbers: Print, 0031-4005; Online, 1098-4275).

FINANCIAL DISCLOSURE: The authors have indicated they have no financial relationships relevant to this article to disclose.

FUNDING: No external funding.

To cite: Powers ME, Takagishi J, AAP COMMITTEE ON ADOLESCENCE, AAP COUNCIL ON EARLY CHILDHOOD. Care of Adolescent Parents and Their Children. *Pediatrics*. 2021; 147(5):e2021050919

1000), followed by Hispanic (28.9 per 1000), Black (27.5 per 1000), and white teenagers (13.2 per 1000).[4] Repeat birth rates in teen mothers have also declined from 20% in 2004 to 17% in 2016.[6] This decline is likely attributable to the increase in sexual education and/or increased contraception use among this population over the past 20 years.[7] Despite the perceptions that teen mothers have high preterm birth rates (10.3%), the highest rates of preterm births occur in women 40 years and older (14.6%). However, among teen births, mothers younger than 17 years are at increased risk of preterm delivery, of delivering low birth weight infants, and of neonatal mortality, compared with older teen mothers.[8,9]

The Pediatrician's Role

Pediatricians can shape the health of adolescent parents and their children because they are optimally trained to provide comprehensive care for infants, children, and adolescents and they understand the importance of creating a medical home for all patients, including the adolescent parent. The adolescent parent may first present to the pediatrician or adolescent specialist to seek a pregnancy test and options counseling. The AAP policy statement on options counseling provides more detailed recommendations for best practices when discussing positive pregnancy test results with newly pregnant teenagers.[10] Once the adolescent decides to continue with a pregnancy, the pediatrician can advise the pregnant adolescent to start prenatal care from an obstetrician, family physician, or other qualified health care provider.[11] It is also optimal for the pregnant adolescent to resume routine pediatric or adolescent care and initiate the care of her future child with the pediatrician with whom she has built a long-lasting relationship.

The pediatrician can play an important role in assessing the social supports of adolescent parents and linking them to proper resources, including transportation, medical insurance, housing, and accessible food.[12] It is also important for the pediatrician to understand the legal rights adolescent parents have regarding decisions for their children. Some states do not allow adolescent parents to make decisions for their children. Pediatricians can research online through the Guttmacher Institute to determine what their state's laws mandate (https://www.guttmacher.org/state-policy/explore/minors-rights-parents). Pediatricians may provide information concerning community-based options for social supports to adolescent parents, including school-based programs, community programs, and home visitation programs. There is an association between prenatal and early childhood home visitation programs and reductions in the number of subsequent pregnancies, use of governmental assistance, child abuse and neglect, and criminal behavior in adolescent mothers.[13,14] Beginning prenatally, home visitation programs can reduce risk of serious antisocial behavior and substance use by children born to adolescents during the first 15 years of life.[13,14] The Nurse-Family Partnership is an evidence-based program that pairs young first-time mothers with trained nurses beginning in early pregnancy and continuing through the child's second birthday. It is available in many communities (nursefamilypartnership.org) and is one of many community programs that can aid young mothers. Programs such as Head Start and Early Head Start are designed to address the needs of both low-income parents and children.[15] Some health insurance companies offer coordination services during prenatal care, and the provider can encourage pregnant teenagers to access these support services. Lastly, pediatricians are encouraged to begin early discussions regarding the teen parent's plan to continue and complete her education after giving birth as well as birth control options to prevent rapid repeat pregnancies.

Perceptions of Adolescent Parents

Pervasive negative stereotypes of both adolescent mothers and fathers persist, with society often viewing adolescent mothers as irresponsible, sexually promiscuous, and ambivalent about their future educational and career goals and adolescent fathers as absent from their children's lives and ambivalent toward their children.[16] Although much of the literature is focused on the negative aspects, teen fathers' involvement in the lives of teen mothers and their children can have beneficial effects, such as improved self-esteem of the mothers, decreased maternal postpartum depression, and decreased infant distress in the newborn period, in addition to positive effects on fathers.[17,18] In cases in which the pregnancy may be a result of coercion or rape, the pediatrician can identify supportive parents or partners during the prenatal and postpartum periods. In other cases, the teenager may have chosen to become a parent because they live in cultures in which it is normative behavior to have children between 16 and 18 years old. Despite the negative perceptions that may persist regarding adolescent parents, it is important to highlight positive aspects and solutions.

Adolescent parenthood can present itself in different ways, such as an adolescent mother with her female partner, an adolescent mother with the father of the infant, an adolescent mother with a male partner who is not the biological father, an adolescent mother with maternal or paternal grandparents, or the adolescent alone. It is important to acknowledge that not all people who will become pregnant identify as

female (such as transgender men) and not all people who contribute sperm that lead to pregnancy identify as men (such as transgender women). In addition, not all adolescent parents are heterosexual, and pregnancies can occur as the result of sexual contact that is consensual, coerced, related to sex work, or in the context of sexual assault. To date, however, the majority of the literature has been focused on adolescent parents who are cisgender and in heterosexual relationships. Although it is critical to continue to explore the varying landscape of adolescent parenthood, for simplicity throughout this report, the term "adolescent mother" is used to describe a young person who experienced a pregnancy and chose to parent a child, and the term "adolescent father" is used to describe a young person who has contributed to a pregnancy as a result of heterosexual sexual contact. Additionally, "partner" will be used to refer to a male or female partner of the adolescent mother. Because this clinical report aims to provide pediatricians with concrete management guidance for the care of the adolescent parent, it is important to dispute these negative stereotypes, concentrate on the positive influences that can aid in decreasing repeat teen pregnancy, and promote healthy behaviors, social supports, and longitudinal educational and career goals to improve adolescent parents' lives.

MEDICAL MANAGEMENT OF THE ADOLESCENT PARENT AND CHILD

Prenatal Management

Once the pediatrician diagnoses a pregnancy, it is important to provide a timely referral to prenatal care, ideally occurring within the first trimester. There are obstetric providers who have expertise in adolescent pregnancy and in using a medical home model. Timely entry into prenatal care can help reduce medical complications of teen pregnancy. As the mother approaches the end of the third trimester, the obstetric provider can stress the importance of the postpartum visit and give anticipatory guidance on health insurance options for the mother and infant. The teenager can then be referred back to her primary medical home after the pregnancy (whether this is back to her pediatrician or an adult or family provider). Some health care payers may provide patient navigators to assist the mother in care coordination.

Medical complications associated with adolescent pregnancy include poor maternal weight gain, anemia, and pregnancy-induced hypertension, and these complications are greatest for the youngest adolescents.[19] Poverty, lower educational level, and inadequate family support can contribute to a lack of adequate prenatal care, which may account for most negative health outcomes for both the adolescent mother and her child, including anemia, preeclampsia, poor nutrition, preterm birth, and low birth weight.[20]

The Prenatal Visit: Meet the Pediatrician

It is optimal for the pregnant teenager, the partner, and a trusted family member to schedule a prenatal visit with the pediatrician during the last trimester. The AAP *Bright Futures: Guidelines for Health Supervision of Infants, Children, and Adolescents,* Fourth Edition, outlines the goals of this visit to include assessing family resources, community resources, and parental well-being and discussing breastfeeding decisions.[12] The AAP prenatal visit policy statement advocates that pediatricians meet with mothers during their third trimester to establish and/or reestablish care.[21] The adolescent mother may not have seen her pediatrician while she was receiving prenatal care; thus, it is important for her to reconnect with her pediatrician and establish care for herself and her infant. This policy statement discusses the importance of this visit, especially for first-time parents, single parents, and/or women with high-risk pregnancies.[21] Intent to breastfeed may drive breastfeeding initiation[22] and allow for time to attend classes and seek support. The prenatal visit is also an opportunity to meet extended family members who may be assisting in the care of the child. The pediatrician can determine the need for resources, such as child care, transportation, financial support, housing, and food. Additional support systems, including the involvement of the partner and other family members who may be assisting (ie, maternal or paternal grandparents), are important in the care of both the adolescent parents and the child.[12,21] Although this visit is ideal, we acknowledge that there may be potential barriers to scheduling these visits (ie, time constraints, insurance payment for the visit, etc). When possible, this visit can help transition the mother back to the pediatrician.

The Newborn Visit and Well-Baby Visits

The newborn and subsequent well-baby visits are opportunities for the pediatrician to evaluate the needs of the adolescent mother and other close caregivers.[21] *Bright Futures: Guidelines for Health Supervision of Infants, Children, and Adolescents,* Fourth Edition, recommends pediatricians address family readiness, home life of the newborn infant, and routine infant care.[12] In addition to obtaining a full prenatal history and neonatal course, the pediatrician may obtain a full social history, including maternal wellness, adjustment to new parenthood, and family resources.[12] During these visits, the grandparents may be present to provide support. It is important for the pediatrician to

reinforce that the teen parent is primarily responsible for the care of the infant. The adolescent mother can give explicit permission for the pediatrician to speak with the grandparents about the infant's health care. The pediatrician may use the "meet the pediatrician visit," newborn visit, and the subsequent well-baby visits to discuss contraceptive plans and safe sleep practices, perform psychological and/or depression screening, and ask about educational plans of the mother. Dual appointments for the adolescent parent and child may assist in time constraints to address all these issues.

"Teen-tot" clinics, in which the teenage parent or parents and their children are seen by the same provider at the same appointment, have successfully cared for these families in a patient-centered approach.[23,24] Brief parenting and/or life skills interventions coupled with these medical appointments improved maternal self-esteem and decreased repeat pregnancy during a 36-month trial study.[25]

Contraception Management

Approximately 17% of births to adolescents are repeat births.[5,26] There is a significant relationship between repeat adolescent births and decreased educational achievement, increased dependence on governmental support by the adolescent mother, increased infant mortality, and low birth weight.[27] In contrast to adult women experiencing a second pregnancy, adolescents with a repeat pregnancy tend to delay prenatal care.[28] A second adolescent birth may have negative effects on the teen mother and her offspring by compounding negative socioeconomic effects and the influence of a short interpregnancy interval. The American College of Obstetricians and Gynecologists recently published recommendations for interpregnancy care, including the following: interpregnancy intervals shorter than 6 months should be avoided; family-planning counseling should be encouraged during prenatal care visits, with conversations about interest in future childbearing; women at high risk (including adolescents) should be screened for sexually transmitted infections; and the mother should be counseled on safe sex practices.[29]

Research has revealed that provision of intrauterine devices (IUDs) and implants immediately postpartum is acceptable to teenagers and reduces rapid repeat pregnancies.[30] Long-acting reversible contraceptives (LARCs) can be placed immediately after delivery of the placenta (IUD) or before hospital discharge (implants).[30] Adolescent mothers who receive IUDs are more likely to continue this form of contraception, with low risk of expulsion.[30,31] In addition, there is a reduction in repeat pregnancy rates among adolescent mothers who receive immediate postpartum (labor or delivery unit) contraceptive implants compared with those who do not.[32] Any LARC implementation before 8 weeks' postpartum is associated with decreased repeat pregnancy rates within 2 years,[33] which demonstrates the importance of LARCs in the postpartum period in reducing short-interval repeat pregnancies. The AAP policy statements on contraception for adolescents and LARCs[34,35] recommend that pediatricians have a working knowledge of the various types of contraception and be able to counsel adolescent patients on all available methods, including implants and IUDs, which are the most effective reversible methods. After the obstetric postpartum visit, the adolescent mother can choose to return to the pediatrician for primary care. If she is not on a form of birth control at that time, the pediatrician can provide contraceptive counseling to determine the mother's preferred form of contraception. She can then be referred to an obstetrician or gynecologist or adolescent health care provider if the pediatrician is not comfortable with managing her contraception needs. Pediatricians, in conjunction with obstetric and gynecologic providers, can help improve LARC use by counseling adolescent mothers on the benefit of these contraceptive methods.

Breastfeeding by Adolescent Mothers

The AAP and Centers for Disease Control and Prevention recommend that mothers exclusively breastfeed their infants for the first 6 months of life, followed by continued breastfeeding, after introducing complementary foods, until the infant is 1 year old and beyond, as desired.[36,37] Adolescent mothers who lack social support and who are at a lower socioeconomic status are less likely to breastfeed compared with older mothers.[38] Adolescent mothers who are at a higher socioeconomic status and attend prenatal classes have higher rates of exclusive breastfeeding at the time of hospital discharge.[22] Preparation before birth and early breastfeeding support are crucial to successful breastfeeding among adolescent parents.[22] Studies have shown early maternal behaviors, such as skin-to-skin contact, are associated with positive breastfeeding decisions and initiation before hospital discharge.[39] Breastfeeding education extends the duration of breastfeeding for adolescent mothers.[40,41] Breastfeeding interventions, including school-based programs, home visits, and telephone support, demonstrate that combining education and lactation counseling yields improved breastfeeding initiation, duration, or exclusivity outcomes.[42,43] Professional and peer support programs have shown promise in increasing both initiation and duration of breastfeeding but can be resource intensive.[44] Regular use of a breast pump has also been shown to help continue exclusive

breastfeeding.[45] Policies for pumping, including appropriate space and break times at school and work, should be encouraged.

Breastfeeding cessation has been related to the lack of parental knowledge of breastfeeding and pain associated with breastfeeding, often a result of improper positioning and attachment to the breast.[45] The role of the adolescent mother's partner is important because partner involvement in the adolescent mother's life is associated with an increase in breastfeeding.[46] The pediatrician can inquire about challenges related to breastfeeding and provide supportive counseling to promote breastfeeding success.

Pediatricians can encourage adolescent mothers to breastfeed their infants to improve bonding as well as the cognitive development of their children.

Adjustment to Motherhood

The transition to motherhood for adolescents can be difficult, and common themes and barriers arise in adolescent mothers of all ethnicities.[47–51] One common theme is coparenting, in which the maternal grandmother or another parent figure helps in the parenting of the child. Studies have shown the most prevalent coparenting, specifically with maternal grandmothers, can have positive effects on adolescent parenting efficacy, social competence, and academic achievement of children.[51] These results may be strongly influenced when the family of origin places high priority on positive family values.[47]

In addition to the adolescent mothers learning successful parenting techniques, such as strong communication and minimal coparenting conflict, it is important for providers to identify the adolescents' readiness for parenthood. Some adolescent mothers do not anticipate the new responsibilities, and this is reflected in their emotional readiness to parent.[50] There are screening tools to identify mothers at high risk for nonoptimal parenting and depressive symptoms, such as the Parenting Responsibility and Emotional Preparedness (PREP) screening tool.[50]

Adolescent mothers may also experience low self-esteem during pregnancy and may benefit from social supports to improve parenting efficacy.[52] The bodily changes of pregnancy may lead to poorer body image, which can lead to poor maternal attitudes and affect the ability to adjust to motherhood during pregnancy and after delivery.[48] Adolescent mothers can have difficulty accepting their pregnancy, leading them to avoid thinking about their motherhood role during pregnancy and to only intermittently incorporate thoughts of maternal identity during pregnancy.[50] Despite risk factors, teen mothers can demonstrate resilience and ability to manage their households without the risk of child maltreatment or other adverse effects on their children.[53] These findings underscore the importance of supportive families and pediatricians in helping adolescent mothers in their transition to parenthood and self-discovery of their identity as a parent.

Fatherhood

When discussing teen pregnancy, pediatricians may inadvertently overlook the role of the partner of the adolescent mother. Of all pregnancies to adolescent mothers, it is estimated that 18% to 35% of the pregnancies involve fathers younger than 20 years at the time of birth.[54] A long-standing gender bias related to male adolescents' perspectives on and attitudes toward pregnancy and pregnancy outcomes exists, as most of the research has been focused on female adolescents' perspectives of male adolescents' views. Little research specifically explores the male adolescent's views directly.[55]

Although much of the attention to adolescent parenting is focused on the mother, the adolescent father's or partner's involvement and commitment in the life of his child is important to the psychosocial development of the child.[56] The literature defines paternal involvement in terms of a father's engagement, accessibility to the child, and responsibility to the child, in other words, the amount of support from the father to his partner and child.[57]

A number of factors play a role in the father-child dynamic, including the nature of the romantic relationship with the adolescent mother during the pregnancy and after birth, paternal ability to provide and support the family, the father's level of education and socioeconomic status, the father's relationship with his family of origin, and the father's ethnic background, cultural values, and beliefs.[58] Evidence supports that fathers who remain in a romantic relationship with adolescent mothers are more involved with their children.[58] The fatherhood relationship between the male adolescent and his child or children is related to the type of relationship he had with his own father. Adolescent fathers who had high conflict with their own fathers are more likely to have signs and symptoms of depression and less engagement with their children.[59] It is important to encourage positive relationships between adolescent fathers and their children. Social workers, parenting classes, and formal parenting education can be great resources for the adolescent father.[60] Future research is needed on teen fatherhood because most of the literature on adolescent pregnancy and parenting includes only mothers. Furthermore, adolescent pregnancy prevention programs often target young girls.[61–63] The positive

contributions of adolescent fathers have not been well studied. It is important to understand the social and demographic context of adolescent fathers to provide comprehensive support for both parents.

Adolescent fathers are more likely to live in poverty, which often repeats from one generation to the next. Sons of adolescent fathers are more likely to become adolescent fathers compared with sons of older fathers.[64] In addition, substance use, early adolescent dating, school delinquency, and high physical-risk environment are significant predictors of becoming an adolescent father.[64] Research has shown that risky sexual behaviors, low educational attainment, and lack of birth control self-efficacy are associated with future fatherhood in male adolescents.[57] Young adult men who father children with adolescent mothers are also more likely to be impoverished and have lack of contraceptive knowledge.[65] It is important for adolescent fathers to be aware of contraception methods and engage in conversations with their partners to help decrease repeat pregnancies and the potential for further economic stress. Pediatricians can encourage adolescent fathers to play a central role in their children's lives. If adolescent fathers feel like their parenting role is peripheral or insignificant, they will likely not seek future advice or education around fatherhood topics.[66] Therefore, it is important for pediatricians to promote equal parenting with adolescent parents and provide community resources to assist in their developing role as parents.

Children of adolescent mothers who continue to have close ties with the child's biological father have better outcomes in employment and education, are less depressed, and are at lower risk of becoming adolescent parents themselves.[67] Fathers' engagement positively affects the psychosocial, cognitive, and behavioral outcomes of children, with evidence that cohabitation of the mother and father is associated with less externalizing behavioral problems in their children.[67] Adolescent or adult fathers who maintain active participation in the prenatal, neonatal, and immediate postpartum processes with adolescent mothers have a greater likelihood of ongoing involvement with their children.[68] Such interactions include playing with their children, giving them gifts, or feeding them but are less likely to involve diapering, bathing, and caring for the child alone. Conversely, adolescent fathers who exhibit depressive symptoms within the first year of the child's life are more likely to have depressive symptoms within the next 3 to 5 years and have lower paternal involvement.[69] Depressed fathers read to their children less frequently and are 4 times more likely to spank their children.[70] Parenting interventions can help teach such skills to adolescent fathers as well as to adolescent mothers. There are several successful adolescent parenting programs that are focused on fatherhood, but it is important for all adolescent parenting programs to engage the adolescent father in his journey of becoming a successful parent.[71]

Additional education should be focused on prevention of child abuse because risk factors for abuse include young parental age, low income, and mental health issues,[72] all of which can be observed in adolescent pregnancies. Because the alleged perpetrator of child abuse is male in the majority of cases,[73,74] this education should be aimed at including fathers.

Family Support and Management

Family factors associated with improved outcomes for the adolescent mother and her child include early child care provided by the infant's family of origin, which allows the adolescent mother to focus on positive outlooks during her journey through motherhood.[75] Adolescent mothers who experience positive health outcomes are more likely to have a positive outlook, set educational goals, and have strong social supports. It is also important for the adolescent mother to develop autonomy from her mother figure to fully adjust to her own motherhood journey.[76]

Management of Mental Health

Adolescent parents encounter multiple competing challenges, including transition to parenthood, complex living situations, and varying relationship dynamics between adolescent parents and the maternal and/or paternal grandparents.[77] A number of studies suggest that being a teen mother may be related to poorer mental health outcomes, such as mood disorders.[78] The Pregnancy Risk Assessment Monitoring System (PRAMS) reported approximately 12% of postpartum women of all ages self-reported depressive symptoms in 2012–2013.[79] Younger parental age (15–24 years) at the time of the birth of the child was associated with a higher risk of maternal depression.[79] In addition, 3% of fathers experienced postpartum depression within the first year.[80] Young fathers (15–24 years of age) with no previous history of mood disorders were more likely to experience depression compared with older fathers.[80] Parental stress during pregnancy and the postpartum period increases the risk of developing postpartum depression, and adolescent mothers with higher parenting stress and parent-child dysfunction scores have higher rates of depression.[81]

It is important for pediatricians to be aware of adolescent parents who have previous diagnoses of mental health disorders and refer them back to mental health care during the

postpartum period if they have been lost to follow-up. Research underscores the importance of detecting depression in parents, particularly younger parents, because parental depression is associated with adverse outcomes for children.[78–81] The AAP recommends integrating postpartum depression surveillance and screening at the prenatal pediatric visit and at the 1-, 2-, 4-, and 6-month well-baby visits.[21] Both the American College of Obstetricians and Gynecologists and the AAP recommend using a validated tool, but the AAP prioritizes the Edinburgh Postnatal Depression Screen (EPDS) or a 2-question screen, such as the Patient Health Questionnaire 2 (PHQ-2) or EPDS-2. Recent studies have shown the EPDS and its subscales (EPDS-7 and EPDS-2), are accurate screening tools for adolescent mothers.[21,82] Once an adolescent parent demonstrates symptoms of depression, the pediatrician can refer to or provide treatment. Prevention and treatment of postpartum depression are important in the management of adolescent parents; however, there are few studies that have shown consistent improvement in depressive symptoms.[83] Some studies have shown improvements in depressive symptoms with increased therapy use and use of a variety of care management models.[83] Further research in the area of prevention and treatment of perinatal depression in adolescent mothers is paramount for health care providers to better serve the mental health of this population.[84]

Pediatricians can also screen adolescent fathers or partners for depressive symptoms. The 2018 AAP clinical report "Incorporating Recognition and Management of Perinatal and Postpartum Depression Into Pediatric Practice" recommends screening the adolescent father or male partner at the 6-month well-baby visit with the EPDS or having the male partner fill out the screen at home and mail it back.[85] Pediatricians may find other useful mental health screening tools for primary care settings in the AAP's mental health screening and assessment tools for primary care grid (available at https://downloads.aap.org/AAP/PDF/Mental_Health_Tools_for_Pediatrics.pdf).

In addition to depression, stress exposures for both the adolescent mother and her partner may affect behavioral and health risks, such as substance use, and have implications for both the pregnant adolescent and her fetus. As with all adolescents, screening for substance use, brief intervention, and referral to treatment (SBIRT) will be even more critical for pregnant adolescents.[86,87] During the health visits, pediatricians can ascertain information about the history of substance use (including electronic cigarettes and similar devices) in the adolescent parent and any increased risk of child abuse.[10,12,88] The AAP has additional guidance regarding alcohol, tobacco, and marijuana use during pregnancy.[89–91] Pregnancy provides opportunities to assist both the mother and partner in reducing stress exposures and to support the pair to change or establish healthier behaviors.[92]

Intimate Partner Violence

The prevalence of intimate partner violence (IPV) specifically among teen mothers is 7%, compared with 2% in mothers older than 30 years.[93] Formal screening for IPV of adolescent parents during pregnancy and in the postpartum period is important. Violence during pregnancy is recognized as a serious public health concern, particularly for those of younger age (12–24 years). In the United States, approximately 27% of female and 11% of male individuals have experienced IPV during their lifetimes.[94] The National Intimate Partner and Sexual Violence Survey defines 5 types of IPV, including sexual violence, stalking, physical violence, psychological aggression, and control of reproductive and sexual health. IPV, which can include verbal abuse, assault by a partner or family member, being in a fight or being hurt, or witnessing violence, may increase during pregnancy, with 3% to 19% of pregnant women identified as victims of IPV.[95] Another form of IPV can be "contraceptive sabotage," in which a partner refuses to allow the female partner to use contraception for pregnancy prevention.[96] An adolescent mother's own exposure to violence as a child complicates and sometimes normalizes her view of IPV.[92] Specifically, there is a direct relationship between IPV and the adolescent mothers' childhood violence experiences.[97] Teen mothers may be reluctant to disclose IPV to their providers and may be more likely to stay with the abusive partner or father of the child so that the father can remain in the life of the child.[97] Children who witness IPV are more likely to experience child abuse or child mistreatment, especially children born to mothers younger than 21 years.[98,99] Pediatricians can use multiple screening tools to assess for IPV. Use of universal screening methods is suggested, preferably the use of self-administered surveys versus verbally administered assessment tools.[94] Examples of self-administered IPV surveys include the Woman Abuse Screening (WAST) Tool[100] and the Hurt, Insulted, Threatened, and Screamed (HITS) Tool.[101]

Social Determinants of Health

Newer research suggests that social determinants of health strongly influence teen pregnancy. The Centers for Disease Control and Prevention defines social determinants of health as "conditions in the places where people live, learn, work, and play that affect a wide range of health and quality-of life risks and outcomes."[102]

Poverty, a key social determinant of health, greatly affects teen mothers, fathers, and their children.[103] Within the first year of a child's life, 63% of teen mothers will receive public assistance benefits, and 52% of mothers who receive welfare will have had their first child in their teen years.[104] Poverty also influences rapid repeat pregnancies. Thus, it is ideal for prevention efforts to be expanded from the individual level to the community level, including the social, political, and economic environments in which teenagers live, work, and play. These efforts involve forging partnerships between health care programs and nontraditional groups, such as male mentorship programs and transportation services.[105] A broader focus on the communities where teenagers and their children live, rather than just a focus on individuals, may also assist in decreasing other social disadvantages for teenagers.[61]

For many teen parents and their children, poverty plays a key role in the difficult circumstances in which the children are raised. Therefore, focusing on a 2-generational approach to reducing poverty may improve outcomes for low-income families.[103] This strategy is aimed at helping both low-income children and their parents simultaneously through interventions such as job training for parents while their children attend high-quality child care programs[103] or addressing risk factors that increase the likelihood of daughters of teen mothers becoming pregnant,[62] which may decrease the continuation of this cycle. Other programs may be found at https://www.childwelfare.gov/topics/preventing/promoting/parenting/pregnant-teens/.

Other social determinants of health for adolescent mothers include high rates of residential mobility, decreased levels of financial support, and limited resources for child care support during the prenatal and postnatal periods.[63] Teen pregnancy is a high-risk period for homelessness as a result of parents kicking out the pregnant teenager or partner conflict or violence.[106] Pediatricians can inquire about housing status or safe shelter and refer the pregnant teenager to social and/or community supports if needed. Teenagers may self-report the need for financial support and job training in the early postpartum period but may have a relatively low use of community resources to meet their needs.[63] Further research is needed to determine potential barriers to adolescent parents receiving community resources.

Addressing Toxic Stressors

Adverse childhood experiences may increase lifelong risks for psychological and medical diseases, such as obesity, heart disease, diabetes, and suicidality.[107] To prevent the effects of childhood adversity, models that aim to address both adolescent parents and their children (ie, a 2-generational approach) can be used.[108] This approach includes increasing resources available to adolescent parents and their children, supporting workforce development, and raising awareness of adverse childhood experiences.[109] Directing resources toward schools and early childhood programs may help mitigate risk.[109] Identifying exposure to childhood adversity, focusing on parenting practices, and encouraging return to school may reduce the effects of adversity and promote healthy development.[109] Two types of programs have been shown to improve school completion: multiservice packages with academic and vocational support, case management, and child care provision and attendance-monitoring programs with financial support.[110]

Assessment of the effects of social disadvantage, such as housing insecurity, neighborhood violence, and racial discrimination, is important. Capitalizing on teen mothers' strengths and their families' strengths may facilitate intergenerational repair of the effects of childhood adversity on both the mother and the child.[111]

Median block income, low infant birth weight, maternal smoking, maternal childhood history of neglect, IPV perpetrated by either the mother or her partner, and maternal use of mental health services are associated with infant neglect.[112] Identifying high-risk families and intervening during the earliest months of life may prevent neglect and the subsequent effects on the child.[112] This intervention includes provision of counseling on effective, nonphysical discipline to decrease potential physical and emotional harm to the child.

Cognitive Development of Children Born to Teen Parents

Maternal support can directly affect the cognitive development of children. Children born to adolescent mothers who have low levels of emotional responsiveness and show no maternal support during playtime with their infants are at higher risk of having poorer cognitive and receptive language abilities compared with children born to adult mothers.[15] Conversely, higher levels of maternal support during infantile play may lead to greater gains in both cognitive and language abilities from infancy to age 3 years.[15] Greater resources within the family setting and lower levels of family conflict may enhance developmental gains over time.

Although children of adolescent mothers may have lower school readiness, there are modifiable factors related to higher school readiness, including maternal gains in education, maternal age of at least 18 years, lower rates of postpartum depressive symptoms, and receiving nonparental child care in infancy.[113] The following policy changes may

improve school readiness: Children should attend on-site child care centers with qualified staff while their mothers attend school, and targeted pregnancy prevention services should be provided for school-aged adolescents who have not yet attained a high school diploma.[113]

Despite studies showing concern for lowered IQ and long-term intellectual development of children of teen parents,[114] there are interventions that may improve cognitive development; specifically, interventions that were shorter in duration, conducted in smaller groups, or placed strong emphasis on the quality of parent-child interactions led to greater gains in cognitive achievement among the children.[115]

Social Development of Infants

Adverse social developmental outcomes of infants born to adolescent parents are associated with high levels of maternal depression and preterm birth.[116,117] Increased social support, including social work involvement, home visiting nursing programs, and early intervention programs, positively influences the development of infants of adolescent mothers.[117] Head Start and Early Head Start programs support early learning, including social and emotional health realms, physical health, and family well-being for low-income families.[118] Comprehensive follow-up and coordinated care services for extremely preterm infants and their adolescent mothers are important.[117] Other clinical interventions, such as those focused on coparenting relationships and conflict resolution skills between adolescent mothers and their partners, may improve the social-emotional development of children of teen mothers.[119]

Teen parents may not be prepared to handle a young child's social-emotional development, and studies suggest that teaching parents how to play with their children can improve children's vocabulary skills and emotional regulation.[120] Sit Down and Play[121] and Reach Out and Read[122] are interventions that pediatricians can integrate into their practices. Sit Down and Play teaches low-income families to make toys for their children and interact with their children in a positive fashion. Promotion of this program may involve partnerships with community resources, such as Parents as Teachers, to facilitate positive parenting behaviors through take-home play activities. The AAP clinical report on the importance of play[123] also provides advice for encouraging play for children at high risk. Reach Out and Read promotes child development through strengthened parent-child relationships, advises families on the importance of early literacy and modeling reading together, and provides a new book to children 6 months through 5 years of age during well-child visits.[122] Additional early literacy resources can be found at https://www.aap.org/en-us/literacy/Pages/Early-Literacy-Resources.aspx. Another method to encourage social-emotional development is teaching the 3 T's (tune in, take turns, and talk more) during well-child visits.[124]

Role of the Medical Community

The medical community consists of pediatricians who can have positive effects on teen parents and their children, particularly during the prenatal period. Obstetric providers care for the pregnant adolescent, and other support providers include doulas, who are lay prenatal, childbirth, and postnatal paraprofessionals. Doulas can provide emotional, physical, and social support and information during pregnancy, childbirth, and the postpartum period.[125]

The pediatrician can play an important role in mitigating some effects of teen pregnancy by encouraging early entry into prenatal care. If the adolescent mother chooses to return to her pediatrician for primary care after the postpartum obstetrical visit, the pediatrician's role can include social and financial supports, educational support, and contraception management in addition to routine adolescent care. The pediatrician may provide anticipatory guidance to strengthen a family's social supports, encouragement for a parent's adoption of positive parenting techniques, and facilitation of a child's emerging social, emotional, and language skills.[126] Resilience refers to the ability to overcome adversity built through positive experiences and learned coping skills. Primary prevention includes promoting the 7 C's of resilience: competence (knowing that you can handle a situation effectively), confidence (believing in your own abilities), connectedness (developing close ties to family and community), character (developing a solid set of morals and values to determine right from wrong and demonstrating a caring attitude toward others), contribution (realizing that the world is a better place because you are in it), coping (coping effectively with stress), and control (realizing that you can control the outcomes of your decisions).[127] The pediatrician can also link the family with supports to help promote optimism as well as encourage early learning via programs and provide information on community resources to promote emotional coaching and other positive parenting strategies.[128,129]

CONCLUSIONS

Teen parents and their children face multiple barriers to optimal development, including negative stereotypes, lack of resources, depression, poverty, lack of support, and lowered educational achievement. Pediatric health care

providers can positively influence the long-term health and lifelong trajectories for teen parents, including young fathers and mothers, and their children by creating a supportive and educational environment.

GUIDANCE FOR THE PEDIATRICIAN

1. Create a patient-centered medical home for adolescent parents and their children. Teen-tot clinics, in which both the adolescent parent or parents and their child complete appointments at the same visit, model this approach.
2. Involve partners and families in the newborn period and infancy, actively supporting their involvement in their children's care.
3. Provide a multidisciplinary and comprehensive approach to caring for parenting adolescents by using community resources, such as doulas, social services, and nurse home visitation programs.
4. Promote breastfeeding initiation and continuation among adolescent mothers by providing lactation resources and encouraging partners and maternal grandmothers to be supportive around breastfeeding.
5. Provide contraceptive counseling during the pre- and postnatal periods in partnership with obstetricians and in subsequent health supervision visits. Offer access to the full range of contraceptive services, including LARCs. Provide adolescent fathers with contraceptive counseling.
6. Use a validated screening tool for assessing postpartum depression in all adolescent parents and refer to mental health resources when indicated.
7. Screen for IPV and provide community resources to address positive responses from pregnant and parenting adolescents.
8. Emphasize the importance of completing high school and pursuing higher education or vocational training. Advocate for on-site child care in schools or training programs that can facilitate this goal.
9. Recognize all forms of parenting, including coparenting, and support the role of the adolescent father or partner.
10. Advocate for longitudinal, comprehensive solutions that are focused on primary prevention strategies to continue to decrease teen pregnancy rates. Push for funding of programs that support adolescent parents to reduce repeat pregnancies and optimize the health of both parent and child (ie, health care, food assistance, housing, and home visitation programs).
11. Promote low-cost activities with high yield in improving the social and cognitive development of young children, such as play and reading.
12. Recognize that social determinants of health, such as poverty and childhood adversity, contribute to health outcomes for adolescent parents and their children. Provide referrals to community resources to address these needs.
13. Become aware of programs in your community that support pregnant adolescents and adolescent parents.
14. Screen for substance use according to the screening, brief intervention, and referral to treatment (SBIRT) framework and refer to appropriate community resources.
15. Advocate for a 2-generational approach to improving outcomes for the dyad in areas such as poverty, education, and social-emotional development.
16. Coverage of, access to, and coordination of services among medical providers needs to be a priority for payers to assist pregnant and parenting adolescents.

LEAD AUTHORS

Makia E. Powers, MD, MPH, FAAP
Jennifer Takagishi, MD, FAAP

COMMITTEE ON ADOLESCENCE, 2019–2020

Elizabeth M. Alderman, MD, FSAHM, FAAP, Chairperson
Richard J. Chung, MD, FAAP
Laura K. Grubb, MD, MPH, FAAP
Janet Lee, MD, FAAP
Makia E. Powers, MD, MPH, FAAP
Krishna K. Upadhya, MD, FAAP
Stephenie B. Wallace, MD, FAAP

PAST COMMITTEE ON ADOLESCENCE MEMBER CONTRIBUTORS

Cora C. Breuner, MD, MPH, FAAP
Laurie L. Hornberger, MD, MPH, FAAP

LIAISONS

Anne-Marie Amies, MD – *American College of Obstetricians and Gynecologists*
Liwei L. Hua, MD, PhD – *American Academy of Child and Adolescent Psychiatry*
Seema Menon, MD – *North American Society of Pediatric and Adolescent Gynecology*
Maria H. Rahmandar, MD, FAAP – *Section on Adolescent Health*
Ellie Vyver, MD – *Canadian Paediatric Society*
Lauren B. Zapata, PhD, MSPH – *Centers for Disease Control and Prevention*

STAFF

Karen Smith
James Baumberger, MPP

COUNCIL ON EARLY CHILDHOOD EXECUTIVE COMMITTEE, 2019–2020

Sherri Louise Alderman, MD, MPH, IMH-E, FAAP, Chairperson
Jill M. Sells, MD, FAAP, Immediate Past Chairperson
Mariana Glusman, MD, FAAP
James P. Guevara, MD, FAAP
Andrew Nobuhide Hashikawa, MD, FAAP
Anna Miller-Fitzwater, MD, FAAP
Dipesh Navsaria, MD, MPH, MSLIS, FAAP
Bergen Ballard Nelson, MD, FAAP
Amy E. Shriver, MD, FAAP
Douglas Lee Vanderbilt, MD, FAAP

ABBREVIATIONS

AAP: American Academy of Pediatrics
EPDS: Edinburgh Postnatal Depression Screen
IPV: intimate partner violence
IUD: intrauterine device
LARC: long-acting reversible contraceptive

POTENTIAL CONFLICT OF INTEREST: The authors have indicated they have no potential conflicts of interest to disclose.

REFERENCES

1. Pinzon JL, Jones VF; Committee on Adolescence; Committee on Early Childhood. Care of adolescent parents and their children. *Pediatrics*. 2012; 130(6). Available at: www.pediatrics.org/cgi/content/full/130/6/e1743
2. Martinez G, Copen CE, Abma JC. Teenagers in the United States: sexual activity, contraceptive use, and childbearing, 2006-2010 National Survey of Family Growth. *Vital Health Stat 23*. 2011;(31):1–35
3. Martin JA, Hamilton BE, Osterman MJK. Births in the United States, 2017. *NCHS Data Brief*. 2018;(318):1–8
4. Martin JA, Hamilton BE, Osterman MJK, Driscoll AK, Drake P. Births: final data for 2017. *Natl Vital Stat Rep*. 2018; 67(8):1–50
5. Martin JA, Hamilton BE, Osterman MJK, Driscoll AK, Drake P. Births: final data for 2016. *Natl Vital Stat Rep*. 2018; 67(1):1–55
6. Dee DL, Pazol K, Cox S, et al. Trends in repeat births and use of postpartum contraception among teens - United States, 2004-2015. [published correction appears in *MMWR Morb Mortal Wkly Rep*. 2017;66(46):1282]. *MMWR Morb Mortal Wkly Rep*. 2017; 66(16):422–426
7. Kann L, McManus T, Harris WA, et al. Youth Risk Behavior Surveillance - United States, 2017. *MMWR Surveill Summ*. 2018;67(8):1–114
8. Neal S, Channon AA, Chintsanya J. The impact of young maternal age at birth on neonatal mortality: evidence from 45 low and middle income countries. *PLoS One*. 2018;13(5):e0195731
9. Chen XK, Wen SW, Fleming N, Demissie K, Rhoads GG, Walker M. Teenage pregnancy and adverse birth outcomes: a large population based retrospective cohort study. *Int J Epidemiol*. 2007;36(2):368–373
10. Hornberger LL; Committee on Adolescence. Options counseling for the pregnant adolescent patient. *Pediatrics*. 2017;140(3):e20172274
11. Leftwich HK, Alves MVO. Adolescent pregnancy. *Pediatr Clin North Am*. 2017; 64(2):381–388
12. Hagan JF Jr, Shaw JS, Duncan PM, eds. *Bright Futures: Guidelines for Health Supervision of Infants, Children, and Adolescents*. 4th ed. Elk Grove Village, IL: American Academy of Pediatrics; 2017
13. Kitzman HJ, Olds DL, Cole RE, et al. Enduring effects of prenatal and infancy home visiting by nurses on children: follow-up of a randomized trial among children at age 12 years. *Arch Pediatr Adolesc Med*. 2010;164(5): 412–418
14. Eckenrode J, Campa M, Luckey DW, et al. Long-term effects of prenatal and infancy nurse home visitation on the life course of youths: 19-year follow-up of a randomized trial. *Arch Pediatr Adolesc Med*. 2010;164(1):9–15
15. Rafferty Y, Griffin KW, Lodise M. Adolescent motherhood and developmental outcomes of children in early head start: the influence of maternal parenting behaviors, well-being, and risk factors within the family setting. *Am J Orthopsychiatry*. 2011; 81(2):228–245
16. Weed K, Nicholson JS. Differential social evaluation of pregnant teens, teen mothers and teen fathers by university students. *Int J Adolesc Youth*. 2015; 20(1):1–16
17. Angley M, Divney A, Magriples U, Kershaw T. Social support, family functioning and parenting competence in adolescent parents. *Matern Child Health J*. 2015;19(1):67–73
18. Riesch SK, Anderson LS, Pridham KA, Lutz KF, Becker PT. Furthering the understanding of parent-child relationships: a nursing scholarship review series. Part 5: parent-adolescent and teen parent-child relationships. *J Spec Pediatr Nurs*. 2010;15(3):182–201
19. Kawakita T, Wilson K, Grantz KL, Landy HJ, Huang CC, Gomez-Lobo V. Adverse maternal and neonatal outcomes in adolescent pregnancy. *J Pediatr Adolesc Gynecol*. 2016;29(2):130–136
20. Pinto e Silva JL, Surita FG. Pregnancy in adolescence - a challenge beyond public health policies. *Rev Bras Ginecol Obstet*. 2017;39(2):41–43
21. Yogman M, Lavin A, Cohen G; Committee on Psychosocial Aspects of Child and Family Health. The prenatal visit. *Pediatrics*. 2018;142(1):e20181218
22. Leclair E, Robert N, Sprague AE, Fleming N. Factors associated with breastfeeding initiation in adolescent pregnancies: a cohort study. *J Pediatr Adolesc Gynecol*. 2015;28(6):516–521

23. Furey A. Are support and parenting programmes of value for teenage parents? Who should provide them and what are the main goals? *Public Health*. 2004;118(4):262–267

24. Woods ER, Obeidallah-Davis D, Sherry MK, et al. The parenting project for teen mothers: the impact of a nurturing curriculum on adolescent parenting skills and life hassles. *Ambul Pediatr*. 2003;3(5):240–245

25. Cox JE, Harris SK, Conroy K, et al. A parenting and life skills intervention for teen mothers: a randomized controlled trial. *Pediatrics*. 2019;143(3):e20182303

26. Committee on Adolescent Health Care. Committee opinion no 699: adolescent pregnancy, contraception, and sexual activity. *Obstet Gynecol*. 2017;129(5): e142–e149

27. Santelli JS, Jacobson MS. Birth weight outcomes for repeat teenage pregnancy. *J Adolesc Health Care*. 1990; 11(3):240–247

28. Scholl TO, Hediger ML, Belsky DH. Prenatal care and maternal health during adolescent pregnancy: a review and meta-analysis. *J Adolesc Health*. 1994;15(6):444–456

29. American College of Obstetricians and Gynecologists; Society for Maternal-Fetal Medicine. Obstetric care consensus No. 8: interpregnancy care. *Obstet Gynecol*. 2019;133(1):e51–e72

30. Teal SB, Sheeder J. IUD use in adolescent mothers: retention, failure and reasons for discontinuation. *Contraception*. 2012;85(3):270–274

31. Jatlaoui TC, Whiteman MK, Jeng G, et al. Intrauterine device expulsion after postpartum placement: a systematic review and meta-analysis. *Obstet Gynecol*. 2018;132(4):895–905

32. Tocce KM, Sheeder JL, Teal SB. Rapid repeat pregnancy in adolescents: do immediate postpartum contraceptive implants make a difference? *Am J Obstet Gynecol*. 2012;206(6): 481.e1-481.e7

33. Damle LF, Gohari AC, McEvoy AK, Desale SY, Gomez-Lobo V. Early initiation of postpartum contraception: does it decrease rapid repeat pregnancy in adolescents? *J Pediatr Adolesc Gynecol*. 2015;28(1):57–62

34. Ott MA, Sucato GS; Committee on Adolescence. Contraception for adolescents. *Pediatrics*. 2014;134(4). Available at: www.pediatrics.org/cgi/content/full/134/4/e1257

35. Menon S; Committee on Adolescence. Long-acting reversible contraception: specific issues for adolescents. *Pediatrics*. 2020;146(2):e2020007252

36. Section on Breastfeeding. Breastfeeding and the use of human milk. *Pediatrics*. 2012;129(3). Available at: www.pediatrics.org/cgi/content/full/129/3/e827

37. HealthyPeople.gov. Increase the proportion of infants who are breastfed. Available at: https://www.healthypeople.gov/2020/topics-objectives/topic/maternal-infant-and-child-health/objectives. Accessed July 21, 2020

38. Apostolakis-Kyrus K, Valentine C, DeFranco E. Factors associated with breastfeeding initiation in adolescent mothers. *J Pediatr*. 2013;163(5): 1489–1494

39. Godbout JM, Goldsberry WN, Franklin TE. Factors associated with infant feeding choices in the adolescent population. *J Hum Lact*. 2016;32(4): 642–647

40. Dias de Oliveira L, Justo Giugliani ER, Córdova do Espírito Santo L, Meirelles Nunes L. Counselling sessions increased duration of exclusive breastfeeding: a randomized clinical trial with adolescent mothers and grandmothers. *Nutr J*. 2014;13:73

41. Schwartz R, Vigo Á, de Oliveira LD, Justo Giugliani ER. The effect of a pro-breastfeeding and healthy complementary feeding intervention targeting adolescent mothers and grandmothers on growth and prevalence of overweight of preschool children. *PLoS One*. 2015;10(7):e0131884

42. Sipsma HL, Jones KL, Cole-Lewis H. Breastfeeding among adolescent mothers: a systematic review of interventions from high-income countries. *J Hum Lact*. 2015;31(2): 221–229–322

43. Cota-Robles S, Pedersen L, LeCroy CW. Challenges to breastfeeding initiation and duration for teen mothers. *MCN Am J Matern Child Nurs*. 2017;42(3): 173–178

44. Grenadier A. *Reaching Teen Moms With Breastfeeding Education & Support*. Washington, DC: National Association of County and City Health Officials; 2016. Available at: https://www.naccho.org/blog/articles/reaching-teen-moms-with-breastfeeding-education-support. Accessed July 21, 2020

45. Smith PH, Coley SL, Labbok MH, Cupito S, Nwokah E. Early breastfeeding experiences of adolescent mothers: a qualitative prospective study. *Int Breastfeed J*. 2012;7(1):13

46. Torres de Lacerda AC, Lucena de Vasconcelos MG, Nascimento de Alencar E, Osório MM, Pontes CM. Adolescent fathers: knowledge of and involvement in the breast feeding process in Brazil. *Midwifery*. 2014;30(3): 338–344

47. Perez-Brena NJ, Updegraff KA, Umaña-Taylor AJ, Jahromi L, Guimond A. Coparenting profiles in the context of Mexican-origin teen pregnancy: links to mother-daughter relationship quality and adjustment. *Fam Process*. 2015; 54(2):263–279

48. Figueiredo B, Tendais I, Dias CC. Maternal adjustment and maternal attitudes in adolescent and adult pregnant women. *J Pediatr Adolesc Gynecol*. 2014;27(4):194–201

49. Lanzi RG, Ramey SL, Bert SC. The parenting responsibility and emotional preparedness (PREP) screening tool: a 3-item screen that identifies teen mothers at high risk for nonoptimal parenting. *Arch Pediatr Adolesc Med*. 2012;166(8):749–755

50. Macintosh J, Callister LC. Discovering self: childbearing adolescents' maternal identity. *MCN Am J Matern Child Nurs*. 2015;40(4):243–248

51. Zeiders KH, Umaña-Taylor AJ, Jahromi LB, Updegraff KA. Grandmothers' familism values, adolescent mothers' parenting efficacy, and children's well-being. *J Fam Psychol*. 2015;29(4): 624–634

52. Seay DM, Jahromi LB, Umaña-Taylor AJ, Updegraff KA. Intergenerational transmission of maladaptive parenting strategies in families of adolescent mothers: effects from grandmothers to

young children. *J Abnorm Child Psychol*. 2016;44(6):1097–1109

53. Easterbrooks MA, Chaudhuri JH, Dym Bartlett J, Copeman A. Resilience in parenting among young mothers: family and ecological risks and opportunities. *Child Youth Serv Rev*. 2011;33(1):42–50
54. Roye CF, Balk SJ. The relationship of partner support to outcomes for teenage mothers and their children: a review. *J Adolesc Health*. 1996;19(2): 86–93
55. Lohan M, Cruise S, O'Halloran P, Alderdice F, Hyde A. Adolescent men's attitudes in relation to pregnancy and pregnancy outcomes: a systematic review of the literature from 1980-2009. *J Adolesc Health*. 2010;47(4):327–345
56. Yogman M, Garfield CF; Committee on Psychosocial Aspects of Child and Family Health. Fathers' roles in the care and development of their children: the role of pediatricians. *Pediatrics*. 2016; 138(1):e20161128
57. Murray AL, Rosengard C, Weitzen S, Raker CA, Phipps MG. Demographic and relationship predictors of paternity establishment for infants born to adolescent mothers. *J Pediatr Adolesc Gynecol*. 2012;25(5):322–327
58. Johnson WE Jr. Paternal involvement among unwed fathers. *Child Youth Serv Rev*. 2001;23(6–7):513–536
59. Hunt TK, Caldwell CH, Assari S. Family economic stress, quality of paternal relationship, and depressive symptoms among African American adolescent fathers. *J Child Fam Stud*. 2015;24(10): 3067–3078
60. Hollman D, Alderman E. Fatherhood in adolescence. *Pediatr Rev*. 2008;29(10): 364–366
61. Mollborn S. Teenage mothers today: what we know and how it matters. *Child Dev Perspect*. 2017;11(1):63–69
62. Meade CS, Kershaw TS, Ickovics JR. The intergenerational cycle of teenage motherhood: an ecological approach. *Health Psychol*. 2008;27(4):419–429
63. Kumar NR, Raker CA, Ware CF, Phipps MG. Characterizing social determinants of health for adolescent mothers during the prenatal and postpartum periods. *Womens Health Issues*. 2017; 27(5):565–572
64. Sipsma H, Biello KB, Cole-Lewis H, Kershaw T. Like father, like son: the intergenerational cycle of adolescent fatherhood. *Am J Public Health*. 2010; 100(3):517–524
65. Garfield CF, Duncan G, Peters S, et al. Adolescent reproductive knowledge, attitudes, and beliefs and future fatherhood. *J Adolesc Health*. 2016; 58(5):497–503
66. Dallas CM. Rapid repeat pregnancy among unmarried, African American adolescent parent couples. *West J Nurs Res*. 2013;35(2):177–192
67. Sarkadi A, Kristiansson R, Oberklaid F, Bremberg S. Fathers' involvement and children's developmental outcomes: a systematic review of longitudinal studies. *Acta Paediatr*. 2008;97(2): 153–158
68. Cox JE, Bithoney WG. Fathers of children born to adolescent mothers. Predictors of contact with their children at 2 years. *Arch Pediatr Adolesc Med*. 1995; 149(9):962–966
69. Lee Y, Fagan J, Chen WY. Do late adolescent fathers have more depressive symptoms than older fathers? *J Youth Adolesc*. 2012;41(10): 1366–1381
70. Davis RN, Davis MM, Freed GL, Clark SJ. Fathers' depression related to positive and negative parenting behaviors with 1-year-old children. *Pediatrics*. 2011; 127(4):612–618
71. Savio Beers LA, Hollo RE. Approaching the adolescent-headed family: a review of teen parenting. *Curr Probl Pediatr Adolesc Health Care*. 2009;39(9): 216–233
72. Centers for Disease Control and Prevention. Risk and protective factors. Available at: https://www.cdc.gov/violenceprevention/childabuseandneglect/riskprotectivefactors.html. Accessed April 23, 2019
73. Scribano PV, Makoroff KL, Feldman KW, Berger RP. Association of perpetrator relationship to abusive head trauma clinical outcomes. *Child Abuse Negl*. 2013;37(10):771–777
74. Joyce T, Gossman W, Huecker MR. Pediatric Abusive Head Trauma. In: *StatPearls*. Treasure Island, FL: StatPearls Publishing; 2021. Available at: https://www.ncbi.nlm.nih.gov/books/NBK499836/
75. Solivan AE, Wallace ME, Kaplan KC, Harville EW. Use of a resiliency framework to examine pregnancy and birth outcomes among adolescents: a qualitative study. *Fam Syst Health*. 2015;33(4):349–355
76. Umaña-Taylor AJ, Updegraff KA, Jahromi LB, Zeiders KH. Trajectories of ethnic-racial identity and autonomy among Mexican-origin adolescent mothers in the United States. *Child Dev*. 2015;86(6): 2034–2050
77. Letourneau NL, Stewart MJ, Barnfather AK. Adolescent mothers: support needs, resources, and support-education interventions. *J Adolesc Health*. 2004; 35(6):509–525
78. Birkeland R, Thompson JK, Phares V. Adolescent motherhood and postpartum depression. *J Clin Child Adolesc Psychol*. 2005;34(2):292–300
79. Centers for Disease Control and Prevention. PRAMS. Available at: https://www.cdc.gov/prams/index.htm. Accessed July 21, 2020
80. Davé S, Petersen I, Sherr L, Nazareth I. Incidence of maternal and paternal depression in primary care: a cohort study using a primary care database. *Arch Pediatr Adolesc Med*. 2010;164(11): 1038–1044
81. Venkatesh KK, Phipps MG, Triche EW, Zlotnick C. The relationship between parental stress and postpartum depression among adolescent mothers enrolled in a randomized controlled prevention trial. *Matern Child Health J*. 2014;18(6):1532–1539
82. Venkatesh KK, Zlotnick C, Triche EW, Ware C, Phipps MG. Accuracy of brief screening tools for identifying postpartum depression among adolescent mothers. *Pediatrics*. 2014; 133(1). Available at: www.pediatrics.org/cgi/content/full/133/1/e45
83. Lieberman K, Le HN, Perry DF. A systematic review of perinatal depression interventions for adolescent mothers. *J Adolesc*. 2014;37(8): 1227–1235

84. Dinwiddie KJ, Schillerstrom TL, Schillerstrom JE. Postpartum depression in adolescent mothers. *J Psychosom Obstet Gynaecol*. 2018;39(3):168–175

85. Earls MF, Yogman MW, Mattson G, Rafferty J; Committee on Psychosocial Aspects of Child and Family Health. Incorporating recognition and management of perinatal and postpartum depression into pediatric practice. *Pediatrics*. 2019;143(1):e20183259

86. Levy SJL, Williams JF; Committee on Substance Use and Prevention. Substance use screening, brief intervention, and referral to treatment. *Pediatrics*. 2016;138(1):e20161211

87. Committee on Substance Use and Prevention. Substance use screening, brief intervention, and referral to treatment. *Pediatrics*. 2016;138(1):e20161210

88. Smith VC, Wilson CR; Committee on Substance Use and Prevention. Families affected by parental substance use. *Pediatrics*. 2016;138(2):e20161575

89. Ryan SA, Ammerman SD, O'Connor ME; Committee on Substance Use and Prevention; Section on Breastfeeding. Marijuana use during pregnancy and breastfeeding: implications for neonatal and childhood outcomes. *Pediatrics*. 2018;142(3):e20181889

90. Williams JF, Smith VC; Committee on Substance Abuse. Fetal alcohol spectrum disorders. *Pediatrics*. 2015;136(5). Available at: www.pediatrics.org/cgi/content/full/136/5/e1395

91. Farber HJ, Walley SC, Groner JA, Nelson KE; Section on Tobacco Control. Clinical practice policy to protect children from tobacco, nicotine, and tobacco smoke. *Pediatrics*. 2015;136(5):1008–1017

92. Divney A, Gordon D, Magriples U, Kershaw T. Stress and behavioral risk among young expectant couples. *J Adolesc*. 2016;53:34–44

93. Chisholm CA, Bullock L, Ferguson JEJ II. Intimate partner violence and pregnancy: epidemiology and impact. *Am J Obstet Gynecol*. 2017;217(2):141–144

94. Thackeray JD, Hibbard R, Dowd MD; Committee on Child Abuse and Neglect; Committee on Injury, Violence, and Poison Prevention. Intimate partner violence: the role of the pediatrician. *Pediatrics*. 2010;125(5):1094–1100

95. Smith SG, Chen J, Basile KC, et al. *The National Intimate Partner and Sexual Violence Survey (NISVS): 2010-2012 State Report*. Atlanta, GA: National Center for Injury Prevention and Control, Centers for Disease Control and Prevention; 2017, Available at https://www.cdc.gov/violenceprevention/pdf/NISVS-StateReportBook.pdf. Accessed July 21, 2020

96. Rowlands S, Walker S. Reproductive control by others: means, perpetrators and effects. *BMJ Sex Reprod Health*. 2019;45(1):61–67

97. Bekaert S, SmithBattle L. Teen mothers' experience of intimate partner violence: a metasynthesis. *ANS Adv Nurs Sci*. 2016;39(3):272–290

98. Hamby S, Finkelhor D, Turner H, Ormrod R. The overlap of witnessing partner violence with child maltreatment and other victimizations in a nationally representative survey of youth. *Child Abuse Negl*. 2010;34(10):734–741

99. Keenan HT, Runyan DK, Marshall SW, Nocera MA, Merten DF, Sinal SH. A population-based study of inflicted traumatic brain injury in young children. *JAMA*. 2003;290(5):621–626

100. Brown JB, Lent B, Brett PJ, Sas G, Pederson LL. Development of the Woman Abuse Screening Tool for use in family practice. *Fam Med*. 1996;28(6):422–428

101. Sherin KM, Sinacore JM, Li XQ, Zitter RE, Shakil A. HITS: a short domestic violence screening tool for use in a family practice setting. *Fam Med*. 1998;30(7):508–512

102. Centers for Disease Control and Prevention. Social determinants of health: know what affects health. Available at: https://www.cdc.gov/socialdeterminants/index.htm. Accessed April 23, 2019

103. Council on Community Pediatrics. Poverty and child health in the United States. *Pediatrics*. 2016;137(4):e20160339

104. National Conference of State Legislatures. Teen pregnancy prevention. Available at: https://www.ncsl.org/research/health/teen-pregnancy-prevention.aspx. Accessed April 23, 2019

105. Fuller TR, White CP, Chu J, et al. Social determinants and teen pregnancy prevention: exploring the role of nontraditional partnerships. *Health Promot Pract*. 2018;19(1):23–30

106. Dworsky A, Morton MH, Samuels GM. *Missed Opportunities: Pregnant and Parenting Youth Experiencing Homelessness in America*. Chicago, IL: Chapin Hall at the University of Chicago; 2018 Available at: https://voicesofyouthcount.org/wp-content/uploads/2018/05/VoYC-PP-Brief-FINAL.pdf. Accessed July 21, 2020

107. Felitti VJ, Anda RF, Nordenberg D, et al. Relationship of childhood abuse and household dysfunction to many of the leading causes of death in adults. The Adverse Childhood Experiences (ACE) Study. *Am J Prev Med*. 1998;14(4):245–258

108. Chase-Lansdale L, Brooks-Gunn J. Two-generation programs in the twenty-first century. *Future Child*. 2014;24(1):13–39

109. Mayer LM, Thursby E. Adolescent parents and their children: a multifaceted approach to prevention of adverse childhood experiences (ACE). *J Prev Interv Community*. 2012;40(4):304–312

110. Wilson SJ, Tanner-Smith EE, Lipsey MW, Steinka-Fry K, Morrison J. Dropout prevention and intervention programs: effects on school completion and dropout among school-aged children and youth. *Campbell Systematic Reviews*. 2011;7(1):1–61

111. SmithBattle L. The past is prologue? The long arc of childhood trauma in a multigenerational study of teen mothering. *Soc Sci Med*. 2018;216:1–9

112. Bartlett JD, Raskin M, Kotake C, Nearing KD, Easterbrooks MA. An ecological analysis of infant neglect by adolescent mothers. *Child Abuse Negl*. 2014;38(4):723–734

113. Mollborn S, Dennis JA. Ready or not: predicting high and low school readiness among teen parents' children. *Child Indic Res*. 2012;5(2):253–279

114. Khatun M, Al Mamun A, Scott J, William GM, Clavarino A, Najman JM. Do

children born to teenage parents have lower adult intelligence? A prospective birth cohort study. *PLoS One*. 2017; 12(3):e0167395

115. Baudry C, Tarabulsy GM, Atkinson L, Pearson J, St-Pierre A. Intervention with adolescent mother-child dyads and cognitive development in early childhood: a meta-analysis. *Prev Sci*. 2017;18(1):116–130

116. Huang CY, Costeines J, Ayala C, Kaufman JS. Parenting stress, social support, and depression for ethnic minority adolescent mothers: impact on child development. *J Child Fam Stud*. 2014; 23(2):255–262

117. Hoffman L, Bann C, Higgins R, Vohr B; Eunice Kennedy Shriver National Institute of Child Health and Human Development Neonatal Research Network. Developmental outcomes of extremely preterm infants born to adolescent mothers. *Pediatrics*. 2015; 135(6):1082–1092

118. US Department of Health and Human Services. Head start early childhood learning and knowledge center. Getting young children and their families ready for school and ready for life. Available at: https://eclkc.ohs.acf.hhs.gov/. Accessed July 21, 2020

119. Lewin A, Mitchell SJ, Beers LS, Feinberg ME, Minkovitz CS. Coparenting in teen mothers and their children's fathers: evidence from the early childhood longitudinal study-birth cohort. *Acad Pediatr*. 2012;12(6):539–545

120. Cabrera NJ, Karberg E, Malin JL, Aldoney D. The magic of play: low-income mothers' and fathers' playfulness and children's emotion regulation and vocabulary skills. *Infant Ment Health J*. 2017;38(6):757–771

121. Shah R, DeFrino D, Kim Y, Atkins M. Sit down and play: a preventive primary care-based program to enhance parenting practices. *J Child Fam Stud*. 2017;26(2):540–547

122. High PC, Klass P; Council on Early Childhood. Literacy promotion: an essential component of primary care pediatric practice. *Pediatrics*. 2014; 134(2):404–409

123. Milteer RM, Ginsburg KR; Council on Communications and Media; Committee on Psychosocial Aspects of Child and Family Health. The importance of play in promoting healthy child development and maintaining strong parent-child bond: focus on children in poverty. *Pediatrics*. 2012;129(1). Available at: www.pediatrics.org/cgi/content/full/129/1/e204

124. Suskind D. *Thirty Million Words: Building a Child's Brain*. New York, NY: Penguin Random House; 2015

125. Thomas MP, Ammann G, Brazier E, Noyes P, Maybank A. Doula services within a Healthy Start program: increasing access for an underserved population. *Matern Child Health J*. 2017; 21(suppl 1):59–64

126. Harvard University Center on the Developing Child. Resilience. Available at: https://developingchild.harvard.edu/science/key-concepts/resilience/. Accessed July 21, 2020

127. American Academy of Pediatrics. Building resilience in children. Available at: https://www.healthychildren.org/English/healthy-living/emotional-wellness/Building-Resilience/Pages/Building-Resilience-in-Children.aspx. Accessed July 21, 2020

128. Garner AS, Shonkoff JP; Committee on Psychosocial Aspects of Child and Family Health; Committee on Early Childhood, Adoption, and Dependent Care; Section on Developmental and Behavioral Pediatrics. Early childhood adversity, toxic stress, and the role of the pediatrician: translating developmental science into lifelong health. *Pediatrics*. 2012;129(1). Available at: www.pediatrics.org/cgi/content/full/129/1/e224

129. Shonkoff JP, Garner AS; Committee on Psychosocial Aspects of Child and Family Health; Committee on Early Childhood, Adoption, and Dependent Care; Section on Developmental and Behavioral Pediatrics. The lifelong effects of early childhood adversity and toxic stress. *Pediatrics*. 2012; 129(1).Available at: www.pediatrics.org/cgi/content/full/129/1/e232

Caring for American Indian and Alaska Native Children and Adolescents

- *Policy Statement*

POLICY STATEMENT Organizational Principles to Guide and Define the Child Health Care System and/or Improve the Health of all Children

American Academy of Pediatrics
DEDICATED TO THE HEALTH OF ALL CHILDREN®

Caring for American Indian and Alaska Native Children and Adolescents

Shaquita Bell, MD, FAAP,[a,*] Jason F. Deen, MD, FAAP,[a,*] Molly Fuentes, MD, MS,[b] Kelly Moore, MD, FAAP,[c] COMMITTEE ON NATIVE AMERICAN CHILD HEALTH

American Indian and Alaska Native (AI/AN) populations have substantial health inequities, and most of their disease entities begin in childhood. In addition, AI/AN children and adolescents have excessive disease rates compared with the general pediatric population. Because of this, providers of pediatric care are in a unique position not only to attenuate disease incidence during childhood but also to improve the health status of this special population as a whole. This policy statement examines the inequitable disease burden observed in AI/AN youth, with a focus on toxic stress, mental health, and issues related to suicide and substance use disorder, risk of and exposure to injury and violence in childhood, obesity and obesity-related cardiovascular risk factors and disease, foster care, and the intersection of lesbian, gay, bisexual, transgender, queer, and Two-Spirit and AI/AN youth. Opportunities for advocacy in policy making also are presented.

INTRODUCTION

We acknowledge that this policy statement was written together on Coast Salish and Pueblo lands, both diverse, strong, and enduring communities that uphold a sacred legacy of protecting future generations. As American Indian (AI) authors and physicians ourselves, we acknowledge that we intend to represent a diverse and far-reaching group of Indigenous peoples. We humbly submit that not all aspects of caring for our communities could be captured in our article. We ask that this policy statement be used to support and advocate for improved health outcomes and the well-being of children and youth from all tribal and urban AI communities. Many solutions to the problems illustrated below can be found within these very communities.[1]

American Indian and Alaska Native (AI/AN) children and adolescents are found throughout the United States, with more now living in urban rather than rural areas.[2] Many tribal nations have their own languages, and all have rich histories, but most AI/AN people now live in metropolitan areas that may include many different tribal groups. Care for this special

abstract

[a]Departments of Pediatrics and [b]Rehabilitation Medicine, School of Medicine, University of Washington and Seattle Children's Hospital, Seattle, Washington; and [c]Centers for American Indian and Alaska Native Health, Colorado School of Public Health, University of Colorado Anschutz Medical Campus, Aurora, Colorado

**Contributed equally as co-first authors*

Drs Bell, Deen, Fuentes, and Moore were equally responsible for conceptualizing, writing, and revising the manuscript, while also considering input from all reviewers; and all authors approved the final manuscript as submitted.

Policy statements from the American Academy of Pediatrics benefit from expertise and resources of liaisons and internal (AAP) and external reviewers. However, policy statements from the American Academy of Pediatrics may not reflect the views of the liaisons or the organizations or government agencies that they represent.

The guidance in this statement does not indicate an exclusive course of treatment or serve as a standard of medical care. Variations, taking into account individual circumstances, may be appropriate.

All policy statements from the American Academy of Pediatrics automatically expire 5 years after publication unless reaffirmed, revised, or retired at or before that time.

DOI: https://doi.org/10.1542/peds.2021-050498

Address correspondence to Shaquita Bell, MD. Email: shaquita.bell@seattlechildrens.org

To cite: Bell S, Deen JF, Fuentes M, et al. AAP COMMITTEE ON NATIVE AMERICAN CHILD HEALTH. Caring for American Indian and Alaska Native Children and Adolescents. *Pediatrics*. 2021;147(4):e2021050498

population presents a unique and complex clinical opportunity for pediatricians, other providers of pediatric care, and pediatric care organizations because of the high level of documented health inequities within a sociocultural context unfamiliar to most practicing providers of pediatric care. Not only do AI/AN youth face medical access barriers, but they also have a higher prevalence of chronic stress and adverse childhood experiences (ACEs) and exposure to environmental hazards resulting in poorer health outcomes[3] when compared with the general population.[4] In addition, several other significant barriers to care deserve mention. These include conventional barriers for underresourced families, such as lack of transportation, difficulty finding child care, inability to miss work, caring for elders, and other family and work obligations, as well as other socioeconomic challenges. Moreover, less well-recognized issues exist, such as long-standing mistrust of governmental agencies, discrimination in clinical settings attributable to implicit and explicit bias leading to mistrust of health care and of health care–related research, and the cumulative burden of generations of unresolved traumas and racism.[5–8] This policy statement explores the roles historical trauma and health inequities have played in shaping the current socioeconomic and health status of AI/AN youth. Disproportionate needs in mental and cardiovascular health and disease processes that are overrepresented in AI/AN youth are discussed to provide a summary of salient issues for pediatric care providers. This statement also provides strategies for culturally sensitive family-centered care to mitigate morbidity and policy recommendations to facilitate institutional and system changes needed for improved health outcomes.

Of note, Native Hawaiians and Pacific Islanders are considered a unique population of Indigenous people who live within the territories discussed but are not considered AI. They have their own distinct cultural identity as well as distinct health outcomes and needs. In addition, they are not considered tribes by the US federal government, so they are not beneficiaries of the Indian Health Service (IHS) or eligible for funding from the Bureau of Indian Affairs. Given these differences and the need for them to be addressed fully, this policy statement does not address this population.

Many of the cited publications in this document compare AI/AN youth to non-Hispanic white youth; the authors would like to note that this phenomenon can lead to white centering. Where possible, we avoided comparing racial groups in this way but were somewhat limited by the available studies.

ACES

The call to pediatricians to employ strategies to mitigate toxic stress caused by ACEs is especially critical for AI/AN children.[9] In a landmark study of more than 13 000 adults, categories of childhood abuse, neglect, and other forms of household dysfunction were linked to adult mortality and morbidity. Risk was quantified by using an ACE score, or the number of categories experienced by an individual before age 18 years.[10] A higher ACE score's association with poor health outcomes is postulated to stem from altered neurodevelopment with subsequent social, emotional, and neurocognitive impairment, which in turn leads to detrimental health behavior and poor health outcomes. For example, compared with those without ACEs, adults with an ACE score of 3 or more are twice as likely to smoke or have cardiovascular disease and 1.5 times more likely to have severe obesity or diabetes.[11,12] AI adults and children experience a disparate number of ACEs compared with the general US population. A recent study of 516 AI adults from South Dakota revealed an ACE score of 3 or more in 45.4% of participants as compared with 17.4% of region-matched controls.[13] Among AI adults from 7 geographically diverse tribes, AI adults were 5 times more likely than non-AI adults to have had 4 or more ACEs.[14] According to the National Survey of Children's Health data collected in 2011 and 2012, 1453 AI children and adolescents aged 0 to 17 years were more likely to have had multiple ACEs compared with non-Hispanic white (NHW) children.[15] In that study, >25% of AI youth had 3 or more ACEs, compared with only 11.5% of NHW children. Regarding the types of ACEs endured, AI populations suffer from a disproportionate prevalence of emotional and physical neglect, substance use disorder, and incarceration among family members, as well as witnessed intimate partner violence, when compared with the general population.[13–16] The authors of another study of AI adolescents and young adults also found that historical loss–associated symptoms and perceived discrimination are relevant factors in considering ACEs for Indigenous children and youth, suggesting the importance of considering loss of culture and structural racism as contributors to childhood adversity in this population.[16]

OBESITY

Obesity prevalence in AI/AN youth is among the highest of all races and ethnicities.[17–19] Obesity onset occurs at a younger age compared with other racial and ethnic groups in the United States; AI children between 2 and 5 years of age have a higher combined prevalence of overweight and obesity (58.8%) than children of all other races or ethnicities (30%).[17,20,21]

Moreover, AI/AN children experienced an increase in obesity prevalence between 2003 and 2008, whereas the prevalence for other US racial groups declined. Recent data have revealed an alarmingly high prevalence of obesity compared with the general US population but suggest that obesity prevalence (29.7%) in AI/AN children 2 to 19 years of age may have stabilized.[22,23] Although recent research from 2010–2014 suggests a decline in severe obesity among children 2 to 4 years of age from low-income families, severe obesity remains high for young AI/AN children and is among the highest of all racial and/or ethnic groups receiving benefits through the Special Supplemental Nutrition Program for Women, Infants, and Children.[24] It follows that a significant portion of AI children with obesity have significantly abnormal blood lipid levels, higher blood glucose levels, and higher abdominal adiposity compared with children with normal-weight.[25]

Obesity may largely be determined in infancy, with excess prenatal maternal weight gain, macrosomia, and premature cessation of breastfeeding significantly predicting BMI at 1 year of age in a previous study.[26] In the same children, overweight or obesity status at age 1 year persisted to ages 5 to 8 years and was associated with unhealthy levels of low-density lipoprotein. In AI children, once obesity is established, it likely persists into adulthood and increases the risk of chronic disease.[27,28] The prevalence of disproportionate rates of obesity emerge in early childhood[17,20,29]; thus, tailored prevention and intervention strategies are needed for young AI/AN children.

Given the high rates of obesity, AI/AN youth also experience high rates of type 2 diabetes mellitus (T2DM). Testing, as recommended by the American Diabetes Association, for prediabetes and T2DM should be considered in AI/AN children and adolescents with overweight or obesity.[30,31] Further information is available in American Academy of Pediatrics technical and clinical reports on management of T2DM for children[32] and specifically for AI/AN youth.[33]

BREASTFEEDING

The benefits of human milk nutrition for infants are well documented and include wide-ranging effects, such as the reduction of respiratory tract infections, obesity and diabetes incidence, atopic disease, and infant mortality.[34] Although the breastfeeding initiation rate for the general US population is 75%, minority populations experience significant disparities in initiating and continuing breastfeeding at 6 and 12 months.[35] AI/AN women have the second-lowest prevalence of breastfeeding initiation, duration, and exclusivity compared with all other US racial and ethnic groups. In a previous study, only 59% of AI women initiated breastfeeding, and most of those (76%) stopped breastfeeding within 4 months.[26] Encouragingly, those who continued to breastfeed for 6 months tended to continue through infancy.[36] Health benefits of breastfeeding have been demonstrated in all populations, including AI/AN populations. For example, in a retrospective cohort study, a lower BMI was reported among AI/AN adolescents breastfed for >6 months.[37] Breastfeeding promotion is needed in AI/AN tribal communities and would ideally be coordinated by tribal entities and would involve community members, elders, and health care providers, including paraprofessionals.[38,39]

CHILDREN AND YOUTH WITH SPECIAL HEALTH CARE NEEDS

AI/AN children and youth with special health care needs (CYSHCN) are at particular risk of health disparities. Although there is no evidence of a higher prevalence of special health care needs among AI/AN children compared with NHW children, AI/AN children are more likely than NHW children to meet criteria for special health care needs on the basis of functional difficulties.[40] In addition, AI/AN CYSHCN are more likely than NHW CYSHCN to have 3 or more functional difficulties,[40] which can be interpreted as AI/AN CYSHCN likely having more disability. Although there are no studies on the prevalence of developmental delay, functional difference, or disability among AI/AN children, it is possible that there is a higher prevalence in AI/AN children, compared with the general population, because of a disproportionate burden of injury,[41] inadequate prenatal care,[42,43] preterm birth,[43] environmental stressors,[42,44] and other social determinants of health and function.

CYSHCN benefit from the accessible, comprehensive, and coordinated care provided by a medical home, but AI/AN CYSHCN are significantly less likely than children without special health care needs to receive care meeting the medical home definition (odds ratio 0.2; 95% confidence interval 0.1–0.4).[7] In addition to difficulties receiving medical home–based primary care, AI/AN CYSHCN may have challenges accessing subspecialty medical care or pediatric rehabilitation therapies; those who live in rural or remote communities may have to travel many hours to access specialized care. Even among urban AI/AN CYSHCN, there may still be barriers related to transportation,[45,46] funding, and wait times.[47] The care used by AI/AN CYSHCN may not be sensitive to the family's values[7] or address the child's functional needs related to their tribal culture.[48] Efforts should be made to identify CYSHCN in a timely manner, implement culturally sensitive medical home–based care for AI/AN

TABLE 1 Risk Behaviors and Emotional Distress Reported by Ninth- and 11th-Grade Students in a Minnesota Student Survey Sample

Reported	AI/AN LGBTQ (*n* = 149 Ninth- and 11th-Graders)	Full MSS Sample (*n* = 81 885 Ninth- and 11th-Graders)	All LGBTQ (*n* = 8758 Ninth- and 11th-Graders)
Substance use			
Smoked cigarettes (past 30 d)	32.9	6.1	14.1
Drank alcohol (past 30 d)	25.2	17.2	22.3
Binge drinking (past 30 d)	16.8	8.4	10.7
Smoked marijuana (past 30 d)	33.1	10.8	17.0
Sexual behaviors			
Ever had sex	33.8	22.1	28.8
≥2 partners (past year)[a]	18.3	8.7	14.7
Emotional distress			
Depressive symptoms	51.7	22.3	48.1
Self-harm (past year)	52.1	15.4	43.7
Suicidal ideation (ever)	60.5	21.0	53.6
Suicide attempt (ever)	37.7	7.7	24.4

Minnesota Student Survey (MSS) data were provided by public school students in Minnesota via local public school districts and are managed by the Minnesota Student Survey Interagency Team (M. Eisenberg, ScD, MPH, personal communication, 2018). LGBTQ, lesbian, gay, bisexual, transgender, and queer.

[a] Among sexually active ninth- and 11th-grade students only.

CYSHCN, and facilitate access to services that will help AI/AN CYSHCN achieve their full functional potential and be included in their communities.

SUICIDE AND MENTAL HEALTH

Suicide is the second-leading cause of death for AI/AN and non-AI/AN youth 10 to 24 years of age,[49,50] but the 2016 age-adjusted suicide mortality rate among AI/AN youth (15.59 per 100 000) is more than 1.5 times higher than that of the general population (9.60 per 100 000).[51] There is significant regional and intertribal variation in AI/AN youth suicide mortality, with some tribes having youth suicide rates 7 times higher than the national AI/AN rate and 12 times higher than the general population rate.[52,53]

In previous studies, differences in risk and protective factors that may attenuate that risk (such as having a connectedness to family and having the ability to discuss problems with family and friends[54]) explained the higher prevalence of suicidal behaviors among AI/AN students compared with other students.[55,56] ACEs were also associated with suicide attempts; after controlling for multiple factors, each additional ACE increased the risk of lifetime suicide attempt by 37% for AI youth.[16] AI/AN individuals of all ages who died by suicide were less likely than NHW individuals to have received mental health diagnoses or treatments and were more likely to have a family member or friend's death precipitate suicide.[57]

Suicide prevention initiatives that are strengths based, community driven, and culturally centered have been used in several AI/AN communities to reduce youth suicide behaviors.[57,58] For AI/AN youth who do not have access to a community-specific suicide prevention program, efforts should be made to identify youth with an increased burden of suicide risk factors and to strengthen protective factors, particularly cultural protective factors.[55] If available, school-based health centers may be used for adjunctive mental health care.[59]

INTERSECTIONS OF HEALTH AND IDENTITY

Lesbian, gay, pansexual, bisexual, transgender, gender queer, intersex, and Two-Spirit AI/AN youth experience exponential increases in risk for health disparities.[60–63] "Two-Spirit" is a unifying term that encompasses both gender identity and traditional Indigenous understandings of identity and is a widely used term in Indigenous communities across North America. In the 2015 US National Transgender Health Survey, AI/AN transgender respondents reported having experienced harassment (86%), physical assault (51%), and sexual assault (21%). Fifty-seven percent of AI/AN youth identifying as transgender have attempted or contemplated suicide, compared with 4.6% of the general US population and 33.7% of transgender youth as a whole.[64,65] In this same study, 23% of transgender respondents (all ages) identifying as AI/AN experienced unemployment in the last year.[66] In another study, youth at the intersection of gender and racial identity had higher rates of risk behaviors and emotional distress (Table 1). Careful attention to gender-affirming care and risk assessments may mitigate these effects.[67]

VIOLENCE

Violence affects AI/AN youth in unique but disproportionate ways. In a study using data from the National Trauma Data Bank, 11.8% of AI/AN children hospitalized for traumatic

injury experienced injury as a result of violent assaults, compared with only 4.2% of NHW children.[68] Many communities have started to focus on the crisis of missing and murdered Indigenous women and girls. Although limited data exist on rates of missing and murdered Indigenous women and girls and underreporting is extremely likely, a recent study completed by the Urban Indian Health Institute reveals staggering rates of violence toward Indigenous women and girls.[69] Pediatricians have an opportunity to advocate for better data collection and unbiased media coverage. The Urban Indian Health Institute has created a tool kit (https://www.uihi.org/resources/mmiwg-we-demand-more-partner-toolkit/) on how further work in this area can be tailored in a culturally appropriate manner.[69]

AI/AN youth and communities are also vulnerable to sex trafficking.[70] It is estimated that 30% of AI girls between 11 and 17 years old have a history of sexual abuse, and 11% have reported being raped.[71,72] Alaska Native women and girls make up 8% of the population in Alaska but represent 33% of sex-trafficking victims.[73] In turn, AI/AN girls are 5 times more likely to be incarcerated for prostitution than NHW girls.[73] It is important to recognize that men and nonbinary-gendered youth can also experience trafficking, and often times, finding data on these groups proves to be challenging. Identifying, preventing, and addressing trafficking and reducing violence is an integral part of caring for AI/AN communities.[74]

FOSTER CARE

The National Child Abuse and Neglect Data System, the Bureau of Indian Affairs, and the IHS report high rates of child protective services referrals for AI/AN youth.[75,76] In a previous study, AI/AN youth in foster care were more likely to have special health care needs compared with others in foster care.[77] Historically, AI/AN children were systematically removed from their homes in an effort to assimilate them into mainstream culture and to terminate the existence of tribal culture. Rates of ongoing referrals reflect both historical trauma and ongoing social and environmental determinants of inequities at work. The Indian Child Welfare Act was ratified in 1978 after decades of fierce advocacy by tribes for the right to keep their children within families that identify as AI/AN. Often used as a leverage point to threaten the sovereignty of tribal nations, the Indian Child Welfare Act remains an opportune protection for AI/AN children and adolescents.[78]

OTHER HEALTH DISPARITIES

The poor oral health status of AI/AN children is a major public health concern. AI/AN children have the highest rates of tooth decay among any racial and ethnic group in the United States.[79] The prevalence of tooth decay among AI/AN children between 2 and 4 years of age is 5 times greater than the average US rate.[79,80] AI/AN children also have limited access to dental services because of ongoing difficulties with recruitment and retention of qualified dentists in the IHS.[79] More severe early childhood caries frequently requires extensive treatment under general anesthesia, creating an additional health care access barrier for AI/AN children. More information is available in the joint American Academy of Pediatrics and Canadian Paediatric Society policy statement on early childhood caries and its impact on Indigenous communities.[81] In addition to oral health conditions, chronic otitis media and many other conditions disproportionally and inequitably affect AI/AN children and adolescents.[82,83] The authors have chosen some of the most prominent to focus on but do not consider this an exhaustive list.

GOVERNMENTAL AND POLITICAL INFLUENCES

The delivery of health care to AI/AN children is influenced by governmental policy at the federal, state, and tribal level. Treaties between the federal government and sovereign tribal nations established a trust relationship for health care. Although these treaties are unique agreements between tribal nations and the US government, failure of the government to honor them has also shaped mistrust among many AI/AN people and communities. Today, that treaty-based health care system is organized through the IHS, an agency within the US Department of Health and Human Services. Many health care settings serving AI/AN people receive funding through the IHS, including IHS federally operated clinics and hospitals, tribally operated clinics and hospitals, and urban AI clinics run by urban AI health organizations in metropolitan areas. Yet many AI/AN children receive health care services at clinics that are not associated with the IHS, including private clinics and federally qualified health centers.

Not all people who identify as AI/AN are members of tribes that have been federally recognized. Tribes that are not federally recognized are not eligible for federal funding from the IHS or the Bureau of Indian Affairs.

The IHS is chronically underfunded, with the budget determined by annual federal appropriations. By way of comparison, in 2017 the IHS was funded at $4078 per person, whereas the US government spent $10 692 per person in the Veterans Affairs system.[80] An underfunded IHS results in workforce instability and reduced ability to effectively deliver a full spectrum of necessary health

care. Chronic underfunding leads to infrastructure issues as well. Many facilities are overdue for updates, many locations have trouble providing housing for staff and providers, and much of the equipment is outdated. Furthermore, funding shortages lead to challenges in providing specialty care through contract health services.

Medicaid payment rates are directly tied to the likelihood of a practice accepting Medicaid patients, which is subsequently correlated with access to health care for children with Medicaid.[84,85] It follows, therefore, that increasing Medicaid payment rates and access to Medicaid coverage would potentially improve health care access for AI/AN youth. With more than 300 000 AI/AN children covered by Medicaid, there is an obvious need for continued and improved access to health services.[86,87] Continuing to expand access to Medicaid coverage for AI/AN children is essential for ensuring access to needed services.

Another complicating factor for many AI/AN communities is the inconsistent and overenforcement of punitive drug laws targeting pregnant women. Punitive drug screening practices for pregnant women lead to a decrease in prenatal visits, which, in turn, increases the risk of preterm birth.[88,89] Often, tribal laws differ from state and local laws, and in some instances, tribal jurisdictional boundaries may cross multiple states. Federally operated IHS facilities are bound by federal laws and policies. This overlap of governing bodies often results in confusing policies and a lack of standard and universal screening of pregnant AI/AN women, leading to late or inadequate detection of infants with a history of in utero substance exposure, including infants with neonatal opioid withdrawal syndrome.

RECOMMENDATIONS

Opportunities for Pediatric Care Providers in Practice

Pediatric care providers, because of their early interaction with AI/AN youth and their families, have a distinct opportunity to promote resilience and improve the health of these children, which will have far-reaching benefits as they age and raise their own children. Pediatricians and other pediatric care providers can implement systems in their practice that can help all patients and families, including AI/AN families, feel that they are welcome and will be treated respectfully and that high-quality family- and patient-centered care will be delivered regardless of social class, personal history, or cultural, spiritual, gender, racial, or ethnic identity. These strategies include providing trauma-informed care,[90–92] screening for substance use[93] and social determinants of health,[94–96] connecting to substance use prevention and treatment programs,[93] home visiting,[97] literacy programs,[98,99] and leveraging school-based health centers if available.[59] Addressing social determinants of health also includes addressing housing insecurity[100] and food insecurity.[101] The inclusion of the AI/AN perspective and disaggregated data in early childhood initiatives should be sought to improve outcomes within broader systems-based efforts. When implementing these strategies, pediatricians are encouraged to seek programs and interventions that incorporate AI/AN culture, tradition, and practices.[102] The following recommendations reflect the issues raised above and provide opportunities for pediatricians and others who provide care to AI/AN pediatric patients:

- Partner with local tribes and communities to set health priorities, understand historical experiences, and combine efforts already underway, such as cultural enrichment and preservation programs.
- Provide opportunities for adequate training of clinical and office staff in culturally sensitive care practices. Advocate for local and regional models that incorporate culturally and linguistically appropriate services tailored for local tribes.
- Provide evidence-based supports for parents and young children by promoting the use of home visiting models, high-quality child care, and early childhood programs, such as Early Head Start, Head Start, and Nurse-Family Partnership (https://www.nursefamilypartnership.org).[103]
- Start a Reach Out and Read program in AI/AN clinics and any clinic serving these families. Include books representing AI/AN and Indigenous children and families.
- Assess patients for ACEs and social determinants of health (eg, poverty, food insecurity, homelessness, lack of neighborhood safety, incarceration of parents or other family members, mental health conditions of parents or other household family members, housing inequity, access to schools, academic achievement, intimate partner violence, child abuse and neglect, and involvement with the juvenile legal system) to help families identify and implement practical solutions.
- Identify strengths and screen youth and families for protective factors to promote positive youth development.
- Create efforts to promote and strengthen protective factors for youth, focusing on cultural preservation–based efforts.
- Consider testing for prediabetes and T2DM in AI/AN children and adolescents with overweight or

obesity, as recommended by the American Diabetes Association.

- Promote breastfeeding in AI/AN tribal communities, ideally coordinated by tribal entities and involving community members, elders, and health care providers, including paraprofessionals.
- Include early childhood oral health as part of overall childhood health and well-being. Perform oral health screening during early childhood health assessments and provide referrals as needed to dental health providers. Be knowledgeable of fluoride levels in the drinking water for local tribal communities in your area.[81]
- Create a medical home that acknowledges and is sensitive to discrimination in clinical settings and generations of unresolved traumas and racism that AI/AN children and families experience. Work with local community hospitals and pediatric emergency departments, which may serve as a referral source, to become a medical home for AI/AN children whose families use emergency departments rather than seek primary care.
- Create a medical home model that facilitates access to services that will help AI/AN CYSHCN achieve their functional potential. Identify AI/AN CYSHCN, engaging staff, including care coordinators, in cultural competency training and partnering with the community.
- Assess patients for mental health conditions, including signs of posttraumatic stress, anxiety, grief, depressive symptoms, and suicidality, as well as their mothers for perinatal depression[104] using validated screening tools and a trauma-informed approach. Participate in strengths-based, community-driven, and culturally centered suicide prevention programs.[58]
- Screen AI/AN youth for substance use, and if identified, conduct a brief intervention and then refer for ongoing treatment.[105–107]
- Work with local schools to identify AI/AN students in need of mental health and educational services.
- Offer gender-affirming care in line with the previously published American Academy of Pediatrics policy statement.[67]
- Work to prevent, identify, and address sex trafficking in AI/AN youth.

Opportunities for Public Policy Advocacy

Pediatricians also have an opportunity to advocate for systems change that addresses health inequities and other systemic factors that contribute to ongoing health disparities experienced by AI/AN children and youth. The following recommendations are intended to support the policies and systems needed to promote and protect the health of AI/AN children and youth:

- Advocate for community initiatives and develop partnerships to address health disparities, such as altering practices of frequent consumption of sugar-sweetened beverages through education and improving the selection of foods locally available, to address healthy weight and oral health.
- Share information with the US Congress, state legislatures, foundations, and other appropriate advocacy groups about the inequities and tremendous health disparities that exist between AI/AN populations and the general US population.
- Invest in new research and clinical pathways to create culturally relevant screening and interventions for ACEs.
- Advocate for federal, state, and local policy to end AI/AN homelessness through consultation and engagement with tribal leaders, AI/AN communities, and AI/AN young people with lived experience of homelessness. Advocate for the investment in improved data collection on homelessness among both rural and urban AI/AN youth and culturally responsive interventions to address homelessness among diverse tribal nations.
- Work with local tribes and communities to address the need for research and advocacy around missing and murdered Indigenous women and girls.[69]
- Advocate for the protection and enforcement of the Indian Child Welfare Act.
- Advocate for increased Medicaid coverage for children and families as well as increased payment for services.
- Advocate for improved IHS budget and funding, which is chronically underfunded. IHS expenditures are among the lowest per capita compared with other federal health care expenditures, such as Medicare and the Veterans Health Administration. This disparity contributes significantly to the ongoing health inequities experienced by AI/AN people. Advocate for policies such as advanced appropriations or mandatory funding to provide the IHS with predictable and continuous funding.
- Work with local government and tribal communities to understand and mitigate the negative effects of punitive drug laws for pregnant women.

LEAD AUTHORS

Shaquita Bell, MD, FAAP
Jason F. Deen, MD, FAAP
Molly Fuentes, MD, MS
Kelly Moore, MD, FAAP

ABBREVIATIONS

ACE: adverse childhood experience
AI: American Indian
AI/AN: American Indian and Alaska Native
CYSHCN: children and youth with special health care needs
IHS: Indian Health Service
NHW: non-Hispanic white
T2DM: type 2 diabetes mellitus

PEDIATRICS (ISSN Numbers: Print, 0031-4005; Online, 1098-4275).

FINANCIAL DISCLOSURE: Dr Moore was a paid consultant for the Public Health Institute (Oakland, CA); and Drs Bell, Deen, and Fuentes have indicated they have no financial relationships relevant to this article to disclose.

FUNDING: No external funding.

POTENTIAL CONFLICT OF INTEREST: Dr Moore was a paid consultant for the Public Health Institute (Oakland, CA); and Drs Bell, Deen, and Fuentes have indicated they have no potential conflicts of interest to disclose.

REFERENCES

1. Brave Heart MY. The historical trauma response among natives and its relationship with substance abuse: a Lakota illustration. *J Psychoactive Drugs*. 2003;35(1):7–13
2. US Census Bureau. Facts for Features: American Indian and Alaska Native Heritage Month: November 2018. Available at: https://www.census.gov/newsroom/facts-for-features/2018/aian.html. Accessed February 25, 2021
3. Hoover E, Cook K, Plain R, et al. Indigenous peoples of North America: environmental exposures and reproductive justice. *Environ Health Perspect*. 2012;120(12):1645–1649
4. Sarche M, Spicer P. Poverty and health disparities for American Indian and Alaska native children: current knowledge and future prospects. *Ann N Y Acad Sci*. 2008;1136:126–136
5. Call KT, McAlpine DD, Johnson PJ, Beebe TJ, McRae JA, Song Y. Barriers to care among American Indians in public health care programs. *Med Care*. 2006;44(6):595–600
6. Puumala SE, Burgess KM, Kharbanda AB, et al. The role of bias by emergency department providers in care for American Indian children. *Med Care*. 2016;54(6):562–569
7. Barradas DT, Kroelinger CD, Kogan MD. Medical home access among American Indian and Alaska native children in 7 states: National Survey of Children's Health. *Matern Child Health J*. 2012;16(suppl 1):S6–S13
8. Trent M, Dooley DG, Dougé J; Section on Adolescent Health; Council on Community Pediatrics; Committee on Adolescence. The impact of racism on child and adolescent health. *Pediatrics*. 2019;144(2):e20191765
9. Garner AS, Shonkoff JP; Committee on Psychosocial Aspects of Child and Family Health; Committee on Early Childhood, Adoption, and Dependent Care; Section on Developmental and Behavioral Pediatrics. Early childhood adversity, toxic stress, and the role of the pediatrician: translating developmental science into lifelong health. *Pediatrics*. 2012;129(1). Available at: www.pediatrics.org/cgi/content/full/129/1/e224
10. Felitti VJ, Anda RF, Nordenberg D, et al. Relationship of childhood abuse and household dysfunction to many of the leading causes of death in adults. The Adverse Childhood Experiences (ACE) Study. *Am J Prev Med*. 1998;14(4):245–258
11. Dong M, Anda RF, Felitti VJ, et al. The interrelatedness of multiple forms of childhood abuse, neglect, and household dysfunction. *Child Abuse Negl*. 2004;28(7):771–784
12. Anda RF, Felitti VJ, Bremner JD, et al. The enduring effects of abuse and related adverse experiences in childhood. A convergence of evidence from neurobiology and epidemiology. *Eur Arch Psychiatry Clin Neurosci*. 2006;256(3):174–186
13. Warne D, Dulacki K, Spurlock M, et al. Adverse childhood experiences (ACE) among American Indians in South Dakota and associations with mental health conditions, alcohol use, and smoking. *J Health Care Poor Underserved*. 2017;28(4):1559–1577
14. Koss MP, Yuan NP, Dightman D, et al. Adverse childhood exposures and alcohol dependence among seven Native American tribes. *Am J Prev Med*. 2003;25(3):238–244
15. Kenney MK, Singh GK. Adverse childhood experiences among

American Indian/Alaska native children: the 2011-2012 National Survey of Children's Health. *Scientifica (Cairo)*. 2016;2016:7424239

16. Brockie TN, Dana-Sacco G, Wallen GR, Wilcox HC, Campbell JC. The relationship of adverse childhood experiences to PTSD, depression, poly-drug use and suicide attempt in reservation-based Native American adolescents and young adults. *Am J Community Psychol*. 2015;55(3–4): 411–421
17. US Department of Health and Human Services. Obesity and American Indians/Alaska natives. Available at: https://aspe.hhs.gov/basic-report/obesity-and-american-indiansalaska-natives. Accessed December 2, 2016
18. Lindsay RS, Cook V, Hanson RL, Salbe AD, Tataranni A, Knowler WC. Early excess weight gain of children in the Pima Indian population. *Pediatrics*. 2002;109(2):E33
19. Salbe AD, Weyer C, Lindsay RS, Ravussin E, Tataranni PA. Assessing risk factors for obesity between childhood and adolescence: I. Birth weight, childhood adiposity, parental obesity, insulin, and leptin. *Pediatrics*. 2002;110(2 pt 1): 299–306
20. Dalenius K, Borland E, Smith B, Polhamus B, Grummer-Strawn L. *Pediatric Nutrition Surveillance 2010 Report*. Atlanta, GA: Centers for Disease Control and Prevention; 2012
21. Schell LM, Gallo MV. Overweight and obesity among North American Indian infants, children, and youth. *Am J Hum Biol*. 2012;24(3):302–313
22. Centers for Disease Control and Prevention (CDC). Obesity prevalence among low-income, preschool-aged children - United States, 1998-2008. *MMWR Morb Mortal Wkly Rep*. 2009; 58(28):769–773
23. Bullock A, Sheff K, Moore K, Manson S. Obesity and overweight in American Indian and Alaska native children, 2006-2015. *Am J Public Health*. 2017;107(9): 1502–1507
24. Pan L, Park S, Slayton R, Goodman AB, Blanck HM. Trends in severe obesity among children aged 2 to 4 years enrolled in Special Supplemental Nutrition Program for Women, Infants, and Children from 2000 to 2014. *JAMA Pediatr*. 2018;172(3):232–238
25. Tomayko EJ, Prince RJ, Cronin KA, Adams AK. The Healthy Children, Strong Families intervention promotes improvements in nutrition, activity and body weight in American Indian families with young children. [published correction appears in Public Health Nutr. 2017;20(2):380]. *Public Health Nutr*. 2016;19(15):2850–2859
26. Lindberg SM, Adams AK, Prince RJ. Early predictors of obesity and cardiovascular risk among American Indian children. *Matern Child Health J*. 2012;16(9):1879–1886
27. Institute of Medicine. *Early Childhood Obesity Prevention Policies*. Washington, DC: National Academies Press; 2011
28. Whitaker RC, Wright JA, Pepe MS, Seidel KD, Dietz WH. Predicting obesity in young adulthood from childhood and parental obesity. *N Engl J Med*. 1997; 337(13):869–873
29. Pan L, May AL, Wethington H, Dalenius K, Grummer-Strawn LM. Incidence of obesity among young U.S. children living in low-income families, 2008-2011. *Pediatrics*. 2013;132(6):1006–1013
30. American Diabetes Association. Type 2 diabetes in children and adolescents. *Diabetes Care*. 2000;23(3):381–389
31. American Diabetes Association. 2. Classification and diagnosis of diabetes: *Standards of Medical Care in Diabetes-2018*. *Diabetes Care*. 2018; 41(suppl 1):S13–S27
32. Springer SC, Silverstein J, Copeland K, et al; American Academy of Pediatrics. Management of type 2 diabetes mellitus in children and adolescents. [published correction appears in Pediatrics. 2013; 131(5):1014]. *Pediatrics*. 2013;131(2). Available at: www.pediatrics.org/cgi/content/full/131/2/e648
33. Gahagan S, Silverstein J; American Academy of Pediatrics Committee on Native American Child Health; American Academy of Pediatrics Section on Endocrinology. Prevention and treatment of type 2 diabetes mellitus in children, with special emphasis on American Indian and Alaska native children. *Pediatrics*. 2003;112(4). Available at: www.pediatrics.org/cgi/content/full/112/4/e328
34. Section on Breastfeeding. Breastfeeding and the use of human milk. *Pediatrics*. 2012;129(3). Available at: www.pediatrics.org/cgi/content/full/129/3/e827
35. Jones KM, Power ML, Queenan JT, Schulkin J. Racial and ethnic disparities in breastfeeding. *Breastfeed Med*. 2015; 10(4):186–196
36. Sparks PJ. Racial/ethnic differences in breastfeeding duration among WIC-eligible families. *Womens Health Issues*. 2011;21(5):374–382
37. Zamora-Kapoor A, Omidpanah A, Nelson LA, Kuo AA, Harris R, Buchwald DS. Breastfeeding in infancy is associated with body mass index in adolescence: a retrospective cohort study comparing American Indians/Alaska natives and non-Hispanic whites. *J Acad Nutr Diet*. 2017;117(7):1049–1056
38. Houghtaling B, Byker Shanks C, Ahmed S, Rink E. Grandmother and health care professional breastfeeding perspectives provide opportunities for health promotion in an American Indian community. *Soc Sci Med*. 2018;208: 80–88
39. Walkup JT, Barlow A, Mullany BC, et al. Randomized controlled trial of a paraprofessional-delivered in-home intervention for young reservation-based American Indian mothers. *J Am Acad Child Adolesc Psychiatry*. 2009; 48(6):591–601
40. Kenney MK, Thierry J. Chronic conditions, functional difficulties, and disease burden among American Indian/Alaska native children with special health care needs, 2009-2010. *Matern Child Health J*. 2014;18(9): 2071–2079
41. Wong CA, Gachupin FC, Holman RC, et al. American Indian and Alaska native infant and pediatric mortality, United States, 1999-2009. *Am J Public Health*. 2014;104(suppl 3):S320–S328
42. Cappiello MM, Gahagan S. Early child development and developmental delay in indigenous communities. *Pediatr Clin North Am*. 2009;56(6):1501–1517
43. MacDorman MF. Race and ethnic disparities in fetal mortality, preterm birth, and infant mortality in the United

States: an overview. *Semin Perinatol*. 2011;35(4):200–208

44. Barros N, Tulve NS, Heggem DT, Bailey K. Review of built and natural environment stressors impacting American-Indian/Alaska-native children. *Rev Environ Health*. 2018;33(4):349–381
45. Itty TL, Hodge FS, Martinez F. Shared and unshared barriers to cancer symptom management among urban and rural American Indians. *J Rural Health*. 2014;30(2):206–213
46. Call KT, McAlpine DD, Garcia CM, et al. Barriers to care in an ethnically diverse publicly insured population: is health care reform enough? *Med Care*. 2014; 52(8):720–727
47. Fuentes MM, Thompson L, Quistberg DA, et al. Auditing access to outpatient rehabilitation services for children with traumatic brain injury and public insurance in Washington State. *Arch Phys Med Rehabil*. 2017;98(9): 1763–1770.e7
48. Fuentes M, Lent K. Culture, health, function, and participation among American Indian and Alaska native children and youth with disabilities: an exploratory qualitative analysis. *Arch Phys Med Rehabil*. 2019;100(9): 1688–1694
49. Centers for Disease Control and Prevention. Web-based Injury Statistics Query and Reporting System (WISQARS) [online]. Details of leading cause of death: 2016, United States, suicide, ages 10-24, American Indian/Alaska native, both sexes. Available at: www.cdc.gov/injury/wisqars. Accessed November 29, 2018
50. Centers for Disease Control and Prevention. Web-based Injury Statistics Query and Reporting System (WISQARS) [online]. Details of leading cause of death: 2016, United States, suicide ages 10-24, all races, both sexes. Available at: www.cdc.gov/injury/wisqars. Accessed November 29, 2018
51. Centers for Disease Control and Prevention. Web-based Injury Statistics Query and Reporting System (WISQARS) [online]. 2016, United States, suicide injury deaths and rates per 100,000, all races, both sexes, ages 10-24. Available at: www.cdc.gov/injury/wisqars. Accessed November 29, 2018
52. Herne MA, Bartholomew ML, Weahkee RL. Suicide mortality among American Indians and Alaska natives, 1999-2009. *Am J Public Health*. 2014;104(suppl 3): S336–S342
53. Mullany B, Barlow A, Goklish N, et al. Toward understanding suicide among youths: results from the White Mountain Apache tribally mandated suicide surveillance system, 2001-2006. *Am J Public Health*. 2009;99(10): 1840–1848
54. Borowsky IW, Resnick MD, Ireland M, Blum RW. Suicide attempts among American Indian and Alaska native youth: risk and protective factors. *Arch Pediatr Adolesc Med*. 1999;153(6): 573–580
55. Mackin J, Perkins T, Furrer C. The power of protection: a population-based comparison of native and non-native youth suicide attempters. *Am Indian Alsk Native Ment Health Res*. 2012;19(2): 20–54
56. Qiao N, Bell TM. Indigenous adolescents' suicidal behaviors and risk factors: evidence from the National Youth Risk Behavior Survey. *J Immigr Minor Health*. 2017;19(3):590–597
57. Leavitt RA, Ertl A, Sheats K, Petrosky E, Ivey-Stephenson A, Fowler KA. Suicides among American Indian/Alaska natives - National Violent Death Reporting System, 18 states, 2003-2014. *MMWR Morb Mortal Wkly Rep*. 2018;67(8): 237–242
58. Allen J, Rasmus SM, Fok CCT, Charles B, Henry D; Qungasvik Team. Multi-level cultural intervention for the prevention of suicide and alcohol use risk with Alaska native youth: a nonrandomized comparison of treatment intensity. *Prev Sci*. 2018;19(2):174–185
59. Koenig KT, Ramos MM, Fowler TT, Oreskovich K, McGrath J, Fairbrother G. A statewide profile of frequent users of school-based health centers: implications for adolescent health care. *J Sch Health*. 2016;86(4):250–257
60. Almeida J, Johnson RM, Corliss HL, Molnar BE, Azrael D. Emotional distress among LGBT youth: the influence of perceived discrimination based on sexual orientation. *J Youth Adolesc*. 2009;38(7):1001–1014
61. Kessler RC, Borges G, Walters EE. Prevalence of and risk factors for lifetime suicide attempts in the National Comorbidity Survey. *Arch Gen Psychiatry*. 1999;56(7):617–626
62. Institute of Medicine Committee on Lesbian, Gay, Bisexual, and Transgender Health Issues and Research Gaps and Opportunities. *The Health of Lesbian, Gay, Bisexual, and Transgender People: Building a Foundation for Better Understanding*. Washington, DC: National Academies Press; 2011
63. Angelino A, Evans-Campbell T, Duran B. Assessing health provider perspectives regarding barriers American Indian/Alaska native transgender and two-spirit youth face accessing healthcare. *J Racial Ethn Health Disparities*. 2020; 7(4):630–642
64. Perez-Brumer A, Day JK, Russell ST, Hatzenbuehler ML. Prevalence and correlates of suicidal ideation among transgender youth in California: findings from a representative, population-based sample of high school students. *J Am Acad Child Adolesc Psychiatry*. 2017;56(9):739–746
65. Bostwick WB, Meyer I, Aranda F, et al. Mental health and suicidality among racially/ethnically diverse sexual minority youths. *Am J Public Health*. 2014;104(6):1129–1136
66. James SE, Herman JL, Rankin S, Keisling M, Mottet L, Anafi M. *The Report of the 2015 U.S. Transgender Survey*. Washington, DC: National Center for Transgender Equality; 2016
67. Rafferty J; Committee on Psychosocial Aspects of Child and Family Health; Committee on Adolescence; Section on Lesbian, Gay, Bisexual, and Transgender Health and Wellness. Ensuring comprehensive care and support for transgender and gender-diverse children and adolescents. *Pediatrics*. 2018;142(4):e20182162
68. Fuentes MM, Moore M, Qiu Q, Quistberg A, Frank M, Vavilala MS. Differences in injury characteristics and outcomes for American Indian/Alaska native people hospitalized with traumatic injuries: an analysis of the National Trauma Data Bank. *J Racial Ethn Health Disparities*. 2019;6(2):335–344
69. Urban Indian Health Institute. *Missing and Murdered Indigenous Women &*

Girls: A Snapshot of Data from 71 Urban Cities in the United States. Seattle, WA: Urban Indian Health Institute; 2018

70. Greenbaum J, Bodrick N; Committee on Child Abuse and Neglect; Section on International Child Health. Global human trafficking and child victimization. *Pediatrics*. 2017;140(6): e20173138

71. National Center on Domestic and Sexual Violence. Sexual violence/assault. 2012. Available at: www.ncdsv.org/publications_Sexual-Violence-Assault.html. Accessed November 11, 2019

72. Pierce A. *Shattered Hearts: The Commercial Sexual Exploitation of American Indian Women and Girls in Minnesota*. Minneapolis, MN: Minnesota Indian Women's Resource Center; 2009

73. Wiltz T. *American Indian Girls Often Fall Through the Cracks*. Philadelphia, PA: The Pew Charitable Trusts; 2016. Available at: https://www.pewtrusts.org/en/research-and-analysis/blogs/stateline/2016/03/04/american-indian-girls-often-fall-through-the-cracks. Accessed November 11, 2019

74. Administration for Children and Families. Combating Trafficking: Native Youth Toolkit on Human Trafficking. Washington, DC: Administration for Children and Families; 2017. Available at: https://www.acf.hhs.gov/blog/2018/01/combating-trafficking-native-youth-toolkit-on-human-trafficking. Accessed November 11, 2019

75. Children's Bureau. Child maltreatment 2017. Available at: https://www.acf.hhs.gov/cb/resource/child-maltreatment-2017. Accessed November 11, 2019

76. Williams SC. State-level data for understanding child welfare in the United States. Available at: https://www.childtrends.org/publications/state-level-data-for-understanding-child-welfare-in-the-united-states. Accessed November 11, 2019

77. Hill KM. The prevalence of youth with disabilities among older youth in out-of-home placement: an analysis of state administrative data. *Child Welfare*. 2012;91(4):61–84

78. Earle K, Cross A. *Child Abuse and Neglect Among American Indian/Alaska Native Children: An Analysis of Existing Data*. Seattle, WA: Casey Family Programs; 2001

79. Nash DA, Nagel RJ. Confronting oral health disparities among American Indian/Alaska native children: the pediatric oral health therapist. *Am J Public Health*. 2005;95(8):1325–1329

80. Indian Health Service. *The 1999 Oral Health Survey of American Indian and Alaska Native Dental Patients: Findings, Regional Differences and National Comparisons*. Rockville, MD: US Department of Health and Human Services; 2001

81. Holve S, Braun P, Irvine JD; American Academy of Pediatrics Committee on Native American Child Health and Section on Oral Health; Canadian Paediatric Society First Nations, Inuit and Métis Committee. Early childhood caries in indigenous communities. *Pediatrics*. 2021, In press

82. Ochi JW, Wheelbarger L, Dautenhahn LW. Chronic otitis media in ancient American Indians. *Pediatrics*. 2018; 141(4):e20172308

83. Curns AT, Holman RC, Shay DK, et al. Outpatient and hospital visits associated with otitis media among American Indian and Alaska native children younger than 5 years. *Pediatrics*. 2002;109(3). Available at: www.pediatrics.org/cgi/content/full/109/3/e41

84. Atherly A, Mortensen K. Medicaid primary care physician fees and the use of preventive services among Medicaid enrollees. *Health Serv Res*. 2014;49(4):1306–1328

85. Polsky D, Richards M, Basseyn S, et al. Appointment availability after increases in Medicaid payments for primary care. *N Engl J Med*. 2015;372(6):537–545

86. Alker J, Wagnerman K, Schneider A. *Coverage Trends for American Indian and Alaska Native Children and Families*. Washington, DC: Georgetown University Health Policy Institute; 2017

87. Artiga S, Ubri U, Foutz J. *Medicaid and American Indians and Alaska Natives*. San Francisco, CA: Henry J. Kaiser Family Foundation; 2017

88. Vintzileos AM, Ananth CV, Smulian JC, Scorza WE, Knuppel RA. The impact of prenatal care in the United States on preterm births in the presence and absence of antenatal high-risk conditions. *Am J Obstet Gynecol*. 2002; 187(5):1254–1257

89. Stone R. Pregnant women and substance use: fear, stigma and barriers to care. *Health Justice*. 2015;3: 2

90. Soleimanpour S, Geierstanger S, Brindis CD. Adverse childhood experiences and resilience: addressing the unique needs of adolescents. *Acad Pediatr*. 2017;17(suppl 7):S108–S114

91. Marsac ML, Kassam-Adams N, Hildenbrand AK, et al. Implementing a trauma-informed approach in pediatric health care networks. *JAMA Pediatr*. 2016;170(1):70–77

92. Ginsburg KR, Kinsman SB, eds.. *Reaching Teens: Strength-Based Communication Strategies to Build Resilience and Support Healthy Adolescent Development*. Elk Grove Village, IL: American Academy of Pediatrics; 2014

93. Swaim RC, Stanley LR. Substance use among American Indian youths on reservations compared with a national sample of US adolescents. *JAMA Netw Open*. 2018;1(1):e180382

94. American Academy of Family Physicians. The EveryONE project toolkit. Available at: https://www.aafp.org/patient-care/social-determinants-of-health/everyone-project/eop-tools.html. Accessed December 5, 2018

95. Giuse NB, Koonce TY, Kusnoor SV, et al. Institute of Medicine measures of social and behavioral determinants of health: a feasibility study. *Am J Prev Med*. 2017; 52(2):199–206

96. Arthur KC, Lucenko BA, Sharkova IV, Xing J, Mangione-Smith R. Using state administrative data to identify social complexity risk factors for children. *Ann Fam Med*. 2018;16(1):62–69

97. Duffee JH, Mendelsohn AL, Kuo AA, Legano LA, Earls MF; Council on Community Pediatrics; Council on Early Childhood; Committee on Child Abuse and Neglect. Early childhood home visiting. *Pediatrics*. 2017;140(3): e20172150

98. Klass P, Dreyer BP, Mendelsohn AL. Reach out and read: literacy promotion in pediatric primary care. *Adv Pediatr*. 2009;56:11–27

99. American Indian Library Association. American Indian youth literature award. Available at: https://ailanet.org/activities/american-indian-youth-literature-award/. Accessed December 5, 2018

100. Morton MH, Chávez R, Moore K. Prevalence and correlates of homelessness among American Indian and Alaska native youth. *J Prim Prev*. 2019;40(6):643–660

101. Thomas MMC, Miller DP, Morrissey TW. Food insecurity and child health. *Pediatrics*. 2019;144(4):e20190397

102. Blue Cross Complete of Michigan. Culturally and Linguistically Appropriate Services (CLAS) provider cultural competency. Available at: https://www.bcbsm.com/content/dam/microsites/blue-cross-complete/blue-cross-complete-clas-training-presentation.pdf. Accessed January 15, 2019

103. Donoghue EA; Council on Early Childhood. Quality early education and child care from birth to kindergarten. *Pediatrics*. 2017;140(2):e20171488

104. Earls MF, Yogman MW, Mattson G, Rafferty J; Committee on Psychosocial Aspects of Child and Family Health. Incorporating recognition and management of perinatal depression into pediatric practice. *Pediatrics*. 2019; 143(1):e20183259

105. Committee on Substance Use and Prevention. Substance use screening, brief intervention, and referral to treatment. *Pediatrics*. 2016;138(1): e20161210

106. Levy SJ, Williams JF; Committee on Substance Use and Prevention. Substance use screening, brief intervention, and referral to treatment. *Pediatrics*. 2016;138(1): e20161211

107. Patrick SW, Schiff DM; Committee on Substance Use and Prevention. A public health response to opioid use in pregnancy. *Pediatrics*. 2017; 139(3):e20164070

Child Life Services

POLICY STATEMENT Organizational Principles to Guide and Define the Child Health Care System and/or Improve the Health of all Children

American Academy of Pediatrics

DEDICATED TO THE HEALTH OF ALL CHILDREN®

Child Life Services

Barbara Romito, MA, CCLS,[a] Jennifer Jewell, MD, FAAP,[b] Meredith Jackson, MD, FAAP,[b] AAP COMMITTEE ON HOSPITAL CARE; ASSOCIATION OF CHILD LIFE PROFESSIONALS

Child life programs are an important component of pediatric hospital-based care; they address the psychosocial concerns that accompany hospitalization and other health care experiences. Child life specialists focus on the optimal development and well-being of infants, children, adolescents, and young adults while promoting coping skills and minimizing the adverse effects of hospitalization, health care encounters, and/or other potentially stressful experiences. In collaboration with the entire health care team and family, child life specialists provide interventions that include therapeutic play, expressive modalities, and psychological preparation to facilitate coping and normalization at times and under circumstances that might otherwise prove overwhelming for the child. Play and developmentally appropriate communication are used to (1) promote optimal development, (2) educate children and families about health conditions, (3) prepare children and partner with families for medical events or procedures, (4) plan and rehearse useful coping and pain-management strategies with patients and families, (5) help children work through feelings about past or impending experiences, and (6) partner with families to establish therapeutic relationships between patients, siblings, and caregivers. Child life specialists collaborate with the entire interdisciplinary team to promote coping and enhance the overall health care experience for patients and families.

CHILD LIFE INTERVENTIONS: PSYCHOLOGICAL PREPARATION

Preparing children for hospitalization, clinic visits, surgeries, and diagnostic and/or therapeutic procedures is essential during a child's hospitalization and an important element of a child life program. It is estimated that 50% to 75% of children develop significant fear and anxiety before surgery; recognized risk factors include age, temperament, baseline anxiety, past medical encounters, and caregiver anxiety.[1] Children's anxiety in the perioperative environment is associated with impaired postoperative behavioral and clinical recovery, including increased analgesic requirements and delayed discharge from the recovery room.[2,3] Preparation can reduce anxiety and distress before surgery and/or during mask induction and may also decrease emergence

abstract

[a]*Child Life Program, The Bristol-Myers Squibb Children's Hospital at Robert Wood Johnson University Hospital, New Brunswick, New Jersey; and* [b]*The Barbara Bush Children's Hospital at Maine Medical Center, Portland, Maine*

Ms Romito provided the benchmarking data and the majority of the writing; Dr Jewell designed the outline for the policy, noted and updated information that was irrelevant since the last revision, provided assistance with the writing, and presented the content to the Committee on Hospital Care; Dr Jackson provided technical assistance, draft review, and content expertise for the portions related to medical education; and all authors approved the final manuscript as submitted.

Policy statements from the American Academy of Pediatrics benefit from expertise and resources of liaisons and internal (AAP) and external reviewers. However, policy statements from the American Academy of Pediatrics may not reflect the views of the liaisons or the organizations or government agencies that they represent.

The guidance in this statement does not indicate an exclusive course of treatment or serve as a standard of medical care. Variations, taking into account individual circumstances, may be appropriate.

All policy statements from the American Academy of Pediatrics automatically expire 5 years after publication unless reaffirmed, revised, or retired at or before that time.

DOI: https://doi.org/10.1542/peds.2020-040261

Address correspondence to Barbara Romito, MA, CCLS.
E-mail: Barbara.Romito@rwjbh.org

PEDIATRICS (ISSN Numbers: Print, 0031-4005; Online, 1098-4275).

FINANCIAL DISCLOSURE: The authors have indicated they have no financial relationships relevant to this article to disclose.

To cite: Romito B, Jewell J, Jackson M, AAP COMMITTEE ON HOSPITAL CARE; ASSOCIATION OF CHILD LIFE PROFESSIONALS. Child Life Services. *Pediatrics*. 2021;147(1):e2020040261

delirium after surgery.[4–7] More than 50 years of research and experience supports 3 key elements of the preparation process: (1) the provision of developmentally appropriate information, (2) the encouragement of questions and emotional expression, and (3) the formation of a trusting relationship with a health care professional.[3] A recent systematic review of preparation effectiveness evidence concluded that children who were psychologically prepared for surgery experienced fewer negative symptoms than did children who did not receive formal preparation.[3] Findings included a decrease in posttraumatic stress, lower levels of fear and anxiety, increased cooperative behaviors, and better long-term coping and adjustment to future medical challenges. Research also demonstrates that preparation and coping facilitation interventions decrease the need for sedation in procedures such as MRI and radiotherapy, resulting in lower risks for the child and cost savings in personnel, anesthesia, and throughput-related expenses.[8–12]

Preparation techniques, materials, and language must be adapted to the developmental level, personality, and unique experiences of each child and family. Learning is enhanced with hands-on methods versus exclusively verbal explanations. Photographs, diagrams, tours of surgical or treatment areas, actual and pretend medical equipment, and various models (dolls, puppets) are used to reinforce learning and actively engage the child.[1,13] Caregivers should be included in the preparation process because this can decrease parental anxiety and allow them to provide essential family-centered support.[14,15]

An experimental evaluation of one child life program model revealed that child life interventions resulted in less emotional distress, better overall coping during the hospital stay, a clearer understanding of procedures, and a more positive physical recovery as well as posthospital adjustment for children enrolled.[16] Patients spent less time on narcotics, the length of stay was slightly reduced, and caregivers were more satisfied. In other studies, researchers have found that child life interventions play a major role in calming children's fears and result in higher parent satisfaction ratings of the entire care experience.[8,17,18]

CHILD LIFE INTERVENTIONS: PAIN-MANAGEMENT AND COPING STRATEGIES

When combined with preparation and appropriate pharmacologic interventions, nonpharmacologic pain- and distress-management strategies have proven successful in terms of patient and family experience, staff experience, and cost-effectiveness.[17,19,20] Strategies such as swaddling, oral sucrose, vibratory stimulation, breathing techniques, relaxation, and guided imagery have been shown to decrease behavioral distress and pain experience in children during invasive medical procedures.[21–25]

Distraction strategies have been highly effective in reducing reported and observed pain and distress in children in inpatient, emergency department (ED), and clinic settings.[26–32] The emergence of virtual reality, Internet technology, and electronic and digital devices has been found to be an effective means of distraction in reducing pain.[7,33–38] Child life specialists may also develop comfort kits for use in treatment areas to include age-appropriate distraction items, such as bubbles, pop-up and sound books, light-up toys, and other visual or auditory tools.[39] Distraction techniques have also been shown to be successful in lowering a parent's fear and distress during an invasive procedure.[27]

Child life specialists can effectively provide developmentally appropriate nonpharmacologic pain management and provide coaching and support to patients and caregivers before, during, and after medical procedures.[40,41] They can also provide valuable education and training to nurses, physicians, students, and other personnel, supporting health care team member competencies in the provision of developmentally appropriate, psychosocially sound care.[42,43] Multifaceted institution-wide protocols, such as the Ouchless Place and other similar programs, incorporate the standard use of both pharmacologic and nonpharmacologic techniques, preparation of the patient and family, environmental considerations, and training of all health care team members.[44,45]

Research has demonstrated that children are less fearful and distressed when positioned for medical procedures in a sitting position rather than supine.[46] Child life specialists are often involved in facilitating the use of "comfort holds," techniques for positioning children in a parent or caregiver's lap or other comforting position. In addition to reducing the child's distress and gaining cooperation, these techniques generally require fewer staff to be present in the room, facilitate safe and effective accomplishment of the medical procedure, decrease parent anxiety, and increase parent satisfaction.[47,48] With a goal to severely limit the use of papoose boards and eliminate the practice of multiple staff members holding a child down, these techniques provide a viable and more humane alternative in most cases.

CHILD LIFE INTERVENTIONS: THE THERAPEUTIC VALUE OF PLAY

Therapeutic play during health care experiences is essential and a major component of a child life program and

of the child life professional's role. Play is crucial to a child's social, emotional, and cognitive development and is even more critical during adversity or stress points in a child's life.[49] In addition to its developmentally supportive benefits and as a normalizing activity for children and youth of all ages, play is particularly valuable for children who are anxious or struggling to cope with stressful circumstances of hospitalization, illness, or grief.[50] Erik Erikson[51] writes, "To play out is the most natural auto-therapeutic measure childhood affords. Whatever other roles play may have in the child's development…the child uses it to make up for defeats, sufferings, and frustrations." Play in the health care setting is adapted to address unique needs on the basis of developmental level, self-directed interests, medical condition and physical abilities, psychosocial vulnerabilities, and setting (eg, bedside, playroom, clinic). Play as a therapeutic modality, including health care play or "medical play," has been found to reduce children's emotional distress and help them cope with medical experiences.[52] Research has revealed that physiologic responses, such as palm sweating, excessive body movement, tachycardia, and hypertension, can be reduced with therapeutic play interventions.[53]

Play can be adapted to address the developmental and psychosocial needs of patients in every pediatric age group. For example, infants and toddlers benefit from exploratory and sensorimotor play, and preschoolers enjoy fantasy play and creative art activities.[54] Opportunities for parents to engage in play activities with their young children are beneficial to both the patient and family, alleviating some feelings of helplessness that can be common in caregivers and assisting in the child's adjustment to the hospital.[55]

School-aged children and adolescents seek play that contributes to feelings of mastery and achievement (one reason video games are so popular with this age group[56]). Patients in this age group also benefit from activities that allow them to maintain relationships with peers and establish new connections through, for example, online networking and the availability of teen-aged activity rooms in the hospital setting.[57]

Auxiliary programs, such as animal-assisted therapy, infant massage instruction, therapeutic clowning, performing arts, and artist-in-residence programs, often used in conjunction with child life services and incorporated into child life departments, provide additional outlets for patients of all ages and their families.[58–60] Live, interactive programming using closed-circuit television systems and studios can be a particularly effective way to engage patients restricted to their rooms for infection-control or medical reasons. Other interactive technology, such as video conferencing, can help patients engage with people outside the hospital, including their peers, the community, and their schools. The ability to connect with a child's school, community, and home helps normalize the experience by minimizing disruption of usual routines. Expressive therapies, such as those provided by distinctly certified play therapists, music therapists, and art therapists, can be offered to complement child life programs and to provide support for particularly vulnerable patients.[26,61,62]

CHILD LIFE INTERVENTIONS: PARTNERING WITH FAMILIES TO PROVIDE SUPPORT

The presence and participation of and partnership with family members is a fundamental component of patient- and family-centered care and has a significant positive effect on a child's adjustment to the health care experience.[63] When parents or other family members are highly anxious about the child's illness or diagnostic and treatment regimens, such anxiety is easily transmitted to the patient.[64] Child life specialists help facilitate the family's adjustment to the child's illness and health care experience by providing psychosocial support and coping strategies for caregivers. They can help family members understand their child's response to treatment and support caregiving roles by promoting parent-child play sessions and sharing strategies for comforting or coaching their children during medical procedures. In addition, child life specialists play a pivotal role in encouraging and facilitating family involvement in the patient's care as well as promoting communication between family members, providers, and the interdisciplinary team.

Siblings of pediatric patients present with their own unique anxieties and psychosocial needs, not often assessed or addressed. Siblings, much like children of adult patients, can be helped to comprehend a family member's illness via therapeutic play and educational interventions or by offering support during hospital visits, including diagnoses, critical care, and end-of-life situations.[65,66] Although sibling support is essential in all areas, a critical care hospitalization in the neonatal or pediatric ICU presents additional stressors for the entire family, and child life interventions are often focused on the siblings' psychosocial needs. Sibling support may include preparing the sibling(s) for an initial visit and providing ongoing emotional support throughout the patient's hospital stay. Child life specialists are often involved in providing bereavement support to patients as well as siblings and other family members. Grief support and legacy activities, such as hand molds or memory boxes for siblings and family members, are often provided at the end of life for both pediatric and adult patients throughout the hospital. In conjunction with the interdisciplinary team, child life specialists are critical in helping all family members

understand how to support children in age-appropriate ways during end-of-life events.

RECENT BENCHMARKING DATA

In 2016, the Association of Child Life Professionals (ACLP) constructed the Child Life Professional Data Center (CLPDC), an online database to house comprehensive child life program data and metrics, including staffing models, staffing ratios, budget allocation data, and hospital descriptors.[67] Using a systematic and evidence-based approach to measure the impact of psychosocial services provided to pediatric patients and families, this database has synthesized information from more than 160 child life programs. In addition, the ACLP established a productivity metric measuring the number of patient and family encounters a child life specialist provides in a specified setting within the hospital during a shift. Currently, more than 50 programs have participated in the productivity data collection. The productivity metric is a numerical indicator of the number of patient and family encounters that can be expected during the child life specialist's shift. This measure of productivity is collected for 6 distinct areas of service: (1) inpatient acute care units, (2) critical care, (3) radiology, (4) presurgery, (5) outpatient ambulatory care, and (6) the ED. These 6 distinct areas are being used to collect and segment data because the type and length of child life intervention can depend on which medical service is being provided. A patient encounter is defined as a child life specialist–provided interaction with a patient, sibling, or caregiver, and this serves as the numerator of the productivity metric. The denominator is the length of the child life specialist's shift (eg, 8 hours). The final metric given is the measure of patient and family encounters per hour. These metrics account for nondirect patient care activities and direct patient care interventions. By using the shift length as the denominator, additional nonpatient care responsibilities are accounted for in the productivity calculation, including such things as meetings, committee work, student and staff education, and donor events.[67]

Figure 1 identifies the total number of individual patient and family encounters an individual child life specialist provides in an 8-hour shift in each of the 6 service areas. In radiology, the median productivity is 0.74 patient encounters per hour, or approximately 6 encounters in an 8-hour day. Of all 6 areas of service, radiology encounters trend the longest because radiologic procedures often require significant preparation and support during the procedures, which may be lengthy. Child life specialists in presurgery and the ED have the highest median productivity, with an average of 1.2 patient encounters every hour, roughly 10 patients seen per 8-hour shift in each of these areas.

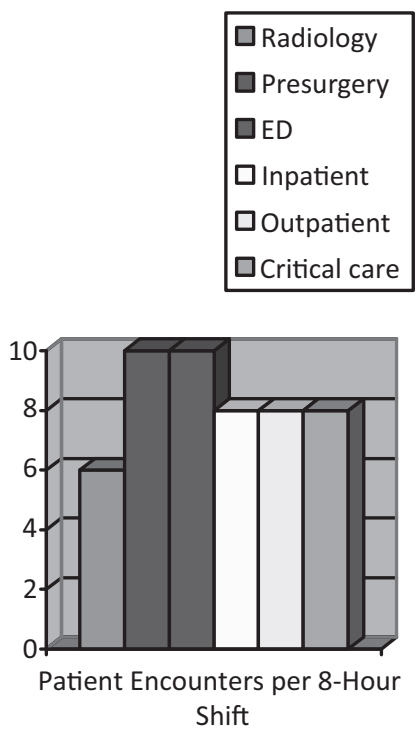


FIGURE 1
Average patient/family encounters per 8-hour shift for child life specialists in various hospital settings.

The remaining 3 areas, inpatient acute care, outpatient ambulatory clinics, and critical care units, all have similar productivity, with approximately 1 patient encounter per hour, or 8 in an 8-hour shift.

The productivity data allow participating hospitals to clearly identify how their program compares to the national average or similar hospitals on the basis of median scores. The data also serve as a tool to support appropriate staffing during hospital program growth by offering a benchmark to adjust staffing depending on changes in patient volumes.

Although these ratios establish national benchmarking and staffing trends, other factors should influence staffing allocations. Child life services should be available to meet identified patient and family needs 7 days per week. Staffing plans should be sufficient to meet fluctuations in anticipated and unanticipated staff absences, seasonal swings in the patient census, and nonclinical community activities (such as school programming, outreach events, and increased visits and in-kind donations during the holiday season). Child variables (such as age, temperament, coping style, and cognitive abilities), family variables (such as caregiver anxiety, presence, and involvement) and diagnosis and treatment variables (acute versus chronic, repeat admissions, number of invasive procedures) are known to affect psychosocial vulnerability and, thus, influence the child's particular child life needs.[68] A combination of psychosocial risk assessment, medical and/or treatment variables (eg, the proportion of patients on isolation precautions and the volume of patient and family teaching needs), and the time requirements associated with particular interventions directly affect operational staff-to-patient ratios in both inpatient and outpatient settings and could necessitate a lower ratio of patients to child life specialist.[69,70]

In addition to establishing a benchmarking standard for child life specialist and patient encounters, the CLPDC houses multifaceted information, such as types of organizations in which child life specialists work, staffing, program funding, reporting structure, services provided, and special services. The CLPDC should be used as a resource for programs and hospitals in evaluation and continuous performance improvement of child life programming.

CHILD LIFE STAFFING AND ROLES

Child life specialists are part of an interdisciplinary, patient- and family-centered model of care, collaborating with the family, physicians, advanced practice providers, nurses, social workers, and other members of the health care team to develop a comprehensive plan of care. Child life contributions to this plan are based on the patient's and family's psychosocial needs, cultural heritage, and responses to the health care experience. Child life specialists can participate in the care plan by, for example, teaching a child coping strategies for adjusting to a life-changing injury, promoting coping with examinations for alleged abuse, assisting families in talking to their children about death, facilitating nonpharmacologic pain-management techniques, preparing and educating children about their medical care in age-appropriate ways, and communicating the child's developmental and individual needs and perspective to others. These interventions are most effective when delivered in collaboration with the entire health care team.

The credentials of a certified child life specialist (CCLS) currently include the minimum of a bachelor's degree in child life, child development, or a closely related field; the successful completion of a 600-hour child life internship under the supervision of a CCLS; and passing a standardized certification examination.[71] Ongoing and future requirements for the CCLS credential are determined by the Child Life Certification Commission of the ACLP.

In some settings, child life services are augmented by child life assistants (or activity coordinators, child life technicians, etc). Child life assistants are typically required to have core college coursework, such as an associate degree in child development, and experience with children in group settings. They generally focus on the normalization of the health care experience, providing play activities, coordinating special events (community visitors, holiday celebrations, etc), and maintaining the playroom environment. Both child life specialists and assistants actively participate in the orientation, training, and supervision of volunteers, thereby contributing to volunteer effectiveness, satisfaction, and retention. This collaboration enables the child life specialist to conduct an assessment and delegate as appropriate, allowing patients with varying degrees of psychosocial vulnerability and activity levels to be supported by the team member whose skills and knowledge are most closely aligned with patient and family needs. Although volunteers are a valuable supplement, they can never be considered an adequate replacement for CCLSs.

EVOLUTION OF CHILD LIFE SERVICES

The provision of child life services is a quality benchmark of an integrated patient- and family-centered health care system, a recommended component of medical education, and an indicator of excellence in pediatric care.[72–74] There are more than 430 child life programs in operation in North America[75]; most are located in freestanding children's hospitals, children's hospitals within hospitals, community hospitals with pediatric units, and EDs.

The scope of child life programs has developed beyond pediatric inpatient acute care settings to include outpatient and other areas in which child life expertise can be effectively applied to support children and families in stressful situations. Child life specialists provide services to presurgery and surgical centers, radiology and imaging departments, dialysis centers, ambulatory clinics, NICUs, urgent care centers, psychiatric units, hospice programs, camps for children with chronic illness, rehabilitation settings, and some outpatient dental and physician offices.[76] Because the majority of children with medical complexities are being treated on an outpatient basis, child life services are increasingly common outside the hospital.[77] Increasingly, CCLSs are also part of interdisciplinary health care teams, including palliative care, behavioral health, trauma, and child protective services. In cases of hospitalized or ill adults, child life specialists may be consulted to work with children of adult patients, particularly in end-of-life, trauma, and critical care situations.

Child life programs continue to evolve and adapt to meet the changing health care needs of patients and families. Children with special health care needs now represent 18.8% of all children, up from 12.8% in 2001.[78] Specifically, the increase in patients with a diagnosis of autism spectrum disorder presents opportunities for child life specialization in supporting this population in medical settings.[36,79,80] In addition, the number of children with mental health and developmental disabilities conditions is increasing, either alone or comorbid with a physical health condition.[81,82] Hospitals are also admitting children with more complex medical conditions, with rates doubling between 1991 and 2005, and may need greater individualization of care from the CCLS.[83,84] The numbers of children with disabilities and

medical complexities are increasing, likely because of the increases in technology that ensures the survival of patients with previously lethal conditions.[85] Given the increasing survival rate of patients with cystic fibrosis, cardiac conditions, spina bifida, short gut, cancer, and other chronic illnesses, more teenagers and young adults face the challenging transition to adult health care.[86] Acknowledging team goals to normalize the transition process and address patient and family anxieties or questions, child life specialists can assist in this transition by providing education and helping patients to communicate their needs, fears, hopes, and expectations.87–89

In recent years, patient experience and/or patient satisfaction has become a key quality and performance indicator. Although the definition of patient experience continues to be explored and honed by health care leaders, there is common agreement that when evaluating health care quality, patient satisfaction is an important metric that translates to health care ratings and payment.[90] Family-centered care is a core principle for child life specialists; the recent emergence of the patient experience as a key quality indicator has resulted in child life specialists often taking the lead in family-centered care and patient experience initiatives. Research studies have demonstrated the positive impact of child life intervention on patient and parent perception and evaluation of the hospital experience, which is increasingly important for incentive-based reimbursement, accreditation, marketing, and public reporting of outcomes.[8,17,34,67,91] Health care professionals and organizations acknowledge the significant impact child life specialists have on the patient experience as well as the role child life plays in helping the concept of patient experience continue to evolve and grow.[80]

Although evidence supports the value of child life services, financial pressures in many health care settings have threatened the growth and sustainability of child life services. In addition to contributions to the patient experience, the literature has also demonstrated financial benefits of child life interventions, including reduced sedation-related costs, and increased compliance during procedures, resulting in procedure completion.[8–12] A child life program improves quality and decreases costs and, therefore, should be included in the value-added equation and discussion of health care cost, including with payers.

ADDITIONAL CONSIDERATIONS

Child life services contribute to an organization's efforts to meet the standards set forth by The Joint Commission and other accreditation agencies, including effective communication, patient- and family-centered care, age-specific competencies, and cultural competence.[92] Child life specialists' psychosocial and developmental expertise and their keen awareness of the benefits of patient- and family-centered care provide a useful perspective at a systems level. Child life input is often incorporated into hospital committees, such as ethics, family-centered care, patient experience, safety, environmental design, bereavement, and strategic planning. Child life expertise has applications beyond conventional hospital care. Interventions can help children transition back to their homes, schools, communities, and medical homes.[11,93] Child life specialists often collaborate with local school districts to arrange hospital or homebound education, and hospital-based teachers may be incorporated into child life program administration. These interventions help provide continued normalization and help make the transition to and from the hospital to the home setting less disruptive. Child life specialists also provide services outside hospital-based settings, including private practice, community agencies, and hospice care, and are becoming increasingly involved in providing support to children and families during catastrophic events.

For hospitals or other health care settings considering the initiation or expansion of child life services, the ACLP offers a consultation service to support existing program review and development, new program startup, interdisciplinary education, and written practice guidelines.[94] In community hospital settings with few pediatric beds and minimal pediatric outpatient or ED visits, the provision of full-time child life services may not be financially feasible. In such cases, part-time or consultative services of a CCLS may be obtained to assist in the ongoing education of staff, students, and volunteers as well as to advise on a psychosocially sound, developmentally appropriate patient- and family-centered approach to care. The advancement of telemedicine also presents an opportunity for child life specialists to intervene when they cannot be on-site. Advocating for child life services as an essential part of the interdisciplinary team is a responsibility of health care organizations to ensure it is a standard of pediatric care and should occur on local and national levels as well as in regulatory and accrediting organizations.

CONCLUSIONS

Child life services are associated with improved quality, outcomes, and patient and family experiences as well as decrease costs in pediatric care. There is evidence that child life services help to contain costs by reducing the length of stay, decreasing the need for sedation and analgesics, and increasing patient satisfaction ratings. Patient

experience data and interdisciplinary team member feedback further confirm the positive effects of child life programs on children, families, and staff. It remains essential for child life services to adapt and grow with the changing health care delivery system in support of the highest possible quality of care for children and their families.

RECOMMENDATIONS

1. Child life collaboration with the entire interdisciplinary team is essential to meeting the overall health care needs of children and families.
2. Child life services are part of an integrated patient- and family-centered model of care and can be used as a quality measure in the delivery of health care services for children and families.
3. Child life services, provided directly by CCLSs, are recommended in pediatric inpatient units, EDs, chronic care centers, and other diagnostic and treatment areas to the extent appropriate for the population served. In hospitals with a small number of inpatient or outpatient pediatric visits, ongoing consultation with a CCLS is needed to educate health care team members and support developmentally appropriate patient- and family-centered practice.
4. Child life services staffing must be individualized to address the needs of specific inpatient and outpatient areas. The ratio of child life specialist to patient should be adjusted to account for the patient's medical, psychosocial, and developmental complexity and vulnerability as well as family needs and preferences. Child life services need to continuously evolve to meet the changing needs in pediatric health care, including the significant increases in children with disabilities and medical complexity.
5. Child life services optimize pediatric health care and, therefore, should be included in the hospital operating budget; they cannot solely rely on contingency or philanthropic funding.
6. Legislative advocacy of child life services by pediatricians and other stakeholders is recommended at the state and federal levels.
7. Additional research is needed to further identify the impact of child life services on patient care outcomes, including patient experience, cost-effectiveness, and quality and safety measures.

LEAD AUTHORS

Barbara Romito, MA, CCLS
Jennifer Jewell, MD, FAAP
Meredith Jackson, MD, FAAP

AAP COMMITTEE ON HOSPITAL CARE, 2018–2019

Jennifer Jewell, MD, FAAP, Chairperson
Kimberly Ernst, MD, MSMI, FAAP
Vanessa Hill, MD, FAAP
Benson Hsu, MD, FAAP – *Section on Critical Care*
Vinh Lam, MD, FAAP
Melissa Mauro-Small, MD, FAAP – *Section on Hospital Medicine*
Charles Vinocur, MD, FAAP

FORMER COMMITTEE ON HOSPITAL CARE MEMBER, 2017–2018

Daniel A. Rauch, MD, FAAP

LIAISONS

Karen Castleberry – *Family Representative*
Nancy Hanson – *Children's Hospital Association*
Kristin Hittle Gigli, PhD, RN, CPNP-AC, CCRN – *National Association of Pediatric Nurse Practitioners*
Michael S. Leonard, MD, MS, FAAP – *Representative to The Joint Commission*
Barbara Romito, MA, CCLS – *Association of Child Life Professionals*

STAFF

S. Niccole Alexander, MPP

ABBREVIATIONS

ACLP: Association of Child Life Professionals
CCLS: certified child life specialist
CLPDC: Child Life Professional Data Center
ED: emergency department

FUNDING: No external funding.

POTENTIAL CONFLICT OF INTEREST: The authors have indicated they have no potential conflicts of interest to disclose.

REFERENCES

1. William Li HC, Lopez V, Lee TLI. Effects of preoperative therapeutic play on outcomes of school-age children undergoing day surgery. *Res Nurs Health*. 2007;30(3):320–332
2. Kain ZN, Caldwell-Andrews AA. Preoperative psychological preparation of the child for surgery: an update. *Anesthesiol Clin North Am*. 2005;23(4):597–614, vii
3. Koller D. *Child Life Council Evidence-Based Practice Statement: Preparing Children and Adolescents for Medical Procedures*. Rockville, MD: Child Life Council; 2009. Available at: https://www.childlife.org/docs/default-source/research-ebp/ebp-statements.pdf?sfvrsn=2. Accessed November 5, 2020
4. Vantaa Benjaminsson M, Thunberg G, Nilsson S. Using picture and text schedules to inform children: effects on distress and pain during needle-related procedures in nitrous oxide sedation. *Pain Res Treat*. 2015;2015:478503

5. Brewer S, Gleditsch SL, Syblik D, Tietjens ME, Vacik HW. Pediatric anxiety: child life intervention in day surgery. *J Pediatr Nurs*. 2006;21(1):13–22
6. Fortier MA, Bunzli E, Walthall J, et al. Web-based tailored intervention for preparation of parents and children for outpatient surgery (WebTIPS): formative evaluation and randomized controlled trial. *Anesth Analg*. 2015;120(4):915–922
7. Lan YP, Huang ZH, Finley GA, Zuo YX. Effects of the combination of mask preconditioning with midazolam pretreatment on anxiety and mask acceptance during pediatric inhalational induction and postoperative mask fear in children. [published correction appears in *Chin Med J (Engl)*. 2016; 129(12):1463]. *Chin Med J (Engl)*. 2012; 125(11):1908–1914
8. Törnqvist E, Månsson Å, Hallström I. Children having magnetic resonance imaging: a preparatory storybook and audio/visual media are preferable to anesthesia or deep sedation. *J Child Health Care*. 2015;19(3):359–369
9. Khan JJ, Donnelly LF, Koch BL, Curtwright LA, Dickerson JM, Hardin JL. A program to decrease the need for pediatric sedation for CT and MRI. *Appl Radiol*. 2007;36(4):30–33
10. Scott MT, Todd KE, Oakley H, et al. Reducing anesthesia and health care cost through utilization of child life specialists in pediatric radiation oncology. *Int J Radiat Oncol Biol Phys*. 2016;96(2):401–405
11. Grissom S, Boles J, Bailey K, et al. Play-based procedural preparation and support intervention for cranial radiation. *Support Care Cancer*. 2016; 24(6):2421–2427
12. Durand DJ, Young M, Nagy P, Tekes A, Huisman TAGM. Mandatory child life consultation and its impact on pediatric MRI workflow in an academic medical center. *J Am Coll Radiol*. 2015;12(6): 594–598
13. Goldberger J, Mohl AL, Thompson R. Psychological Preparation and Coping. In: Thompson RH, ed. *The Handbook of Child Life: A Guide for Pediatric Psychosocial Care*, 1st ed. Springfield, IL: Charles C Thomas; 2009:160–198
14. Benore E, Enlow T. Improving pediatric compliance with EEG: decreasing procedural anxiety and behavioral distress. *Epilepsy Behav*. 2013;27(1): 169–173
15. He HG, Zhu L, Chan SWC, Klainin-Yobas P, Wang W. The effectiveness of therapeutic play intervention in reducing perioperative anxiety, negative behaviors, and postoperative pain in children undergoing elective surgery: a systematic review. *Pain Manag Nurs*. 2015;16(3):425–439
16. Wolfer J, Gaynard L, Goldberger J, Laidley LN, Thompson R. An experimental evaluation of a model child life program. *Child Health Care*. 1988;16(4):244–254
17. Gursky B, Kestler LP, Lewis M. Psychosocial intervention on procedure-related distress in children being treated for laceration repair. *J Dev Behav Pediatr*. 2010;31(3):217–222
18. Madhok M, Milner D, Teele M, Finkelstein M. Child life services and patient satisfaction in emergency department [abstract]. *Pediatr Emerg Care*. 2007; 23(10):764
19. Cohen LL. Behavioral approaches to anxiety and pain management for pediatric venous access. *Pediatrics*. 2008;122(suppl 3):S134–S139
20. Eldridge C, Kennedy R. Nonpharmacologic techniques for distress reduction during emergency medical care: a review. *Clin Pediatr Emerg Med*. 2010;11(4):244–250
21. Srouji R, Ratnapalan S, Schneeweiss S. Pain in children: assessment and nonpharmacological management. *Int J Pediatr*. 2010;2010:474838
22. Uman LS, Chambers CT, McGrath PJ, Kisely S. Psychological interventions for needle-related procedural pain and distress in children and adolescents. *Cochrane Database Syst Rev*. 2006;(4): CD005179
23. Baxter AL, Cohen LL, McElvery HL, Lawson ML, von Baeyer CL. An integration of vibration and cold relieves venipuncture pain in a pediatric emergency department. *Pediatr Emerg Care*. 2011;27(12):1151–1156
24. Berberich FR, Landman Z. Reducing immunization discomfort in 4- to 6-year-old children: a randomized clinical trial. *Pediatrics*. 2009;124(2). Available at: www.pediatrics.org/cgi/content/full/124/2/e203
25. Lipsitz JD, Gur M, Albano AM, Sherman B. A psychological intervention for pediatric chest pain: development and open trial. *J Dev Behav Pediatr*. 2011; 32(2):153–157
26. Nguyen TN, Nilsson S, Hellström AL, Bengtson A. Music therapy to reduce pain and anxiety in children with cancer undergoing lumbar puncture: a randomized clinical trial. *J Pediatr Oncol Nurs*. 2010;27(3):146–155
27. Burgess S, Nativio DG, Penrose JE. Quality improvement project to reduce pain and distress associated with immunization visits in pediatric primary care. *J Pediatr Nurs*. 2015;30(2):294–300
28. Canbulat N, Inal S, Sönmezer H. Efficacy of distraction methods on procedural pain and anxiety by applying distraction cards and kaleidoscope in children. *Asian Nurs Res (Korean Soc Nurs Sci)*. 2014;8(1):23–28
29. Hedén L, VON Essen L, Ljungman G. Randomized interventions for needle procedures in children with cancer. *Eur J Cancer Care (Engl)*. 2009;18(4): 358–363
30. Inal S, Kelleci M. Distracting children during blood draw: looking through distraction cards is effective in pain relief of children during blood draw. *Int J Nurs Pract*. 2012;18(2):210–219
31. Sadeghi T, Mohammadi N, Shamshiri M, Bagherzadeh R, Hossinkhani N. Effect of distraction on children's pain during intravenous catheter insertion. *J Spec Pediatr Nurs*. 2013;18(2):109–114
32. Ha YO, Kim HS. The effects of audiovisual distraction on children's pain during laceration repair. *Int J Nurs Pract*. 2013; 19(suppl 3):20–27
33. Brown NJ, Kimble RM, Rodger S, Ware RS, Cuttle L. Play and heal: randomized controlled trial of Ditto™ intervention efficacy on improving re-epithelialization in pediatric burns. *Burns*. 2014;40(2): 204–213
34. Shahid R, Benedict C, Mishra S, Mulye M, Guo R. Using iPads for distraction to reduce pain during immunizations. *Clin Pediatr (Phila)*. 2015;54(2):145–148
35. Nilsson S, Renning AC. Pain management during wound dressing in children. *Nurs Stand*. 2012;26(32):50–55

36. Isong IA, Rao SR, Holifield C, et al. Addressing dental fear in children with autism spectrum disorders: a randomized controlled pilot study using electronic screen media. *Clin Pediatr (Phila)*. 2014;53(3):230–237

37. Borges L, Huber D, Lugo S. Harnessing the power of digital devices. *Pediatr Nurs*. 2011;37(2):88

38. Nilsson S, Finnström B, Kokinsky E, Enskär K. The use of virtual reality for needle-related procedural pain and distress in children and adolescents in a paediatric oncology unit. *Eur J Oncol Nurs*. 2009;13(2):102–109

39. Blaine S. The where, why and how: coping kits and distraction. *Child Life Focus*. 1999;1(1):1–6

40. Bandstra NF, Skinner L, Leblanc C, et al. The role of child life in pediatric pain management: a survey of child life specialists. *J Pain*. 2008;9(4):320–329

41. Heckler-Medina GA. The importance of child life and pain management during vascular access procedures in pediatrics. *Journal of the Association for Vascular Access*. 2006;11(3):144–151

42. Lawes C, Sawyer L, Amos S, Kandiah M, Pearce L, Symons J. Impact of an education programme for staff working with children undergoing painful procedures. *Paediatr Nurs*. 2008;20(2): 33–37

43. Pederson C. Nonpharmacologic interventions to manage children's pain: immediate and short-term effects of a continuing education program. *J Contin Educ Nurs*. 1996;27(3):131–140

44. Schechter NL. From the ouchless place to comfort central: the evolution of a concept. *Pediatrics*. 2008;122(suppl 3): S154–S160

45. Leahy S, Kennedy RM, Hesselgrave J, Gurwitch K, Barkey M, Millar TF. On the front lines: lessons learned in implementing multidisciplinary peripheral venous access pain-management programs in pediatric hospitals. *Pediatrics*. 2008;122(suppl 3): S161–S170

46. Lacey CM, Finkelstein M, Thygeson MV. The impact of positioning on fear during immunizations: supine versus sitting up. *J Pediatr Nurs*. 2008;23(3):195–200

47. Stephens BK, Barkey ME, Hall HR. Techniques to comfort children during stressful procedures. *Adv Mind Body Med*. 1999;15(1):49–60

48. Sparks LA, Setlik J, Luhman J. Parental holding and positioning to decrease IV distress in young children: a randomized controlled trial. *J Pediatr Nurs*. 2007;22(6):440–447

49. Yogman M, Garner A, Hutchinson J, Hirsh-Pasek K, Golinkoff RM; Committee on Psychosocial Aspects of Child and Family Health; Council on Communications and Media. The power of play: a pediatric role in enhancing development in young children. *Pediatrics*. 2018;142(3):e20182058

50. Brown CD. Therapeutic Play and Creative Arts: Helping Children Cope with Illness, Death, and Grief. In: Armstrong-Dailey A, Zarbock S, eds. *Hospice Care for Children*, 3rd ed. New York, NY: Oxford University Press; 2009:305–338

51. Erikson EH. Studies in the interpretation of play: clinical observation of play disruption in young children. *Genet Psychol Monogr*. 1940;22:557–671

52. Fereday J, Darbyshire P. Making the wait easier: evaluating the role of supervised play in a surgical admission area. *Neonatal, Paediatric and Child Health Nursing*. 2008;11(1):4–9

53. Koller D. *Child Life Council Evidence-Based Practice Statement: Therapeutic Play in Pediatric Health Care: The Essence of Child Life Practice*. Rockville, MD: Child Life Council; 2009. Available at: https://www.childlife.org/docs/default-source/research-ebp/ebp-statements.pdf?sfvrsn=2. Accessed November 5, 2020

54. Hughes FP. *Children, Play, and Development*, 4th ed. Thousand Oaks, CA: SAGE Publications, Inc; 2010

55. Melnyk BM, Alpert-Gillis L, Feinstein NF, et al. Creating opportunities for parent empowerment: program effects on the mental health/coping outcomes of critically ill young children and their mothers. *Pediatrics*. 2004;113(6). Available at: www.pediatrics.org/cgi/content/full/113/6/e597

56. Olson CK. Children's motivations for video game play in the context of normal development. *Rev Gen Psychol*. 2010; 14(2):180–187

57. Nicholas DB, Darch J, McNeill T, et al. Perceptions of online support for hospitalized children and adolescents. *Soc Work Health Care*. 2007;44(3): 205–223

58. Rollins JA. The Arts in Children's Health-Care Settings. In: Rollins JA, Bolig R, Mahan C, eds. *Meeting Children's Psychosocial Needs Across the Health-Care Continuum*, 1st ed. Austin, TX: Pro-Ed; 2005:119–174

59. Kaminski M, Pellino T, Wish J. Play and pets: the physical and emotional impact of child-life and pet therapy on hospitalized children. *Child Health Care*. 2002;31(4):321–335

60. Heilbrunn BR, Wittern RE, Lee JB, Pham PK, Hamilton AH, Nager AL. Reducing anxiety in the pediatric emergency department: a comparative trial. *J Emerg Med*. 2014;47(6):623–631

61. Avers L, Mathur A, Kamat D. Music therapy in pediatrics. *Clin Pediatr (Phila)*. 2007;46(7):575–579

62. Councill T. Medical Art Therapy with Children. In: Malchiodi C, ed. *Handbook of Art Therapy*, 1st ed. New York, NY: Guilford Press; 2003:207–219

63. Committee on Hospital Care, American Academy of Pediatrics. Family-centered care and the pediatrician's role. *Pediatrics*. 2003;112(3, pt 1):691–697

64. Lewindowski L, Baranowski MV. Psychological aspects of acute trauma: intervening with children and families in the inpatient setting. *Child Adolesc Psychiatr Clin N Am*. 1994;3(3):513–529

65. Gursky B. The effect of educational interventions with siblings of hospitalized children. *J Dev Behav Pediatr*. 2007;28(5):392–398

66. Prchal A, Graf A, Bergstraesser E, Landolt MA. A two-session psychological intervention for siblings of pediatric cancer patients: a randomized controlled pilot trial. *Child Adolesc Psychiatry Ment Health*. 2012;6(1):3

67. Association of Child Life Professionals. Child Life Professional Data Center. Available at: https://www.childlife.org/resources/for-child-life-specialists/child-life-professional-data-center. Accessed May 1, 2018

68. Koller D. *Child Life Council Evidence-Based Practice Statement: Child Life*

Assessment: Variables Associated With a Child's Ability to Cope with Hospitalization. Rockville, MD: Child Life Council; 2009. Available at: https://www.childlife.org/docs/default-source/research-ebp/ebp-statements.pdf?sfvrsn=2. Accessed November 5, 2020

69. Turner JC, Fralic J. Making explicit the implicit: child life specialists talk about their assessment process. *Child Youth Care Forum*. 2009;38:39–54
70. Hollon E, Skinner L. Assessment and Documentation in Child Life. In: Thompson R, ed. *The Handbook of Child Life: A Guide for Pediatric Psychosocial Care*, 1st ed. Springfield, IL: Charles C Thomas; 2009:116–135
71. Child Life Council, Child Life Certifying Committee. *Child Life Professional Certification Candidate Manual*. Rockville, MD: Child Life Council; 2011. Available at: https://www.childlife.org/docs/default-source/certification/candidate-manual.pdf?sfvrsn=10. Accessed November 5, 2020
72. National Association of Children's Hospitals and Related Institutions. *Pediatric Excellence in Health Delivery Systems*. Alexandria, VA: National Association of Children's Hospitals and Related Institutions; 1996:9–10
73. Accreditation Council for Graduate Medical Education. *Program Requirements for Graduate Medical Education in Pediatrics*. Chicago, IL: Accreditation Council for Graduate Medical Education; 2007. Available at: https://www.acgme.org/Portals/0/PFAssets/ProgramRequirements/320_Pediatrics_2020.pdf?ver=2020-06-29-162726-647. Accessed November 5, 2020
74. Olmstead MG, Powell R, Murphy J, et al. *Methodology: US News & World Report Best Children's Hospitals 2019–2020*. Research Triangle Park, NC: RTI International; 2019. Available at: https://www.usnews.com/static/documents/health/best-hospitals/BCH_Methodology_2019-20.pdf. Accessed November 5, 2020
75. Association of Child Life Professionals. Directory of child life programs. Available at: http://community.childlife.org. Accessed May 1, 2018
76. Hicks M, ed.. *Child Life Beyond the Hospital*, 1st ed. Rockville, MD: Child Life Council; 2008
77. Berry JG, Hall M, Neff J, et al. Children with medical complexity and Medicaid: spending and cost savings. *Health Aff (Millwood)*. 2014;33(12):2199–2206
78. Centers for Disease Control and Prevention. National survey of children with special health care needs. Available at: https://www.cdc.gov/nchs/slaits/cshcn.htm. Accessed October, 2018
79. Seid M, Sherman M, Seid AB. Perioperative psychosocial interventions for autistic children undergoing ENT surgery. *Int J Pediatr Otorhinolaryngol*. 1997;40(2–3):107–113
80. The Beryl Institute. What patient experience can learn from child life. Available at: https://www.theberylinstitute.org/store/ViewProduct.aspx?id=11084124. Accessed May 1, 2018
81. Perou R, Bitsko RH, Blumberg SJ, et al.; Centers for Disease Control and Prevention (CDC). Mental health surveillance among children–United States, 2005-2011. *MMWR Suppl*. 2013;62(2):1–35
82. Houtrow AJ, Larson K, Olson LM, Newacheck PW, Halfon N. Changing trends of childhood disability, 2001-2011. *Pediatrics*. 2014;134(3):530–538
83. Burns KH, Casey PH, Lyle RE, Bird TM, Fussell JJ, Robbins JM. Increasing prevalence of medically complex children in US hospitals. *Pediatrics*. 2010;126(4):638–646
84. Simon TD, Berry J, Feudtner C, et al. Children with complex chronic conditions in inpatient hospital settings in the United States. *Pediatrics*. 2010;126(4):647–655
85. Kuo DZ, Houtrow AJ; Council on Children With Disabilities. Recognition and management of medical complexity. *Pediatrics*. 2016;138(6):e20163021
86. Scal P. Transition for youth with chronic conditions: primary care physicians' approaches. *Pediatrics*. 2002;110(6, pt 2):1315–1321
87. Cooley WC, Sagerman PJ; American Academy of Pediatrics; American Academy of Family Physicians; American College of Physicians; Transitions Clinical Report Authoring Group. Supporting the health care transition from adolescence to adulthood in the medical home. *Pediatrics*. 2011;128(1):182–200
88. Transitioning Youth to an Adult Health Care Clinician. Available at: https://gottransition.org/six-core-elements/transitioning-youth-to-adult/. Accessed November 5, 2020
89. Orkoskey N. *Transitioning Patients with Cystic Fibrosis from Pediatric to Adult Care: A Lifelong Process*. Rockville, MD: Child Life Council; 2009
90. Wolf JA, Niederhauser V, Marshburn D, LaVela SL. Defining patient experience. *Patient Exp J*. 2014;1(1):7–19
91. Tyson ME, Bohl DD, Blickman JG. A randomized controlled trial: child life services in pediatric imaging. *Pediatr Radiol*. 2014;44(11):1426–1432
92. The Joint Commission. *Advancing Effective Communication, Cultural Competence, and Patient- and Family-Centered Care: A Roadmap for Hospitals*. Oakbrook Terrace, IL: The Joint Commission; 2010. Available at: www.jointcommission.org/Advancing_Effective_Communication/. Accessed May 1, 2018
93. Medical Home Initiatives for Children With Special Needs Project Advisory Committee, American Academy of Pediatrics. The medical home. *Pediatrics*. 2002;110(1, pt 1):184–186
94. Association of Child Life Professionals. Program review and development services. Available at: https://www.childlife.org/resources/for-child-life-specialists/program-review. Accessed November 5, 2020

Collaborative Care in the Identification and Management of Psychosis in Adolescents and Young Adults

• *Clinical Report*

CLINICAL REPORT Guidance for the Clinician in Rendering Pediatric Care

American Academy of Pediatrics

DEDICATED TO THE HEALTH OF ALL CHILDREN®

Collaborative Care in the Identification and Management of Psychosis in Adolescents and Young Adults

Liwei L. Hua, MD, PhD, COMMITTEE ON ADOLESCENCE

Pediatricians are often the first physicians to encounter adolescents and young adults presenting with psychotic symptoms. Although pediatricians would ideally be able to refer these patients immediately into psychiatric care, the shortage of child and adolescent psychiatry services may sometimes require pediatricians to make an initial assessment or continue care after recommendations are made by a specialist. Knowing how to identify and further evaluate these symptoms in pediatric patients and how to collaborate with and refer to specialty care is critical in helping to minimize the duration of untreated psychosis and to optimize outcomes. Because not all patients presenting with psychotic-like symptoms will convert to a psychotic disorder, pediatricians should avoid prematurely assigning a diagnosis when possible. Other contributing factors, such as co-occurring substance abuse or trauma, should also be considered. This clinical report describes psychotic and psychotic-like symptoms in the pediatric age group as well as etiology, risk factors, and recommendations for pediatricians, who may be among the first health care providers to identify youth at risk.

INTRODUCTION

Psychosis is defined as impairment in thought and behavior so severe that the ability to distinguish reality from nonreality is lost. Psychotic symptoms include delusions, fixed and false beliefs, and hallucinations or false sensory perceptions.[1] Although these symptoms do not necessarily portend a primary psychotic disorder, there is a strong association with the presence or future development of other psychiatric disorders.[2,3] Primary mood or anxiety disorders with concurrent psychotic symptoms often indicate a more severe form of mood or anxiety disorder, such as bipolar disorder, with psychotic features and imply more impaired functioning.[4–6]

abstract

Catholic Charities of Baltimore, Baltimore, Maryland

Dr Hua conceptualized, wrote, and revised the manuscript, considering input from all reviewers and the Board of Directors, approved the final manuscript as submitted, and takes responsibility for the final publication.

The guidance in this report does not indicate an exclusive course of treatment or serve as a standard of medical care. Variations, taking into account individual circumstances, may be appropriate.

All clinical reports from the American Academy of Pediatrics automatically expire 5 years after publication unless reaffirmed, revised, or retired at or before that time.

DOI: https://doi.org/10.1542/peds.2021-051486

Address correspondence to Liwei Hua, MD, PhD. E-mail: LLH228@gmail.com

PEDIATRICS (ISSN Numbers: Print, 0031-4005; Online, 1098-4275).

FINANCIAL DISCLOSURE: The authors have indicated they have no financial relationships relevant to this article to disclose.

To cite: Hua LL, AAP COMMITTEE ON ADOLESCENCE. Collaborative Care in the Identification and Management of Psychosis in Adolescents and Young Adults. *Pediatrics*. 2021;147(6):e2021051486

Pediatricians in the medical home may be the first point of contact for adolescents who report psychotic-like symptoms, which may be attributable in part to the ease of access to pediatricians and/or to a shortage of child and adolescent psychiatrists.[7] Therefore, pediatricians should be familiar and comfortable with asking additional questions when patients present with vague or overt psychotic symptoms, to determine the appropriate level of care (eg, close monitoring with specialty mental health consultation with psychiatrist, psychologist, or psychotherapist, or urgent emergency department [ED] evaluation). Management decisions will depend on the severity of the psychotic-like symptoms, how deeply entrenched the beliefs are (level of insight), level of distress, functional impact, and safety of the individual and others.

This clinical report aims to provide pediatricians with a framework for identification, initial assessment, and mental health referral and consultation for youth presenting with psychotic-like symptoms. This report strongly encourages collaboration between pediatricians and mental health specialists to determine the best course of treatment of patients presenting with psychotic-like experiences or psychosis.

EPIDEMIOLOGY

Each year, approximately 100 000 adolescents and young adults in the United States experience a first-episode psychosis (FEP).[8,9] Estimates of the prevalence of early-onset schizophrenia (onset prior to 18 years of age) is approximately 0.5%, whereas the prevalence of schizophrenia in general is believed to be about 1%.[1] In the United States, childhood-onset schizophrenia (onset prior to 13 years of age), with a more severe course and worse prognosis, is rarer, with an estimated prevalence of approximately 0.04%.[1]

In general, the peak onset of psychotic disorders occurs between 15 and 25 years of age.[8] Researchers in a large study of FEP found approximately 18% of adults with schizophrenia experienced their first episode before 18 years of age (53.4% male).[10] In another study, researchers found 11% to 19% of a first-episode schizophrenia sample and 23% to 35% of a clinical high-risk syndrome sample reported onset of attenuated psychotic symptoms in childhood (manifesting at 13 years or younger).[11] Patients who are at clinical high risk (CHR) demonstrate nonspecific and attenuated psychotic symptoms, with subtle changes in cognition, behavior, and affect that are different from their previous baseline functioning. Patients at CHR may also have a history of social isolation or withdrawal as well as odd or suspicious behavior. Family and friends may be the first to notice these symptoms, but eventually individuals themselves may begin to experience distress as well. Patients at CHR have higher likelihood of transitioning to overt psychotic symptoms, such as auditory hallucinations and/or delusions.[12] Increased level of distress experienced with the psychotic symptom or psychotic-like experience appears to differentiate CHR status from non-CHR status, which leads to more help seeking.[13]

The prodrome is the phase before a full psychotic episode but can only be defined retrospectively after a psychotic disorder has developed. Studies indicate that the prodromal period may be an important time for early intervention.[14] The duration of untreated psychosis (DUP) is defined as the period between first presentation of psychotic symptoms and treatment. The median DUP was approximately 74 weeks from a sample of patients (15–40 years of age) in community mental health centers.[15] Individuals with shorter DUP appear to have better response to treatment and better overall prognosis, thus emphasizing the need for early identification and intervention.[15]

TABLE 1 Common Themes of Delusions

Delusions	Definitions
Persecutory	Belief that one is being or is going to be harmed
Referential	Belief that certain occurrences are directed at oneself
Grandiose	Belief that one has special abilities
Erotomanic	Belief that another is in love with oneself
Nihilistic	Belief that a catastrophe will occur or that the world will end
Somatic	Intense preoccupation with health and organ function

CLASSIFICATION AND DEFINITIONS

The key features defining psychotic disorders are delusions, hallucinations, disorganized thinking (speech), grossly disorganized or abnormal motor behavior (including catatonia), and negative symptoms. See the *Diagnostic and Statistical Manual of Mental Disorders, Fifth Edition* (DSM-5)[1] section on schizophrenia spectrum and other psychotic disorders diagnoses for specific diagnoses and criteria.

CORE SYMPTOMS

Delusions

Delusions are fixed, false beliefs.[1] Even if evidence is shown to the contrary of the belief, the belief remains unchanged. See Table 1 for common themes of delusions.

The DSM-5 generally classifies delusions as bizarre or nonbizarre.[1] Thought withdrawal, the belief that one's thoughts are being or have been removed; thought insertion, the belief that an outside force has placed

thoughts in one's head; and delusions of control, the belief that an outside force is controlling one's body, are all categorized as bizarre delusions. Nonbizarre delusions are those that could be plausible, such as the belief that one is being monitored by the police or FBI or that one's phone has been hacked by another person, despite a lack of evidence.

Hallucinations

The DSM-5 defines hallucinations as vivid perception-like experiences occurring in the absence of any external stimuli.[1] Auditory hallucinations are the most common, although visual, tactile, gustatory, and olfactory hallucinations also occur. Patients report most auditory hallucinations as voices that may be familiar or unfamiliar and are distinct from one's own thoughts. Hallucinations occurring when one is falling asleep (hypnagogic) or waking up (hypnopompic) are considered normal in the general population. Hallucinations occur more commonly in youth than delusions, and auditory hallucinations are more common than other sensory hallucinations.

Disorganized Thinking

Providers may assess for disorganized thinking by observing the patient's speech. Jumping from topic to topic may be indicative of derailment or loose associations; inability to answer a question in a goal-directed manner or answering a question that was not asked may reflect tangential thinking. A speech pattern so disorganized that it may not be understood by others is known as incoherence or "word salad" (random words or phrases that are strung together in sentence form but do not make sense).[1]

Disorganized Behavior

The DSM-5 defines grossly disorganized or abnormal motor behavior as difficulty in performing goal-directed behavior, affecting functioning. Catatonia is decreased reactivity to the environment, and it may consist of a range of behaviors from negativism (not following directions) to mutism and stupor (not responding verbally or with appropriate motor responses, respectively) to catatonic excitement (purposeless and excessive motor movement). Catatonia may also include repeated stereotyped movements, echolalia, posturing, or grimacing. Catatonia is more likely to be associated with schizophrenia but can also be found with other psychiatric disorders or medical conditions, including autism spectrum disorder (ASD).[1]

Negative Symptoms

Negative symptoms consist of diminished emotional expression, avolition (lack of motivation), alogia (poverty of speech), anhedonia (inability to experience pleasure), and asociality (reduced desire or motivation to form relationships).[1,16]

RISK FACTORS FOR CONVERSION TO PRIMARY PSYCHOTIC DISORDER

The North American Prodrome Longitudinal Study (NAPLS), a consortium of 8 research centers, aimed to study CHR populations and determine mechanisms of conversion to psychosis to predict conversion in a high-risk population with an age range of participants from 12 to 35 years. In a 2.5-year follow-up, risk of conversion from CHR to full psychotic disorder was 35%, whereas approximately one-third remitted and one-third continued to demonstrate attenuated positive symptoms with poorer overall functioning.[17,18] Once an individual receives a schizophrenia spectrum diagnosis, prognosis is generally poor unless they receive appropriate treatment. Researchers in 1 study using the Multi-Payer Claims Database demonstrated 12-month mortality after initial diagnosis was 1968 per 100 000 compared with the general population, in which it is 89 per 100 000 people.[19] The authors also found teenagers and young adults in whom psychotic disorder is diagnosed have about a 24-times greater 12-month mortality rate than their peers, suggesting that during the year after diagnosis, it is crucial to optimize outcomes by increasing monitoring with regular follow-up and early intervention.[19] An analysis of the database found it did not report cause of death, leaving the authors to speculate that the reason for death might have included suicide or substance use–related accidents.[19]

NAPLS described variables contributing uniquely to psychosis prediction to be genetic risk for schizophrenia with recent worsening of functioning, greater impairment in social functioning, history of substance use, increased levels of suspiciousness or paranoia, and increased levels of unusual thought content.[18] In NAPLS, 92% of the CHR sample had at least 1 positive symptom, the most common of which was unusual thought content and perceptual abnormalities, followed by suspiciousness. Eighty-two percent of subjects endorsed at least 1 negative symptom, of which avolition and poor occupational functioning were the most common, and 44% demonstrated 3 or more negative symptoms. Disorganized communication occurred infrequently and grandiosity less.[15] Greater levels of unusual thought content and suspiciousness, greater decline in social functioning, greater prodromal symptom severity, lower verbal learning and memory performance, more delayed processing speed, and younger age at symptom onset contributed to increased risk of conversion from CHR status to psychosis.[20] Social dysfunction in early adolescence is of particular significance in conversion to psychosis in CHR individuals.[21]

PSYCHOTIC-LIKE SYMPTOMS PRESENTING IN YOUTH

Many children and adolescents report psychotic-like experiences, but most do not go on to develop true psychotic illness.[22,23] Clinically significant psychosis usually involves mental status and behavioral changes and usually imparts a high level of distress. However, data suggest that psychotic-like experiences in childhood and adolescence can be associated with development of other psychiatric disorders in the future, and strong symptomatology in childhood may be associated with increased likelihood of psychotic disorder as adults.[24]

Youth who report psychotic symptoms also have a higher likelihood of experiencing current mental health difficulties than those who do not; however, psychotic-like symptoms that present during childhood and/or adolescence frequently resolve. Jardri et al[25] reported that hallucinations are common in children and may not signify psychiatric pathology; however, persistence of hallucinations into adolescence increases risk of developing psychosis five- to sixfold. In a study of adolescents with hallucinations, half reported no symptoms after 1 year.[26] Similarly, researchers in the Philadelphia Neurodevelopmental Cohort, a 2-year prospective follow-up study, reported 51% persistence or worsening of psychotic symptoms after 2 years.[27]

In youth presenting with delusions or hallucinations, mood disorders should be considered; although pediatric bipolar disorder is rare, early-onset schizophrenia is even rarer.[28] Ulloa et al[29] reported approximately 10% of youth (n = 2031) seen in a pediatric mood and anxiety disorders clinic had psychotic symptoms. Of the 10% reporting psychotic symptoms, 62% of patients had a diagnosis of a depressive disorder, 24% had a diagnosis of bipolar disorder, and 14% had a diagnosis of schizophrenia.

In a general population of youth, hallucinations were more prevalent than delusions.[30] Youth report auditory hallucinations, often with commands and comments, more commonly than conversing voices. Visual and tactile hallucinations may occur with auditory hallucinations. True hallucinations occur when one is fully awake; they are vivid and evoke a response.[30] Delusions may occur but are vague and are usually related to the hallucinations. Symptoms that are specific to a certain situation (such as occurring only at nighttime or only when the individual is angry), overly detailed, and not associated with disorganized thoughts or behaviors are less likely to be indicative of a true psychotic disorder as well.[22]

Adolescents report fewer hallucinations than children do. Kelleher et al[31] found that a median of 17% of 9- to 12-year-olds and a median of 7.5% of 13- to 18-year-olds report auditory hallucinations. An increase in lifetime history of psychiatric disorders also correlated with an increased reporting of hallucinations. Those reporting psychotic-like symptoms were more likely to have a mental health disorder, including anxiety and mood disorder, at the time of presentation and even more likely over the course of their lifetimes. In a mental health clinic sample, Kelleher et al[32,33] found that patients presenting with psychotic experiences were more likely to have multiple psychiatric disorders and socio-occupational difficulties as well as a higher risk for suicidal behavior. A meta-analysis of 10 prospective cohort studies published between 2013 and 2017 found patients who reported psychotic experiences had twofold increased odds of later suicidal ideation, threefold increased odds of later suicide attempt, and fourfold increased odds of subsequent death by suicide.[34]

In a 15-year longitudinal study that followed individuals from 11 to 26 years of age, more than 40% of patients in whom schizophreniform disorder was diagnosed in early adulthood had disclosed symptoms at younger age. Of those who reported the most severe psychotic-like symptoms in preadolescence, approximately 25% had a diagnosis of schizophreniform disorder in early adulthood, and 70% experienced at least 1 of the following: hallucinations, delusions, disorganized speech, catatonia, or anhedonia. Almost all experienced poor occupational or social functioning.[2] When followed out to 38 years of age, those who had reported psychotic symptoms at a young age were at increased likelihood of having a diagnosis of schizophrenia and posttraumatic stress disorder and were also more likely to have attempted suicide. Very few had no psychiatric diagnosis at all.[24]

Youth reporting psychotic symptoms appear to have worse global functioning.[35] Approximately 75% of youth reported that the psychotic-like experiences were distressing to them.[35] Other studies reported those with FEP have significantly slower processing speed; processing speed also predicts social functioning 1 year later.[36] Patients with adolescent-onset psychosis did not demonstrate improvements in processing speed as they aged, which negatively affects functional outcomes. These findings support the idea that adolescent-onset psychosis is associated with a disruption in adolescent brain development, such as myelination.[36] In a study examining a CHR population, comparing those who developed psychosis during the course of the study versus those who did not, authors found only people with psychosis had impaired cognition, with specific impairments

in processing speed, verbal memory, sustained attention, and executive functioning. This finding suggests cognitive deficits exist before manifestation of psychotic symptoms. Carrión et al[37] reported that these deficits persist but do not worsen over the course of the illness.

Although there is overlap, the risks and manifestations of psychotic-like symptoms in youth are heterogeneous. Other presentations that can be confused and/or associated with psychotic-like symptoms are described below. See Appendix 1 for sample case scenarios of psychotic and psychotic-like presentations that may occur in the pediatric ambulatory setting.

Benign Hallucinations

Some adolescents may mention hearing their name called with no other concerning symptoms. The Washington University in St Louis Kiddie Schedule for Affective Disorders and Schizophrenia, which assesses for hallucinations that are benign or pathologic, defines these as "benign hallucinations," because they do not impair functioning, are nonthreatening in content, and occur infrequently.[38] Pathologic hallucinations, such as a voice telling one to harm oneself or others, do impair functioning.[38] A recent review of "healthy voice-hearer" literature found there appeared to be a continuum of voice hearing from healthy controls (no auditory hallucinations) to "healthy voice-hearers" (low frequency, low distress) to "clinical voice-hearers" (high frequency, high distress).[39] Although healthy voice hearers seem to be at higher risk of transitioning to mental health disorders, only a minority end up transitioning.[39]

Illusions are distinct from hallucinations but warrant mention. Illusions are defined as a misperception and/or misinterpretation of an actual stimulus, such as seeing a rope on the ground and thinking it is a snake for an instant, whereas hallucinations consist of perceiving something that is not actually there.[1] Illusions are not necessarily pathologic and can be experienced by people with no psychiatric disorders. In a white noise speech illusion study (hearing speech when only white noise was being played) in adults, there was no association of white noise speech illusion with psychosis in a nonclinical population.[40]

Imaginary Friends

Imaginary friends, which could also be called "hallucination-like phenomenon," are reported in 28% to 65% of children 5 to 12 years of age, and up to 65% of children 7 years of age and younger have imaginary companions.[25,41] There is scarce literature on imaginary companions and association with psychotic symptoms. An imaginary companion could be invisible or embodied by a doll or stuffed animal.[42] Imaginary companions during childhood are normative and are thought to help with development of appropriate social interactions and emotional regulation.[42] Children can identify that imaginary companions are not real.[42] Youth are usually able to make imaginary friends go away, unlike hallucinations.[30] Because of concerns for prognosis and relevance to future mental health disorders, a longitudinal study of "high-risk" middle school students 11 to 14 years of age with imaginary companions, described by their teachers as having the most "problem behaviors" (as assessed by the Child Behavior Checklist 4–18) in school, was performed. The researchers found that although these children had the most behavioral issues and the least social acceptance, they were not at higher risk for any psychiatric disorders and seemed to have greater positive adjustment.[43]

Cultural and Religious Considerations and Bereavement

It is important for pediatricians to consider cultural issues or family background when asking about psychotic-like symptoms, because some symptoms that sound pathologic may be normal cultural or developmental responses. For example, if a youth describing a presence or shadow in their room at night comes from a family that believes strongly in spirits or ghosts, such an experience may not reflect an actual visual hallucination. During bereavement and mourning, youth may report auditory or visual hallucinations of the deceased person.[44–47] In these situations, the individual's degree of distress can be helpful in determining the pediatrician's next step. When symptoms are described as comforting or neutral, they are less likely to be an indication of a psychotic disorder. Distress would indicate something more problematic, and referral to a psychotherapist would be recommended.

Intellectual Disability

People with intellectual disability (ID) may report psychotic-like symptoms, and pediatricians and developmental and behavioral pediatricians can assist with providing a differential diagnosis for youth with ID and ASD and help coordinate a plan of care related to special educational needs and therapies. Providers may consider using a neurodevelopmental framework to assess psychotic-like symptoms. Symptoms suggestive of psychosis in this population could instead reflect self-talk, imaginary friends, or fantasies, depending on an individual's developmental level.[47] Stressful experiences, such as the loss of a loved one, may trigger or exacerbate psychotic-like symptoms.[47] When assessing adolescents or young adults with ID, it is important to determine if they understand the questions being asked

to ensure a valid assessment. Individuals with intellectual limitations and delayed emotional development may feel pressured to answer a question a certain way to please the interviewer or blame negative behaviors on voices in their head to avoid getting in trouble.[44]

Co-occurring mental disorder and ID in youth is common and often persists through the life span.[48] Relative to children and adolescents without ID, the rate of co-occurrence of mental disorders in youth with ID is 3 to 4 times greater.

ASD

Core features of ASD consist of social communication and social interaction deficits as well as restricted interests, stereotyped or repetitive behaviors, and sensory sensitivities. Some of these symptoms may overlap with those occurring in schizophrenia spectrum disorders (SSDs). In addition, a number of individuals with ASD may experience transient hallucinations and engage in vivid fantasies, which may be mistaken for true psychotic symptoms. Although there is a level of co-occurrence of ASD and SSDs, one must be careful to distinguish the overlapping symptoms before giving both diagnoses.[49] Common genetic regions and brain regions may contribute to the comorbidity of ASD and SSDs.[50]

Co-occurring ASD and SSD should be considered when perceptual abnormalities and beliefs or behaviors are noted to be different from those at baseline, especially with associated change in functioning.[50] Thorough developmental, medical, and psychiatric history, as well as any other useful collateral information, is important when assessing for co-occurring conditions. In addition, genetic testing should be considered if not already completed. Clinicians should also monitor for catatonia.

Trauma

In addition to serving as a risk factor for psychotic disorder, trauma can result in posttraumatic symptoms that can be mistaken for psychotic symptoms. For instance, flashbacks can be mistaken for visual and/or auditory hallucinations, and hypervigilance or hyperarousal can be mistaken for paranoid delusions. Withdrawal and avoidance could be mistaken for negative symptoms.[51] Assessment to determine if symptoms are psychotic-like or truly psychotic in nature may need to take place over time to determine the most appropriate course of treatment.

Dissociative episodes can also be associated with trauma and may serve as a protective mechanism to mentally or emotionally escape physical trauma. Dissociation is a detachment from reality, whereas psychosis is a loss of reality. Although the two are distinct, some researchers hypothesize that dissociation may mediate the relationship between traumatic life events and the development of attenuated positive psychotic symptoms.[52]

ETIOLOGY OF PSYCHOTIC SYMPTOMS AND DISORDERS

Neuroanatomical Abnormalities

Schizophrenia is a heterogeneous disorder, but disruptions in brain connectivity and synaptic functioning likely underlie the development of schizophrenia.[53] These disruptions appear to occur first in neural circuits involved in referencing occurrences by time, place, and saliency, potentially resulting in an inability to recognize that certain thoughts have been self-generated, which could eventually contribute to loss of reality testing. Axonal pathology, such as disruption in myelination, may also be involved.[53] Excessive synaptic pruning may also be a factor, possibly associated with the immune system, namely upregulation of complement genes and activation of microglia.[54]

Scientists have found abnormalities in brain structure, likely progressive, including bilateral enlargement of lateral ventricles and volume decreases in the frontal lobe, hippocampus, and thalamus.[55,56] Rapoport et al[57] demonstrated reduced frontal and temporal gray matter volume compared with healthy controls. People with childhood-onset schizophrenia seem to lose more gray matter in the cortex than do children who report brief psychotic episodes.[57] Those with early-onset schizophrenia also show significant gray matter volume decrease and decrease in cortical folding.[55,58]

Neurotransmitters

Schizophrenia is primarily associated with dopamine dysfunction, with increased dopamine synthesis and release leading to psychosis; however, multiple other neurotransmitters and pathways are believed to be involved.[59,60] Olney and Farber found that animals given *N*-methyl-D-aspartate receptor antagonists develop neurotoxic changes similar to those observed in brains of patients with schizophrenia.[61] Administration of agents that increase glutamate, such as phencyclidine or ketamine, increase the likelihood of psychotic symptoms.[62] Serotonin antagonism, as found in some second-generation antipsychotic medications, appears to provide some benefit for extrapyramidal symptoms and for mood symptoms associated with schizophrenia.[63] Serotonergic antagonists also show promise for treatment of negative and cognitive symptoms of schizophrenia.[60,63,64] The muscarinic cholinergic system may play a role in schizophrenia, because blockade of acetylcholine receptors can result in psychotic symptomatology.[60,65] In addition, alterations in the γ-aminobutyric acid neurotransmitter system may also have a role in schizophrenia.[60] Abnormalities in these neurotransmitter systems form the

basis for pharmacologic treatment of psychotic disorders and/or schizophrenia.

Genetic Factors

Family, twin, and adoption studies indicate genetic involvement in schizophrenia. The risk of developing schizophrenia is 5 to 20 times higher in first-degree relatives of patients with schizophrenia.[55,66] Concordance rates are 40% to 60% between monozygotic twins and 5% to 15% in dizygotic twins and other siblings.[55,66] A number of genomic disorders resulting from duplication or deletion of genetic material have been associated with ID, ASD, and schizophrenia. See Table 2 for a list of medical illnesses for which symptoms can include psychosis.[67–69]

Environmental Exposure

Environmental exposure can cause direct neurologic damage or may mediate risk of future development of psychosis with new mutations or epigenetic effects.[55] Environmental exposures include exposure in utero, like maternal starvation, obesity, or infection (such as *Toxoplasma gondii*); obstetric complications (such as hypoxia, pregnancy bleeding, preeclampsia); substance exposure (marijuana, tobacco, alcohol); and advanced paternal age.[55,70–73] The effect of in utero stressors on the development of a psychotic disorder and other psychiatric disorders may be mediated by inflammation, although substances are believed to have negative effects on brain development, neurotransmitters, and cognition.[73–75] Substances that have been most studied are tobacco, alcohol, and marijuana, all of which have been associated with later development of psychosis in offspring exposed in utero.[75–77]

Trauma

Childhood trauma experienced from 0 to 17 years of age, including emotional neglect, physical abuse, sexual abuse, emotional abuse, domestic violence, or bullying, increase the odds of psychotic experiences at 18 years or older.[78] Exposure to more than 1 type of trauma or experience of repeated trauma over multiple age periods further increase the odds of psychotic experiences.[78] Evidence suggests adverse childhood experiences can interact with genetic risk factors to contribute to the development of psychotic disorders or other psychiatric disorders. In a recent review of trauma and stressful life events in a population at high risk for psychosis, up to 80% of adolescents

TABLE 2 Medical Causes Associated With Psychotic Episodes

Causes	Testing to Consider
Infections or fever	CBC, lumbar puncture
Viruses (HSV, HPV, HIV, CMV, measles, mumps, rubella, etc)	And serum titer, HIV ELISA/PCR
Bacteria (*Treponema pallidum*, *Mycoplasma pneumoniae*, Lyme disease, etc)	And antitreponemal IgG, serum titer, lumbar puncture
Parasitic infections (*Toxoplasma gondii*, malaria, TB)	And MRI, skin test
Encephalitis (viral, bacterial)	
Neurologic	MRI
Migraine	And history
Seizures and epilepsy	And EEG
Neoplasms	
Metabolic	CMP
Thyroid disorders	And thyroid function tests
Parathyroid disorders	And thyroid function tests, PTH
Adrenal disorders	And ACTH stimulation test, morning cortisol, CRH stim test
Beriberi	And blood and urine tests for thiamine
Electrolyte disturbances	And testing for specific electrolytes
Genetic	Genetic testing
Fragile X syndrome	And blood and urine tests
Klinefelter syndrome (47, XXY)	And urine porphyrins
Metachromatic leukodystrophy	And ceruloplasmin
Porphyria	
Prader–Willi syndrome	
Velocardiofacial syndrome (22q11.2 deletion)	
Wilson disease	And eye exam (slit lamp for Kayser-Fleischer rings)
Nutritional deficiencies	CBC, magnesium, vitamins A, D, B_1, B_3, B_{12}
Sleep disorders	Polysomnography
Narcolepsy	
Hypnopompic and hypnogogic hallucinations	
Medications	Urine toxicology
Steroids	
Stimulants	
Anticholinergics	
Drug intoxication and abuse	Urine toxicology
Hallucinogens	
Cannabis	
Ecstasy (3,4-methylenedioxymethamphetamine)	
Cocaine	
Amphetamines	
Barbiturates	
Opiates	
Toxicological causes	
Carbon monoxide poisoning	Carboxyhemoglobin
Heavy metal poisoning (eg, lead, mercury)	Physical examination, blood or urine mercury levels, lead levels

Sources: refs 30, 44, 67, 111, 115. ACTH, adrenocorticotropic hormone; BMP, basic metabolic panel; CBC, complete blood cell count; CMV, cytomegalovirus; CRH, corticotropin-releasing hormone; ELISA, enzyme-linked immunosorbent assay; HPV, human papillomavirus; HSV, herpes simplex virus; IgG, immunoglobulin G; PCR; polymerase chain reaction; PTH, parathyroid hormone; TB, tuberculosis.

and young adults reported a history of childhood trauma, including bullying.[79] In adolescents and young adults with history of trauma, the overall odds of experiencing psychotic symptoms or developing a psychotic disorder range between 2.8 and 11.5.[80] A large-scale twin study in England and Wales with mental health assessments performed at 11 and 16 years of age found that bullying resulted in anxiety, mood, and conduct problems, and paranoid thoughts and cognitive disorganization persisted for 5 years.[81] Sexual trauma has the highest risk of conversion to psychosis, followed by physical trauma (eg, abuse, bullying, neglect).[79] Researchers in studies of people with CHR and FEP found both groups showed higher rates of suicide attempts and hospitalizations and generally demonstrated poorer functioning.[79] In the CHR population, there is a higher likelihood of comorbid posttraumatic stress disorder as compared with the healthy control population.

Some longitudinal studies found traumatic life experiences may predict the development of psychotic symptoms.[80–82] People presenting with psychosis who have a history of trauma have increased severity of psychotic symptoms, more frequent hospitalizations, increased number of comorbid disorders, more cognitive deficits, and increased treatment resistance.[80] In a longitudinal cohort study of a CHR population, researchers found a positive association between sexual abuse in childhood and conversion to a psychotic disorder.[83] Therefore, for patients who report a history of trauma, including physical or sexual abuse or bullying, providers may consider inquiring about any experience of psychotic symptoms.

History of trauma is associated with increased risk for future development of borderline personality disorder.[84] Borderline personality disorder can also present with psychotic-like experiences and/or psychotic symptoms and dissociative episodes. In a European study of adolescents 15 to 18 years of age, those with full threshold borderline personality disorder were more likely to experience psychotic symptoms; these symptoms predicted severity of borderline personality disorder.[85] Auditory and visual hallucinations, paranoia, and thought problems, like strange thoughts and confusion, were common and presented early in the course of the disorder. Another study suggested that borderline traits mediate the relationship between history of trauma and psychotic-like experiences in the context of high stress.[86]

Substance Use

The ingestion or use of multiple illicit substances, such as hallucinogens and stimulants, can result in psychotic experiences, although no causal link has been established. In a study of help-seeking youth, those at risk for developing a psychotic disorder had higher rates of tobacco, alcohol, and cannabis use than those individuals who were not.[87] In a study of 404 participants from the Recovery After an Initial Schizophrenia Episode–Early Treatment Program (RAISE-ETP), up to half of adolescents and young adults with FEP reported use of alcohol or cannabis within the month before starting treatment.[88] In addition, about half of this population also reported use of tobacco at the time of enrollment in RAISE-ETP. Authors found that cigarette smoking was associated with reports of more psychiatric symptoms and poorer functioning, more missed pills, and decreased quality of life. Use of alcohol was associated with decreased adherence to medication regimen, and cannabis use was related to increased severity of illness and positive symptoms of schizophrenia.[88] Other meta-analyses of observational and longitudinal studies have demonstrated that daily tobacco use is associated with increased psychosis risk as well as earlier age when psychotic symptoms begin; researchers in these studies concluded that a causal link between tobacco smoking and development of psychosis should be considered and that further studies should be performed.[89–91]

Most studies suggest a consistent association between marijuana use in adolescence and development of psychosis, and persistent use after an initial psychotic episode is associated with poorer prognoses.[92–94] There is also evidence suggesting earlier age at first marijuana use correlates with earlier age at onset of psychotic symptoms, regardless of whether or when marijuana users discontinued use; therefore, cannabis use is a preventable risk factor in psychosis.[93,95,96] There remains controversy over the level of risk for development of psychosis attributed to the use of cannabis and the level to which cannabis use can precipitate people without genetic predisposition to psychosis into illness.[92] One recent multisite study in Europe and Brazil demonstrated daily cannabis use and use of high-potency cannabis were the strongest independent predictors of having a psychotic disorder.[97] The odds of having a psychotic disorder for individuals using cannabis daily was 3.2 times higher than for those who never used cannabis ("never-users"). The odds of having a psychotic disorder in those who used high-potency cannabis versus never-users was 1.6 times higher. Because of the multiple sites and knowledge of incidence rates of psychotic disorders at those sites, researchers of this study were able to demonstrate that the association between use of cannabis and risk of psychosis varies by location depending on how and what kind of cannabis is used in that region. The authors report that in regions where cannabis is used daily and where high-potency cannabis tends to be

used more frequently, there are more cases of psychotic disorders.[97] Synthetic cannabinoids (K2, spice) can also induce psychotic symptoms.[98] Routine urine toxicology screens do not screen for synthetic cannabinoids.[99]

In a study in Denmark following patients with substance-induced psychosis, researchers found that more than 30% converted to bipolar disorder or primary psychotic disorder. In the case of cannabis-induced psychosis, almost half converted. Approximately half of those patients who transitioned to schizophrenia did so within 2 years of diagnosis. A Scottish longitudinal study reported a 15.5-year cumulative hazard rate of 17.3% for diagnosis of schizophrenia after an initial hospital admission with substance-induced psychotic disorder (including cannabis, stimulants, and alcohol). Approximately half of these patients transitioned to schizophrenia within 2 years (80% by 5 years). These studies suggest that follow-up of patients in whom substance-induced psychosis is initially diagnosed could benefit from follow-up of 2 to 5 years to optimize early intervention and mitigate negative outcomes.[100,101]

Perhaps of particular relevance to pediatricians, because they may be more likely to prescribe stimulants for children with attention-deficit/hyperactivity disorder (ADHD), researchers of a recent study using data from 2 commercial insurance claims databases compared the diagnosis of new-onset psychosis in adolescents and young adults with a diagnosis of ADHD treated with either a methylphenidate or amphetamine formulation. Although both classes of stimulants increase overall dopamine, amphetamines potently increase dopamine release from neurons (similar to neurotransmission in a primary psychotic disorder), whereas methylphenidates inhibit dopamine transport, thereby decreasing reuptake of dopamine into the presynaptic terminal.[102] In this large-scale study of adolescents and young adults with stimulant prescriptions, researchers determined that 0.1% in the methylphenidate group and 0.2% in the amphetamine group required treatment of stimulant-induced psychosis. On the basis of this study, authors determined that approximately 1 in 660 patients with ADHD who are treated with a stimulant will develop a new-onset psychosis.[102] Analyses of data from the US Food and Drug Administration (FDA) and case reports demonstrated that stimulant-induced psychotic symptoms generally did not last long and often resolved with cessation of stimulant alone.[103] Cathinones (bath salts) fall under the category of stimulants and can also induce psychosis. Cathinones do not show up on routine urine drug screens.[99]

These data indicate that substance use increases vulnerability for those who are at risk for developing psychotic symptoms.

EVALUATION OF PATIENTS WITH PSYCHOTIC-LIKE SYMPTOMS

The presentation of adolescents and young adults with psychotic-like symptoms can be varied, and a wide differential diagnosis should be considered, including psychiatric disorders, physical illness, and intoxication (see Tables 2 and 3). Pediatricians may initially encounter a patient presenting with vague feelings that something is wrong or "off," with a correlating drop in grades and/or work performance or increased isolation, which may be attributable to suspicions and mistrust of others. Patients may also present with decrease in hygiene and/or self-care, difficulty communicating or confused speech, and new-onset difficulty in concentrating. Additionally, adolescents may present with difficulty separating fantasy from reality. Early-onset schizophrenia can also present with cognitive delays. One of these symptoms merits consideration of referral to a mental health specialist for further evaluation and monitoring and therapy (eg, cognitive behavioral therapy [CBT]), and multiple symptoms warrant referral to a child and adolescent psychiatrist and a therapist. Collaboration with developmental and behavioral pediatricians should also be considered, especially in the context of ID and ASD. If symptoms are more overtly psychotic and could potentially lead to unsafe behavior with possible suicidal or homicidal ideation, pediatricians should arrange for immediate safety evaluation in a mental health facility or ED with resources to stabilize and evaluate children and adolescents with mental health problems.

Screening for psychosis with validated screens, such as the Prodromal Questionnaire–Brief, the PRIME early psychosis screen, and the Youth Psychosis At-Risk Questionnaire, can be helpful to screen for psychotic symptoms

TABLE 3 Nonschizophrenia Spectrum Psychiatric Conditions Associated With Psychotic Episodes in Children and Adolescents

Adjustment disorders
ASDs
Anxiety disorders, severe stress
Bipolar disorder
Catatonia
Delirium
Delusional disorders
Disruptive behavioral disorders
Factitious disorders
Grief or bereavement
Intellectual and/or developmental delay
Major depressive disorder
Obsessive-compulsive disorder
Parasomnias
Personality disorders
Posttraumatic stress disorder, trauma-related disorders, adjustment disorders
Substance-induced psychotic disorders
Tourette's syndrome

Sources: refs 44 and 67.

regularly because they are relatively short and have high specificity. Other longer screens are mostly used in research settings, such as the Structured Interview for Prodromal Symptoms (SIPS), the gold standard for psychosis risk, and the Comprehensive Assessment of At-Risk Mental States (CAARMS), both of which are labor-intensive and require special training by the administrator of the screen.[104,105]

In the case of an adolescent presenting with an acute psychotic break, additional concerns may be relevant, and there should be consultation with a child and adolescent psychiatrist if available. Although the below recommendations and suggestions for interviewing and examination of the patient remain important, pediatricians will also likely have more concern for trauma or signs of intoxication or withdrawal. There may also be more concern for agitation. Early signs of agitation include restlessness, irritability, and inappropriate or aggressive behaviors, which could require pharmacologic interventions, such as an antipsychotic (haloperidol is often used) and/or a benzodiazepine, such as lorazepam. It is best to offer these medications orally to allow the patient to feel that he or she has some control in the situation.[106] Because of safety concerns, these patients may ultimately be admitted to psychiatric inpatient units. If other physical or medical issues are discovered and the adolescent must be hospitalized in a pediatric unit, consultation with a psychiatrist may be helpful to manage agitation.

Interviewing Patients With Psychotic Symptoms

Pediatricians should interview patients in a quiet and private setting, with as few distractions as possible. Parents and guardians may be able to provide more information and a better time line than the patient, depending on the patient's mental status. Attempting to construct a time line of symptom progression is also useful and includes asking about recent stressors or possible precipitating or exacerbating events, such as trauma in the form of physical or sexual abuse, bullying, or the loss of a loved one (or anniversary of such a loss).[55]

Although it is essential to gather history from parents or guardians, it is also important to talk alone with the adolescent. Careful attention to and documentation of the mental status of the adolescent is necessary (such as his or her presentation and hygiene, engagement, response to internal stimuli). When asking about possible psychotic symptoms, it is important for providers to normalize the symptoms if possible. Asking when these symptoms occur (when one is stressed or depressed, at night when one is alone) and how often they occur (randomly, only in stressful situations, constantly) is also helpful. In addition to asking about specific symptoms, it is helpful and important to ask reality-testing questions (testing how valid the patient's beliefs are and trying to differentiate the patient's internal experience from that of real life), which indicate how entrenched the belief is. If patients report hearing voices of others talking about them but feel that the voices could actually be their own thoughts or that there could be other explanations for the feeling that they are being watched, this would be less acutely concerning. Other important information including medical history (birth history, including age of parents, and developmental history); family psychiatric history; history of abuse or other trauma, including bullying; and history of substance use can shed light on possible risk factors and etiology. Although understanding of current symptoms is critical, it is also important to assess premorbid functioning to understand the patient's degree of change from baseline.

Pediatricians also may consider gathering collateral information from teachers, counselors, or coaches, with consent, after the initial interview to gain different perspectives on the adolescent's behavior and functioning. For example, if parents notice increased isolation and withdrawal as well as refusal to engage in regular hygiene, but the teacher states that grades continue to be good and the adolescent continues to engage in appropriate social interactions with peers (who also do not shower regularly), this might be less concerning for a prodromal presentation. See Appendix 2 for example questions.

Patients presenting with psychotic symptoms are at greater risk for suicide; therefore, it is critical to inquire about thoughts of self-harm or suicidal ideation, passive or active, with or without plan or intent. The Ask Suicide Screening Questions screening tool is helpful in determining the presence of suicidal thinking, and the Columbia-Suicide Severity Rating Scale can be used to determine the level of risk.[107,108] Patients may report command hallucinations telling them to hurt or kill themselves or others; derogatory hallucinations, such as voices that say negative things about them or put them down; or persecutory or religious delusions in which they could report feeling threatened by others or "the devil." If there are concerns for safety to self or others, it is important for providers to refer immediately to the ED for evaluation and to ensure safe transportation. Other concerning symptoms that warrant referral to the ED include severe impairment in functioning, such as lack of self-care (eg, severe weight loss because of worry that the food is being poisoned) or complete isolation (eg, refusal to leave the room or home because of a belief that others will place thoughts in their

heads). If there are no acute safety concerns but symptoms seem to be fully psychotic rather than attenuated, the patient is unable to come up with alternative explanations to delusions, the patient appears to be in distress, and/or functioning is affected, the pediatrician should refer the patient to a child and adolescent psychiatrist.

Physical Examination

When a patient presents with psychotic-like symptoms, providers should perform a thorough physical examination with a detailed neurologic examination to exclude medical etiologies. Focal neurologic findings may warrant urgent consultation with neurology and may require additional evaluation such as EEG and brain imaging. Hallucinations that are primarily gustatory or olfactory can be suggestive of organic causes, such as seizure disorder or tumor,[109] although a more recent study suggests tactile, olfactory, and gustatory hallucinations are actually common in primary psychotic disorders and not necessarily indicative of organic brain disease.[110] Authors also found an association of tactile, olfactory, and gustatory hallucinations with earlier age of onset with psychosis.[110] Hallucinations associated with headaches warrant referral to a neurologist as well.[44]

Laboratory and Imaging Studies

Pediatricians may consider the following laboratory tests: complete blood cell count, comprehensive metabolic panel (including glucose, serum urea nitrogen/creatinine, liver function tests), thyroid-stimulating hormone, calcium and phosphorus, ceruloplasmin (to evaluate for Wilson disease), antinuclear antibodies, erythrocyte sedimentation rate, syphilis screening, HIV screening, vitamin B_{12} and folate concentrations, and urinalysis and urine toxicology.[111] Testing levels of heavy metals may also be considered if clinically indicated. Testing for copy number variants in patients with psychosis may be considered when there is suspicion for a genetic syndrome.[112] See Table 2 for a list of medical illnesses, the symptoms of which can include psychosis, and recommended testing.[67–69]

There is limited evidence supporting imaging studies for patients who do not present with associated focal neurologic signs, although it may be helpful in those with a history of head trauma.[30] Patients with positive antinuclear antibody titers should be referred to pediatric rheumatology, and neuroimaging studies should be performed for evaluation of possible lupus cerebritis.[113] The American College of Radiology appropriateness criteria of evidence-based imaging guidelines for specific clinical presentations suggest that MRI or a computed tomographic scan may be appropriate initially in new-onset psychosis but that the yield of brain imaging for psychosis onset was low unless there was an evident neurologic deficit.[114]

There is also insufficient evidence to routinely perform EEG. However, in a patient presenting with FEP who has a history of a seizure disorder, EEG may rule out the possibility of ictal or interictal psychosis.[111,115] Some studies support prognostic, rather than diagnostic, implications of EEG, with abnormal EEG findings reflecting poorer prognosis.[116]

WHEN TO REFER TO SPECIALTY CARE OR ED

As noted previously, if attenuated symptoms worsen or become fully psychotic, pediatricians should refer patients for psychiatric care. If there are any concerns for safety, such as suicidal thoughts, self-harming thoughts or behaviors, or homicidal ideations because of suspicion of others, the pediatrician should immediately refer the patient to the ED or other mental health facility with means to evaluate and stabilize the patient or summon an ambulance for emergency transport to the ED depending on acuity of safety concerns. Although providers should maintain confidentiality for many mental health care concerns, in the event of concerns for danger, such as suicidal or homicidal ideation, abuse, or disorganization that is so severe that basic functioning is lost (such as not eating, drinking, or sleeping), providers must breach confidentiality to protect the minor patient and others from harm and document that they are doing so. If a patient reports symptoms that are not potentially dangerous and do not seem to affect functioning, these can be kept confidential between the patient and the treating physician and documented in a confidential section of the electronic medical record if available. The physician is advised to use his or her clinical judgment with regard to confidentiality and may encourage the patient to discuss these issues with the parent or guardian (even offering to be present during the discussion to lend support). In the case of a young adult, over 18 years, who has capacity and who presents with a parent or guardian, the clinician is able and encouraged to gather collateral information; however, the clinician cannot share confidential information with the family unless the patient asks him or her to do so. If a patient is considered a danger to self or others or is not able to conduct basic activities of daily living because of the severity of symptoms and needs to be psychiatrically hospitalized, the parent or guardian cannot be told unless the patient asks specifically that this be done or the parent has guardianship.

If a patient is at imminent risk to the safety of himself or herself or others or deemed unsafe or unwilling to engage in care, emergency medical services or police transport is

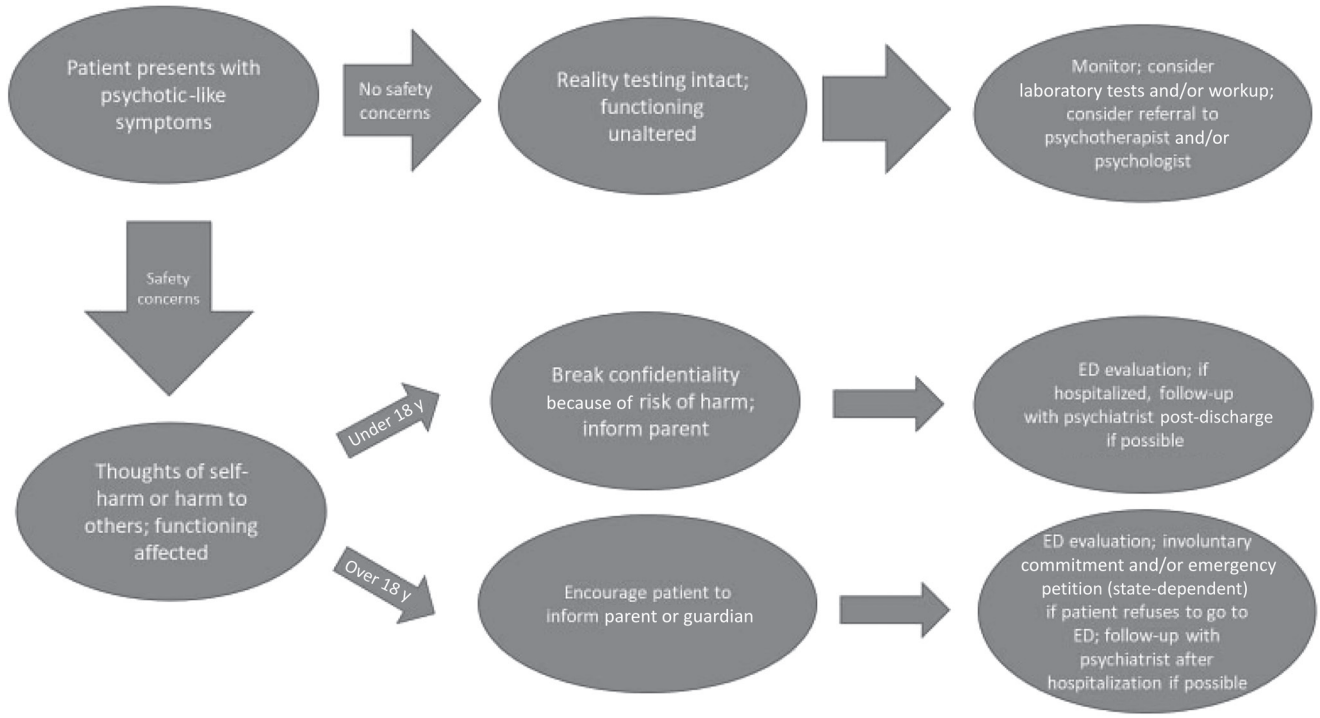


FIGURE 1
Basic algorithm to determine next steps when a patient presents with psychotic-like symptoms.

advised, and referral communication to the ED is recommended. Some states have special procedures to mandate transfer, as well as documents that may accompany patients to indicate the pediatrician's assessment that the patient needs emergency evaluation. Providing this documentation to the guardian who takes the patient to the ED may improve the likelihood of psychiatric hospitalization. States have varying legal requirements for involuntary evaluation and/or treatment of patients, and pediatricians are advised to consult their state department of health Web sites to determine the relevant mental health laws of their state. Although collaboration with a psychiatrist on appropriateness of transfer would be ideal, this is not always possible given the shortage of child psychiatrists. Therefore, in acute situations in which safety is a concern, a pediatrician should feel justified in sending a patient directly to the ED with the guardian if guardian is cognizant of the urgency of the situation and will take the patient to the ED or call 911 to transport the patient. See Fig 1 for consideration of monitoring, breaking confidentiality, and transport to ED for emergency evaluation.

TREATMENT

Pediatricians may be the first providers to assess and identify psychotic-like symptoms. Because visits to the pediatrician may decrease in adolescence, pediatricians should be vigilant in assessing for mental health concerns and changes in functioning or unusual beliefs.[117] Because adolescence can be a difficult time for youth and parents alike, addressing stressors at home and in the environment can be beneficial for all adolescents, including those manifesting psychotic-like symptoms. Recommendations to spend more time in familiar settings among family members and/or close friends can be helpful. Helping the patient to obtain educational or career supports and appropriate psychiatric care earlier may decrease DUP and improve outcomes. In a study of patients presenting with psychotic symptoms associated with a nonpsychotic primary disorder, enhancement of coping skills was associated with improved outcomes.[5]

NAPLS provides a relatively new concept of "clinical staging" for psychotic disorders that may help determine treatment at different levels of presentation and symptom manifestation. Patients presenting with less severe symptoms and/or risk factors receive psychosocial treatments initially, and individuals with increased severity of symptoms and/or more risk factors receive pharmacotherapy in addition to psychosocial treatments.[118] Once a pediatrician identifies psychotic symptoms in an adolescent, it is likely that a referral to a mental health provider will result. Below are the

current treatment modalities for psychotic disorders.

CBT

CBT is an evidence-based treatment of patients presenting with psychotic-like symptoms. CBT aims to lower distress and disability through working with delusions, hallucinations, and negative symptoms, using the "ABC method" (activating event leading to an automatic thought, which in turn affects affect and behavior). CBT aims to derive alternative explanations for the patient's psychotic symptoms that are acceptable to the patient and the therapist and to decrease the patient's distress from the symptom(s).[119,120] In a systematic review and meta-analysis, researchers found CBT lowered the risk of progression to psychosis at 6, 12, and 18 to 24 months and decreased symptoms at 12 months.[121] Authors of a more recent meta-analysis found that CBT resulted in a trend toward significant reduction of attenuated psychotic symptoms at 12 months.[122] In the Dutch Early Detection Intervention Evaluation Trial, authors studied people at "ultrahigh risk" of psychosis who received CBT in addition to routine care compared with a control group with routine care only. CBT plus routine care demonstrated averted transition to psychosis and reduced costs.[123] In addition, the National Institute for Health and Care Excellence recommends CBT with or without family therapy for patients presenting with attenuated psychotic symptoms.[124]

CBT in early psychosis has also revealed some benefit as a stand-alone treatment of psychosis, although most studies have been conducted with CBT in combination with antipsychotic medication treatment. CBT may be more acceptable to patients because of its lower side effect profile and decreased stigma; in addition, discontinuation of CBT is less common than discontinuation of treatment with antipsychotic medications.[125–127]

Other Psychosocial Interventions

Aside from CBT, family-focused interventions, social skills training, supported education and employment, and healthy lifestyle training are early interventions that can be helpful for CHR patients.[128] Family interventions include family psychoeducation and improving communication between family members. In a meta-analysis, family therapy was found to show a nonsignificant trend toward decreasing attenuated psychotic symptoms at 6 months.[122] Because impairment in social skills can be associated with difficulty making friends, bullying, and poor occupational functioning, social skills training can involve role playing as well as practicing specific social skills to improve interpersonal skills.[128] CHR youth may be at higher risk for academic difficulties, so they may benefit from special education services, such as a 504 or individualized education program. Increased resources and appropriate accommodations can help these youth feel successful. In addition, supported employment can be helpful for patients at CHR, who may have trouble finding and maintaining jobs. Healthy lifestyle interventions include emphasis on proper nutrition, physical activity, getting enough sleep, managing stress, and not engaging in behaviors like smoking, substance use, and risky sexual practices.[128]

The Schizophrenia Patient Outcomes Research Team psychosocial treatment recommendations, which report evidence-based psychosocial treatments for people with schizophrenia, include assertive community treatment, supported employment, skills training, CBT, token economy interventions (positive reinforcement for target behaviors), family-based services, psychosocial interventions for alcohol and substance use disorders, and psychosocial intervention for weight management.[129] Correll et al[130] reported that early intervention services were superior to treatment as usual in FEP.

Medications

Initiating medication for the treatment of psychotic symptoms is generally out of the scope of pediatricians. However, limited access to mental health specialists may necessitate prescribing in some circumstances, ideally with consultation from a child and adolescent psychiatrist or developmental-behavioral pediatrician.

Several antipsychotic medications may alleviate psychotic symptoms if the symptoms are caused by a primary psychotic disorder (see Tables 4 and 5), although it is important to mention that ziprasidone and asenapine failed to separate from placebo in treatment of adolescents with schizophrenia.[131,132] When selecting an antipsychotic medication, those with FDA approval should be considered first. Other factors that may help guide the choice of treatment include side effect profile, patient and family preference, cost, insurance coverage, and availability of the medication.[133]

If psychotic symptoms are caused by another psychiatric disorder, the primary disorder (such as depression, bipolar disorder, or anxiety) should be treated first, unless the psychotic symptoms are so severe that brief treatment with an antipsychotic medication concurrently with a medication to treat the primary disorder should be considered. Given the adverse effects associated with antipsychotic medications, great care and consideration are advised before prescribing these medications.

TABLE 4 Commonly Used Antipsychotic Medications and Adverse Effects

	Akathisia	TD	Sedation	Anticholinergic Side Effects	Orthostatic Hypotension	Wt Gain	Dyslipidemia	Hyperglycemia	Prolactin Elevation	QTc Prolongation
First generation										
Chlorpromazine	Mild	Moderate	Moderate	Moderate	Moderate	Severe	Severe	Severe	Mild	Minimal
Haloperidol	Severe	Moderate	Mild	None	None	Mild	Minimal	Minimal	Moderate	Minimal
Second generation (atypical)										
Aripiprazole	Moderate	Minimal	Minimal	None	Minimal	Minimal	Minimal	Minimal	None	Minimal
Clozapine	Mild	None	Severe	Severe	Moderate	Severe	Severe	Severe	Mild	Moderate
Lurasidone	Mild to moderate	Minimal	Mild to moderate	None	Minimal	Minimal	Minimal	Minimal	Mild	Minimal
Olanzapine	Mild	Minimal	Mild to moderate	Moderate	Mild	Severe	Severe	Severe	Mild to Moderate	Minimal
Paliperidone	Mild	Minimal	Minimal	None	Mild	Moderate	Mild	Mild	Severe	Mild
Quetiapine	Mild to moderate	Minimal	Moderate	Mild to moderate	Moderate	Moderate	Moderate	Moderate	None	Mild
Risperidone	Mild	Minimal	Mild	None	Mild	Moderate	Mild	Mild	Severe	Mild
Ziprasidone	Mild to moderate	Minimal	Mild	None	None	Minimal	Minimal	Minimal	Mild	Moderate

Sources: 151 and 152. TD, tardive dyskinesia.

With regard to dosing, the mantra is to "start low, and go slow," always monitoring for adverse effects. Generally, lower doses should be effective in patients with FEP.[111] A meta-analysis and pooled data from 7 randomized controlled trials indicate an observable response usually within 2 weeks and that the initial improvement (in 2 weeks) is greater than in the subsequent 2 weeks.[134,135] See Table 4 for a list of antipsychotic medications and side effects and Table 5 for dose ranges and FDA approval for children and adolescents.

There have been trials comparing efficacy of first-generation and second-generation antipsychotic medications, including the Clinical Antipsychotic Trials of Intervention Effectiveness and European First Episode Schizophrenia Trial. Researchers in these studies did not find significant differences among efficacy of these antipsychotics but did find different side effect profiles, which influenced time to discontinuation.[136,137]

There are 2 main treatment studies of adolescents and young adults with schizophrenia. Researchers in the Treatment of Early-Onset Schizophrenia Symptoms (TEOSS) study compared the efficacy of first-generation or atypical (second generation) antipsychotic medications on early-onset schizophrenia and schizoaffective disorder because providers were prescribing more atypical antipsychotics because of better efficacy and tolerability, although there was no clear evidence of this.[138,139] The study included patients between 8 and 19 years of age receiving risperidone, olanzapine (both atypical antipsychotics), or molindone (first-generation antipsychotic). The 3 medications had similar efficacy (50% treatment response), but adverse effect profiles differed.[138] Molindone was associated with

TABLE 5 Second-Generation Antipsychotic Medications: FDA Approval and Dose Ranges for Adolescents With Schizophrenia

	FDA Approval	Recommended Dose	Starting Dose	Maximum Dose, mg
Aripiprazole	Schizophrenia: ≥13 y	10 mg	2 mg	30
Lurasidone	Schizophrenia: ≥13 y	40–80 mg	20 mg	80
Olanzapine	Schizophrenia: ≥13 y	10 mg	2.5 mg	20
Paliperidone	Schizophrenia: ≥12 y	Wt <51 kg: 3–6 mg	3 mg	6
	Schizophrenia: ≥12 y	Wt >51 kg: 3–12 mg	3 mg	12
Quetiapine	Schizophrenia: ≥13 y	400–800 mg/d	25 mg to 25 mg BID	800
Risperidone	Schizophrenia: ≥13 y	0.5–6 mg/d	0.25–0.5 mg	6

Sources: 153 and 154. BID, twice a day.

akathisia, an inner feeling of restlessness that compels people to be in motion; olanzapine and risperidone were associated with weight gain and metabolic changes. Risperidone also caused increase of prolactin levels.[138]

The National Institute of Mental Health Recovery After Initial Schizophrenia Episode (RA1SE) study of participants 15 to 25 or 30 years of age aimed to develop and implement integrated treatment protocols in FEP. The treatment program is NAVIGATE, named as such to support and guide patients and their families through the experience of FEP toward recovery.[140] NAVIGATE is a team-based comprehensive, multidisciplinary treatment program designed for implementation in community mental health facilities. Treatment interventions include individualized medication treatment (shared decision-making), family education program, individual resiliency training, and supported education and employment.[141,142] Coordinated specialty care with these components is now considered evidence-based care in treatment of early-onset psychosis and is tightly coordinated with primary medical care to optimize both mental and physical health. In a comparison of NAVIGATE and usual community care, NAVIGATE participants continued treatment of longer periods of time, had more improvement in symptoms and quality of life, and were more involved in school and work over a period of 2 years.[141] Patients also had fewer adverse effects and were less depressed.[143] Patients with shorter DUP seemed to benefit more from NAVIGATE than those with longer DUP.[141]

Adverse Effects of Antipsychotic Medications and Recommended Monitoring

The pediatrician may be asked to evaluate a patient with medical symptoms that could be related to antipsychotic medication. Moreover, because of geographic limitations and cost concerns, families may rely on the pediatrician in the medical home to work collaboratively with the psychiatrist to monitor for certain side effects of antipsychotic medications. Adverse effects of antipsychotic medications include extrapyramidal symptoms, weight gain, impaired glucose metabolism, increased lipid concentrations, increased prolactin concentrations (leading to menstruation irregularities and galactorrhea), increased QTc interval, and sedation. Extrapyramidal symptoms include bradykinesia (decreased movement), akathisia, tremor, muscle rigidity, dystonia (intermittent or sustained muscle contractions), and tardive dyskinesia (involuntary and repetitive athetoid or choreiform movements of the body, lasting at least a few weeks).[144,145] Tardive dyskinesia can develop in association with the use of a neuroleptic medication for at least a few months and can persist beyond 4 to 8 weeks[1] (see Table 4).

The American Academy of Child and Adolescent Psychiatry practice parameter provides guidelines on metabolic monitoring for pediatric patients receiving antipsychotics, as second-generation antipsychotics are more likely to increase risk of metabolic syndrome, with increased waist circumference and blood pressure as well as hypertriglyceridemia, hyperglycemia, and low high-density lipoprotein ("good cholesterol") concentration.[144,146,147] The guideline recommends baseline measurement of BMI, waist circumference, fasting blood glucose concentration, hemoglobin A1c, and fasting lipid concentrations. Additionally, monitoring includes BMI and waist circumference monthly for the first 3 months, at 6 months, and then yearly, unless there is a change in medication dose (in which case more frequent measurements should be made until dose stabilization). The guidance recommends measuring fasting glucose concentration, lipid concentrations, and hemoglobin A1c at 3 months and then yearly.[146,147] Providers may consider more frequent monitoring of children and adolescents.

Neuroleptic malignant syndrome (NMS) is a rare but life-threatening adverse effect of treatment with antipsychotic medications caused by excessive dopamine blockade. Symptoms include "lead-pipe" muscle rigidity, fever, autonomic dysfunction, and altered mental status. NMS is mostly likely to occur within hours to days of taking the medication, with the most common laboratory finding of elevated creatine concentrations of 1000 μg/L.[148] Initial management of NMS includes cessation of the causative drug and supportive medical care. Severe NMS may require treatment with bromocriptine

mesylate, which is a dopamine agonist, and dantrolene sodium, a muscle relaxant.[148] If pediatricians detect potential NMS symptoms, it is important that the patient receive immediate assessment and treatment, because it is a potentially fatal emergency.[149]

AVOIDING MISDIAGNOSIS AND UNNECESSARY TREATMENT

Encountering a patient with psychotic-like or frank psychotic symptoms may be unsettling to pediatricians, who may have limited experience with mental health disorders. Psychotic-like symptoms can be frightening and debilitating, often fueling the pressure to treat with medication. Although data have shown an improved prognosis for shorter DUP, these data do not suggest that all psychotic symptoms should be treated with antipsychotic medication.

Pediatricians should proceed cautiously and thoughtfully with their evaluation, keeping a broad differential diagnosis in mind and attending to possible safety concerns. Because presentation of psychotic-like or frank psychotic symptoms can be complex, consultation with a child psychiatrist is generally warranted to avoid misdiagnosis and unnecessary treatment with antipsychotic medications. Additionally, we advise caution before making a diagnosis of unspecified psychotic disorder or any other psychotic disorder because these diagnoses often persist and may unnecessarily stigmatize patients.

RESOURCES FOR PEDIATRICIANS

Because of the shortage of child psychiatrists, there are resources within states that allow "live, real-time" consultations with child and adolescent psychiatrists in the area. Programs across the nation consisting of telephone or video consultations with a range of mental health providers are excellent resources that can guide diagnosis and treatment. These programs are free to primary care physicians, sometimes only within a certain geographic area, and are often funded by the state department of health.[150] Pediatricians can generally call the number for the program and undergo an orientation before beginning use of the telephone consult and, in some cases, telepsychiatry or physical consultation services. Some programs are open only to patients with medical assistance (Medicaid). Other programs not only offer consultation services but also offer training programs or continuing medical education opportunities to primary care physicians on the assessment and management of mental health issues. In some programs, if phone consultations are insufficient, pediatricians can schedule in-person evaluations within a few days of the phone consultation, which may be especially helpful to those practicing in remote or more rural areas where there are few to no child psychiatric providers. Other helpful resources for pediatricians are listed in Appendix 3. The resources include a link for coding recommendations, including new collaborative care codes used in the Psychiatric Collaborative Care Model, with a primary treating practitioner collaborating with a behavioral health care manager and a psychiatric consultant.

CONCLUSIONS

Psychotic symptoms can be frightening and confusing for patients, caregivers, and providers. Pediatric providers are unique in that they may be the first providers to observe attenuated psychotic symptoms or the first providers parents and guardians turn to if they observe such symptoms in their children. Understanding risk factors and symptoms to evaluate in patients who present with attenuated or psychotic symptoms is helpful in the evaluation of these youth and direct intervention, treatment, and referral, as early intervention can improve prognosis and level of functioning.

ADVICE FOR PEDIATRICIANS

1. In patients who present with psychotic-like or full psychotic symptoms, follow-up questions to better characterize the patient's presentation and disposition are helpful.
2. In patients presenting with psychotic-like experiences, pediatricians should evaluate for history of trauma, including sexual, physical, or emotional abuse, neglect, and bullying; substance use; and developmental delays.
3. Clinical interview, comprehensive physical examination including neurologic examination, laboratory studies, and imaging (when clinically indicated) may be helpful in determining an underlying cause of psychotic symptoms.
4. Pediatricians should facilitate referrals to specialists (therapist, psychologist, or child and adolescent psychiatrist or general psychiatrist) according to severity of symptoms. Consultation with psychiatry, if available, can be helpful in ensuring that the appropriate referrals are made. For those with ID or ASD, referral to a developmental-behavioral pediatrician should be considered as well. The medical home model can be helpful in coordinating care and supporting the patient and family as they navigate the mental health system.
5. Screening for suicidal thoughts is an essential component of the evaluation process because psychosis is associated with increased suicidal ideation; if there are suicidal thoughts or thoughts to hurt others, the patient should be transported immediately to the ED for evaluation. Severe decrease in functioning, such as inability to

care for or feed oneself, may also warrant ED evaluation.

6. The time between presentation of attenuated psychotic symptoms and full-blown psychosis is a critical time for monitoring and early intervention. Collaboration with psychiatry can assist in the determination of whether monitoring or referral to another provider would be appropriate. Although care to avoid premature diagnosis of a psychotic disorder is important, evidence shows that minimizing the DUP mitigates symptoms and improves prognosis.
7. Researchers have found that multidisciplinary coordinated specialty care consisting of medication treatment (where indicated), family education, individual resiliency training, and supported education and employment is beneficial in FEP. Patients should be referred to such resources where available, and continued funding and expansion of such programs should be supported.
8. When starting antipsychotic medication, "start low and go slow" and provide regular monitoring for adverse effects. Pediatricians would generally not be expected to initiate antipsychotic medications. However, in some circumstances (eg, severe symptoms that do not meet inpatient criteria in the setting of limited access to mental health care), it may be appropriate for the pediatrician to start or manage a medication while awaiting subspecialty care, ideally with ongoing consultation with a child psychiatrist.
9. In some states, free, state-funded services with telephone, and sometimes in-person, consultations with child and adolescent psychiatrists are available. These programs can be helpful in supporting pediatricians to extend their mental health expertise and should be used where available. Expansion of these programs and continued funding support for them are encouraged.

APPENDIX 1: CASE VIGNETTES

Primary Psychotic Disorder

A 14-year-old patient presented with derogatory auditory hallucinations as well as visual hallucinations of eyes watching him. He had a history of declining grades, social relationships, and self-care. He described a recent visit to the ED after smoking cannabis that he believed may have been laced with something. He believed that he died or fell into a coma after that experience and that nothing is real now. When asked if there could be any other possible explanation, the patient replied that it could be aliens. The patient admitted that he was terrified by these thoughts and contemplated suicide, although part of him believed that he would not actually die if he tried to kill himself, because nothing was real. Because of the patient's level of distress, delusions, and loss of reality testing, he was believed to be in real danger of harm to himself and/or others. He was transported to the ED for further evaluation and safety assessment.

Mood Disorder With Psychotic Features

A 15-year-old, high-achieving patient presented with delusions and auditory hallucinations that peers were talking about her. She believed that her parents were poisoning her food and telling peers about her weaknesses and vulnerabilities to use them against her. Her parents reported that she had been staying up late doing homework and sleeping only 1 to 2 hours a night, with associated racing thoughts, pressured speech, poor concentration, and inability to complete the many tasks she started. Because of the paranoid delusions and effect on her functioning, the patient was transferred to the ED. As part of the evaluation, no suicidal or homicidal ideations were noted, and the parents believed that they could ensure her safety. The patient was discharged from the hospital and referred to a child and adolescent psychiatrist, who ultimately diagnosed the patient with bipolar disorder, type I, severe with psychotic features, most recent episode manic. She was started on an atypical antipsychotic medication initially because of the severity of psychotic symptoms, as a mood stabilizer was slowly titrated to therapeutic level. She also began therapy. When the psychotic symptoms resolved, she returned to school and did well. At that time, her provider slowly discontinued the antipsychotic medication, and she remained on a mood stabilizer. She graduated from high school and went on to college.

Anxiety

A 16-year-old presented with hallucinations of people talking about her and making derogatory comments. She had previously done well but was now unwilling to leave her home because of severe anxiety attacks. The patient was referred to a child and adolescent psychiatrist as well as a psychotherapist. She eventually received a diagnosis of social anxiety disorder and was treated with a selective serotonin reuptake inhibitor (SSRI). She was able to return to school, and social relationships gradually resumed. After a period of stability, the patient returned to her pediatrician to manage her medication but continued to see a therapist.

Obsessive-Compulsive Disorder

A 17-year-old patient presented with intrusive sexual thoughts about her father and friends and worried that people and objects were dirty if they accidentally rubbed against her genitalia. She also expressed fears

APPENDIX 2 Examples of Questions to Ask When Interviewing Adolescents About Psychotic-Like Experiences

Sometimes when people get very, very sad or very, very worried, they may feel like they are hearing voices that other people do not hear. Has this ever happened to you?
Sometimes when people get very, very sad or very, very worried, they may feel like they are seeing things that other people do not see. Has this ever happened to you?
Have you ever felt like people are watching you?
Have you ever felt like people are trying to hurt you or are out to get you?
Have you ever felt like something was putting thoughts into your mind or controlling your thoughts?
Do you sometimes feel that you are getting special messages from the television or a video game?
Do you hear voices/see things when you are sad? Angry? Frightened?
Does anything make the voices/visions/thoughts better or worse?
Do they only occur at certain times of the day or all the time?
Does this (do these) symptom(s) bother you?
If patients report experiencing these symptoms, it is also important to ask reality-testing questions, such as:
Is it possible that your eyes are playing tricks on you?
Is it possible that people are not really talking about you?
Is there another possible explanation?

that she was homosexual when she thought another girl was attractive and would perseverate on this belief for hours to anyone who would listen at home. The patient was devoutly Catholic and feared that having these thoughts meant she was evil and deserved to die, although the thought of doing harm to herself was frightening to her. She began to pray multiple times a day to rid herself of these thoughts. Her pediatrician referred her to a psychologist, who referred her to a psychiatrist while continuing to work with her in therapy. With a combination of intensive CBT and an SSRI, the patient was able to overcome the obsessive thoughts and compulsions. Although she would sometimes still have them, she was able to tell herself that her mind was playing "tricks" on her and challenge these thoughts. She ultimately returned to her pediatrician for management of the SSRI and continued to have "booster" CBT sessions with the psychologist as needed.

ASD

A 14-year-old patient presented with auditory hallucinations consisting of multiple characters in a fantasy world he had created from a young age. He would often isolate himself to immerse himself in this fantasy world, which he preferred to "real life." He had endured years of bullying and had no friends but was able to maintain good grades at school. The parents reported poor peer relationships and better social interactions with adults and younger children. He was obese, which correlated with multiple trials of antipsychotic medications, all of which had been stopped because of reported lack of efficacy. Because of concerns about impaired social interactions and restricted interests, the pediatrician referred the patient to a developmental-behavioral pediatrician for evaluation. After a thorough evaluation, the patient received a diagnosis of ASD. Genetic testing was completed and the result was negative. The developmental pediatrician recommended slow discontinuation of the antipsychotic medication because it became clear that the fantasy characters were a manifestation of ASD and caused no distress; in fact, they served as a coping mechanism against the challenges of real life. He began to participate in psychotherapy and a social skills group. Insight into his diagnosis and improved social interactions developed over time.

ID

A 13-year-old patient reported in a childlike sing-song voice that her mood was happy but that she would often see a shadow figure at night and sometimes visions of a little girl who wanted to give her flowers. She stated that her parents had been telling her she should pray whenever these figures would come, which she would always do. She had an individualized education plan, and past neuropsychological testing indicated low IQ. The pediatrician recommended follow-up in 2 weeks to determine if the visual

APPENDIX 3 Helpful Resources on Mental Health Disorders

https://www.nimh.nih.gov/index.shtml
https://www.aap.org/en-us/advocacy-and-policy/aap-health-initiatives/Mental-Health/Pages/Primary-Care-Tools.aspx
https://www.aacap.org/AACAP/Resources_for_Primary_Care/Home.aspx?hkey=59bfdf7f-149f-43fd-babb-a6a77c5e8caf
https://www.nami.org/
https://www.aap.org/en-us/advocacy-and-policy/aap-health-initiatives/Mental-Health/Pages/Addressing-Mental-Health-Concerns-in-Primary-Care-A-Clinicians-Toolkit.aspx
https://www.aap.org/en-us/professional-resources/practice-transformation/getting-paid/Coding-at-the-AAP/Pages/Private/Trauma-Coding-Fact-Sheet.aspx
https://www.cms.gov/Outreach-and-Education/Medicare-Learning-Network-MLN/MLNProducts/Downloads/BehavioralHealthIntegration.pdf

hallucinations or perceptions were distressing to the patient and whether the symptoms warranted a referral to a mental health specialist. At the 2-week follow-up, the patient began stating that these figures were becoming increasingly frightening, causing trouble sleeping, school refusal, and mood changes. The pediatrician referred her to a child psychiatrist for further assessment. Although the psychiatrist felt strongly that ID and possibly ASD were playing a large role in the patient's presentation, the child's report of distress and subsequent reports of hearing "terrifying" screaming while in school indicated need for medication initiation.

Cultural and Family Beliefs

A 15-year-old patient in treatment for ADHD for several years suddenly confessed to seeing ghosts in his room and feeling them touch him at times. He reported that these ghosts terrified him, so he had taken to wearing crosses, which he believed protected him. When the pediatrician asked if he had told anyone about these ghosts, he reported he had told his mother and father, both of whom also see ghosts. He stated that the ghosts were worse in his parents' home, although he also felt the presence of different ghosts at his aunt's home. Grades continued to be average, and he continued to have appropriate social interactions with peers at school. The provider routinely asked about these ghosts, as well as the patient's functioning, at every follow-up visit but ultimately determined the patient's reports to be associated with family beliefs or superstitions and provided no additional medications or referrals.

Trauma

A 16-year-old female adolescent confidentially told her adolescent medicine provider that she had been sexually assaulted at a party about a month ago and that since then, she was "paranoid" whenever she went out that someone was going to hurt her. If it was dark when she returned home from a school activity or work, she would constantly think that she was hearing footsteps behind her and seeing shadowy figures following her. The pediatrician asked about how she was doing at school, and the patient replied that although her concentration was decreased because of anxiety and flashbacks, she was maintaining good grades and was still managing to function at work. The pediatrician suggested seeing a therapist about the trauma that had occurred but held off on referral to a psychiatrist; he also increased frequency of follow-up visits for a few months, during which he monitored the status of the flashbacks and hyperarousal. With the help of the therapist, who used a combination of trauma-focused CBT and dialectical behavioral therapy techniques to treat the patient, these symptoms steadily decreased without need for medication.

Adverse Effect to Medication

A 7-year-old child with a history of ADHD, combined type, returned to his pediatrician's office 2 weeks after starting a stimulant medication to help with school functioning. The parents expressed concern that the child reported seeing faces and feeling like insects were crawling on his skin. Knowing that psychotic symptoms were a rare adverse effect of stimulant treatment, the pediatrician stopped the medication. Symptoms quickly resolved.

Temporal Lobe Epilepsy

A 19-year-old young adult with no psychiatric history presented with delusions of being dirty and thinking she could not clean herself or rid herself of a foul stench. She also reported the taste of peppermint. Because of the olfactory and gustatory hallucinations, a computed tomographic scan of the head and an EEG were performed. The EEG revealed abnormal brain wave activity, and the pediatrician referred the patient to a neurologist.

LEAD AUTHOR

Liwei L. Hua, MD, PhD

COMMITTEE ON ADOLESCENCE, 2019–2020

Elizabeth M. Alderman, MD, FSAHM, FAAP, Chairperson
Richard J. Chung, MD, FAAP
Laura K. Grubb, MD, MPH, FAAP
Janet Lee, MD, FAAP
Makia E. Powers, MD, MPH, FAAP
Krishna K. Upadhya, MD, FAAP
Stephenie B. Wallace, MD, MSPH, FAAP

PAST COMMITTEE MEMBER

Cora C. Breuner, MD, MPH, FAAP, Former Chairperson

LIAISONS

Liwei L. Hua, MD, PhD – *American Academy of Child and Adolescent Psychiatry*
Ellie Vyver, MD – *Canadian Pediatric Society*
Anne-Maria Amies, MD – *American College of Obstetricians and Gynecologists*
Seema Menon, MD – *North American Society of Pediatric and Adolescent Gynecology*
Lauren B. Zapata, PhD, MSPH – *Centers for Disease Control and Prevention*

STAFF

Karen Smith
James Baumberger, MPP

ABBREVIATIONS

ADHD: attention-deficit/hyperactivity disorder
ASD: autism spectrum disorder
CBT: cognitive behavioral therapy
CHR: clinical high risk
DSM-5: *Diagnostic and Statistical Manual of Mental Disorders, Fifth Edition*
DUP: duration of untreated psychosis
ED: emergency department
FDA: US Food and Drug Administration
FEP: first-episode psychosis
ID: intellectual disability
NAPLS: North American Prodrome Longitudinal Study
NMS: neuroleptic malignant syndrome
SSRI: selective serotonin reuptake inhibitor

FUNDING: No external funding.

POTENTIAL CONFLICT OF INTEREST: The authors have indicated they have no potential conflicts of interest to disclose.

REFERENCES

1. American Psychiatry Association. *Diagnostic and Statistical Manual of Mental Disorders*, 5th ed. Washington, DC: American Psychiatric Publishing; 2013
2. Poulton R, Caspi A, Moffitt TE, Cannon M, Murray R, Harrington H. Children's self-reported psychotic symptoms and adult schizophreniform disorder: a 15-year longitudinal study. *Arch Gen Psychiatry*. 2000;57(11):1053–1058
3. Healy C, Gordon AA, Coughlan H, Clarke M, Kelleher I, Cannon M. Do childhood psychotic experiences improve the prediction of adolescent psychopathology? A longitudinal population-based study. *Early Interv Psychiatry*. 2019;13(5):1245–1251
4. Serra G, Koukopoulos A, De Chiara L, et al. Early clinical predictors of long-term morbidity in major depressive disorder. *Early Interv Psychiatry*. 2019; 13(4):999–1002
5. Wigman JTW, Devlin N, Kelleher I, et al. Psychotic symptoms, functioning and coping in adolescents with mental illness. *BMC Psychiatry*. 2014;14:97
6. Hua LL, Wilens TE, Martelon M, Wong P, Wozniak J, Biederman J. Psychosocial functioning, familiality, and psychiatric comorbidity in bipolar youth with and without psychotic features. *J Clin Psychiatry*. 2011;72(3):397–405
7. American Association of Child and Adolescent Psychiatry. Severe shortage of child and adolescent psychiatrists illustrated in AACAP workforce maps. Press release. 2018. Available at: https://www.aacap.org/App_Themes/AACAP/Docs/press/2018/Press-Release-Workforce-Maps.pdf. Accessed August 26, 2020
8. Heinssen RK, Goldstein AB, Azrin ST; National Institute of Mental Health. Evidence-based treatments for first episode psychosis: components of coordinated specialty care. 2014. Available at: https://www.nimh.nih.gov/health/topics/schizophrenia/raise/evidence-based-treatments-for-first-episode-psychosis-components-of-coordinated-specialty-care.shtml. Accessed August 26, 2020
9. McGrath J, Saha S, Chant D, Welham J. Schizophrenia: a concise overview of incidence, prevalence, and mortality. *Epidemiol Rev*. 2008;30:67–76
10. Schimmelmann BG, Conus P, Cotton S, McGorry PD, Lambert M. Pre-treatment, baseline, and outcome differences between early-onset and adult-onset psychosis in an epidemiological cohort of 636 first-episode patients. *Schizophr Res*. 2007;95(1–3):1–8
11. Woodberry KA, Serur RA, Hallinan SB, et al. Frequency and pattern of childhood symptom onset reported by first episode schizophrenia and clinical high risk youth. *Schizophr Res*. 2014;158(1–3):45–51
12. Addington J, Heinssen R. Prediction and prevention of psychosis in youth at clinical high risk. *Annu Rev Clin Psychol*. 2012;8:269–289
13. Kline E, Thompson E, Bussell K, Pitts SC, Reeves G, Schiffman J. Psychosis-like experiences and distress among adolescents using mental health services. *Schizophr Res*. 2014;152(2–3):498–502
14. Addington J. The prodromal stage of psychotic illness: observation, detection or intervention? *J Psychiatry Neurosci*. 2003;28(2):93–97
15. Addington J, Liu L, Buchy L, et al. North American Prodrome Longitudinal Study (NAPLS 2): the prodromal symptoms. *J Nerv Ment Dis*. 2015;203(5):328–335
16. Marder SR, Galderisi S. The current conceptualization of negative symptoms in schizophrenia. *World Psychiatry*. 2017; 16(1):14–24
17. Addington J, Cornblatt BA, Cadenhead KS, et al. At clinical high risk for psychosis: outcome for nonconverters. *Am J Psychiatry*. 2011;168(8):800–805
18. Cannon TD, Cadenhead K, Cornblatt B, et al. Prediction of psychosis in youth at high clinical risk: a multisite longitudinal study in North America. *Arch Gen Psychiatry*. 2008;65(1):28–37
19. Schoenbaum M, Sutherland JM, Chappel A, et al. Twelve-month health care use and mortality in commercially insured young people with incident psychosis in the United States. *Schizophr Bull*. 2017; 43(6):1262–1272
20. Cannon TD. Brain biomarkers of vulnerability and progression to psychosis. *Schizophr Bull*. 2016;42(suppl 1):S127–S132
21. Tarbox SI, Addington J, Cadenhead KS, et al. Premorbid functional development and conversion to psychosis in clinical high-risk youths. *Dev Psychopathol*. 2013;25(4 pt 1):1171–1186
22. McClellan J. Psychosis in children and adolescents. *J Am Acad Child Adolesc Psychiatry*. 2018;57(5):308–312
23. Hlastala SA, McClellan J. Phenomenology and diagnostic stability of youths with atypical psychotic symptoms. *J Child Adolesc Psychopharmacol*. 2005;15(3): 497–509
24. Fisher HL, Caspi A, Poulton R, et al. Specificity of childhood psychotic symptoms for predicting schizophrenia by 38 years of age: a birth cohort study. *Psychol Med*. 2013;43(10):2077–2086
25. Jardri R, Bartels-Velthuis AA, Debbané M, et al. From phenomenology to neurophysiological understanding of hallucinations in children and adolescents. *Schizophr Bull*. 2014; 40(suppl 4):S221–S232
26. Simon AE, Cattapan-Ludewig K, Gruber K, et al. Subclinical hallucinations in adolescent outpatients: an outcome study. *Schizophr Res*. 2009;108(1–3): 265–271
27. Calkins ME, Moore TM, Satterthwaite TD, et al. Persistence of psychosis spectrum symptoms in the Philadelphia Neurodevelopmental Cohort: a prospective two-year follow-up. *World Psychiatry*. 2017;16(1):62–76
28. Youngstrom EA, Birmaher B, Findling RL. Pediatric bipolar disorder: validity, phenomenology, and recommendations for diagnosis. *Bipolar Disord*. 2008;10(1 pt 2):194–214

29. Ulloa RE, Birmaher B, Axelson D, et al. Psychosis in a pediatric mood and anxiety disorder clinic. *J Am Acad Child Psychiatry.* 2000;39(3):337–345

30. Sikich L. Diagnosis and evaluation of hallucinations and other psychotic symptoms in children and adolescents. *Child Adolesc Psychiatr Clin N Am.* 2013; 22(4):655–673

31. Kelleher I, Connor D, Clarke MC, Devlin N, Harley M, Cannon M. Prevalence of psychotic symptoms in childhood and adolescence: a systematic review and meta-analysis of population-based studies. *Psychol Med.* 2012;42(9): 1857–1863

32. Kelleher I, Devlin N, Wigman JTW, et al. Psychotic experiences in a mental health clinic sample: implications for suicidality, multimorbidity and functioning. *Psychol Med.* 2014;44(8): 1615–1624

33. Kelleher I, Lynch F, Harley M, et al. Psychotic symptoms in adolescence index risk for suicidal behavior: findings from 2 population-based case-control clinical interview studies. *Arch Gen Psychiatry.* 2012;69(12):1277–1283

34. Yates K, Lång U, Cederlöf M, et al. Association of psychotic experiences with subsequent risk of suicidal ideation, suicide attempts, and suicide deaths: a systematic review and meta-analysis of longitudinal population studies. *JAMA Psychiatry.* 2019;76(2): 180–189

35. Kelleher I, Wigman JTW, Harley M, et al. Psychotic experiences in the population: association with functioning and mental distress. *Schizophr Res.* 2015;165(1): 9–14

36. Bachman P, Niendam TA, Jalbrzikowski M, et al. Processing speed and neurodevelopment in adolescent-onset psychosis: cognitive slowing predicts social function. *J Abnorm Child Psychol.* 2012;40(4):645–654

37. Carrión RE, McLaughlin D, Auther AM, Olsen R, Correll CU, Cornblatt BA. The impact of psychosis on the course of cognition: a prospective, nested case-control study in individuals at clinical high-risk for psychosis. *Psychol Med.* 2015;45(15):3341–3354

38. Tillman R, Geller B, Klages T, Corrigan M, Bolhofner K, Zimerman B. Psychotic phenomena in 257 young children and adolescents with bipolar I disorder: delusions and hallucinations (benign and pathological). *Bipolar Disord.* 2008; 10(1):45–55

39. Baumeister D, Sedgwick O, Howes O, Peters E. Auditory verbal hallucinations and continuum models of psychosis: a systematic review of the healthy voice-hearer literature. *Clin Psychol Rev.* 2017; 51:125–141

40. Schepers E, van Os J, Lousberg R. White noise speech illusions in the general population: the association with psychosis expression and risk factors for psychosis. *PLoS One.* 2019;14(2): e0211914

41. Taylor M, Carlson SM, Maring BL, Gerow L, Charley CM. The characteristics and correlates of fantasy in school-age children: imaginary companions, impersonation, and social understanding. *Dev Psychol.* 2004;40(6): 1173–1187

42. Gleason TR. The psychological significance of play with imaginary companions in early childhood. *Learn Behav.* 2017;45(4):432–440

43. Taylor M, Hulette AC, Dishion TJ. Longitudinal outcomes of young high-risk adolescents with imaginary companions. *Dev Psychol.* 2010;46(6): 1632–1636

44. Sidhu KAS, Dickey TO. Hallucinations in children: diagnostic and treatment strategies. *Curr Psychiatr.* 2010;9(10): 53–60

45. Sosland MD, Edelsohn GA. Hallucinations in children and adolescents. *Curr Psychiatry Rep.* 2005;7(3):180–188

46. Zisook S, Shear K. Grief and bereavement: what psychiatrists need to know. *World Psychiatry.* 2009;8(2):67–74

47. Hurley AD. The misdiagnosis of hallucinations ad delusions in persons with mental retardation: a neurodevelopmental perspective. *Semin Clin Neuropsychiatry.* 1996;1(2): 122–133

48. Munir KM. The co-occurrence of mental disorders in children and adolescents with intellectual disability/intellectual developmental disorder. *Curr Opin Psychiatry.* 2016;29(2):95–102

49. Cochran DM, Dvir Y, Frazier JA. "Autism-plus" spectrum disorders: intersection with psychosis and the schizophrenia spectrum. *Child Adolesc Psychiatr Clin N Am.* 2013;22(4):609–627

50. Chandrasekhar T, Copeland JN, Spanos M, Sikich L. Autism, psychosis, or both? Unraveling complex patient presentations. *Child Adolesc Psychiatr Clin N Am.* 2020;29(1):103–113

51. Alsawy S, Wood L, Taylor PJ, Morrison AP. Psychotic experiences and PTSD: exploring associations in a population survey. *Psychol Med.* 2015;45(13): 2849–2859

52. Anglin DM, Polanco-Roman L, Lui F. Ethnic variation in whether dissociation mediates the relation between traumatic life events and attenuated positive psychotic symptoms. *J Trauma Dissociation.* 2015;16(1):68–85

53. Cannon TD. How schizophrenia develops: cognitive and brain mechanisms underlying onset of psychosis. *Trends Cogn Sci.* 2015;19(12):744–756

54. Lieberman JA, Small SA, Girgis RR. Early detection and preventive intervention in schizophrenia: from fantasy to reality. *Am J Psychiatry.* 2019;176(10):794–810

55. McClellan J, Stock S; American Academy of Child and Adolescent Psychiatry (AACAP) Committee on Quality Issues (CQI). Practice parameter for the assessment and treatment of children and adolescents with schizophrenia. *J Am Acad Child Adolesc Psychiatry.* 2013; 52(9):976–990

56. Frazier JA, Giedd JN, Hamburger SD, et al. Brain anatomic magnetic resonance imaging in childhood-onset schizophrenia. *Arch Gen Psychiatry.* 1996;53(7):617–624

57. Rapoport JL, Gogtay N. Childhood onset schizophrenia: support for a progressive neurodevelopmental disorder. *Int J Dev Neurosci.* 2011;29(3): 251–258

58. Penttilä J, Paillére-Martinot ML, Martinot JL, et al. Global and temporal cortical folding in patients with early-onset schizophrenia. *J Am Acad Child Adolesc Psychiatry.* 2008;47(10):1125–1132

59. Yang AC, Tsai S-J. New targets for schizophrenia treatment beyond the dopamine hypothesis. *Int J Mol Sci.* 2017;18(8):1689–1702

60. Steeds H, Carhart-Harris RL, Stone JM. Drug models of schizophrenia. *Ther Adv Psychopharmacol*. 2015;5(1):43–58

61. Olney JW, Farber NB. Glutamate receptor dysfunction and schizophrenia. *Arch Gen Psychiatry*. 1995;52(12):998–1007

62. Farber NB. The NMDA receptor hypofunction model of psychosis. *Ann N Y Acad Sci*. 2003;1003:119–130

63. Fleischhacker W, Galderisi S, Laszlovszky I, et al. The efficacy of cariprazine in negative symptoms of schizophrenia: post hoc analyses of PANSS individual items and PANSS-derived factors. *Eur Psychiatry*. 2019;58:1–9

64. Roth BL, Hanizavareh SM, Blum AE. Serotonin receptors represent highly favorable molecular targets for cognitive enhancement in schizophrenia and other disorders. *Psychopharmacology (Berl)*. 2004; 174(1):17–24

65. Raedler TJ, Bymaster FP, Tandon R, Copolov D, Dean B. Towards a muscarinic hypothesis of schizophrenia. *Mol Psychiatry*. 2007; 12(3):232–246

66. Cardno AG, Gottesman II. Twin studies of schizophrenia: from bow-and-arrow concordances to star wars Mx and functional genomics. *Am J Med Genet*. 2000;97(1):12–17

67. Stevens JR, Prince JB, Prager LM, Stern TA. Psychotic disorders in children and adolescents: a primer on contemporary evaluation and management. *Prim Care Companion CNS Disord*. 2014;16(2)

68. Skikic M, Arriola JA. First episode psychosis medical workup: evidence-informed recommendations and introduction to a clinically guided approach. *Child Adolesc Psychiatr Clin N Am*. 2020;29(1):15–28

69. Merritt J, Tanguturi Y, Fuchs C, Cundiff AW. Medical etiologies of secondary psychosis in children and adolescents. *Child Adolesc Psychiatr Clin N Am*. 2020; 29(1):29–42

70. Liu CH, Keshavan MS, Tronick E, Seidman LJ. Perinatal risks and childhood premorbid indicators of later psychosis: next steps for early psychosocial interventions. *Schizophr Bull*. 2015;41(4): 801–816

71. van der Burg JW, Sen S, Chomitz VR, Seidell JC, Leviton A, Dammann O. The role of systemic inflammation linking maternal BMI to neurodevelopment in children. *Pediatr Res*. 2016;79(1–1):3–12

72. Mackay DF, Anderson JJ, Pell JP, Zammit S, Smith DJ. Exposure to tobacco smoke in utero or during early childhood and risk of hypomania: prospective birth cohort study. *Eur Psychiatry*. 2017;39: 33–39

73. Blomström A, Karlsson H, Wicks S, Yang S, Yolken RH, Dalman C. Maternal antibodies to infectious agents and risk for non-affective psychoses in the offspring–a matched case-control study. *Schizophr Res*. 2012;140(1–3):25–30

74. Allswede DM, Buka SL, Yolken RH, Torrey EF, Cannon TD. Elevated maternal cytokine levels at birth and risk for psychosis in adult offspring. *Schizophr Res*. 2016;172(1–3):41–45

75. Zammit S, Thomas K, Thompson A, et al. Maternal tobacco, cannabis and alcohol use during pregnancy and risk of adolescent psychotic symptoms in offspring. *Br J Psychiatry*. 2009;195(4): 294–300

76. Day NL, Goldschmidt L, Day R, Larkby C, Richardson GA. Prenatal marijuana exposure, age of marijuana initiation, and the development of psychotic symptoms in young adults. *Psychol Med*. 2015;45(8):1779–1787

77. Alpár A, Di Marzo V, Harkany T. At the tip of an iceberg: prenatal marijuana and its possible relation to neuropsychiatric outcome in the offspring. *Biol Psychiatry*. 2016;79(7):e33–e45

78. Croft J, Heron J, Teufel C, et al. Association of trauma type, age of exposure, and frequency in childhood and adolescence with psychotic experiences in early adulthood. *JAMA Psychiatry*. 2019;76(1):79–86

79. Mayo D, Corey S, Kelly LH, et al. The role of trauma and stressful life events among individuals at clinical high risk for psychosis: a review. *Front Psychiatry*. 2017;8:55

80. Gibson LE, Alloy LB, Ellman LM. Trauma and the psychosis spectrum: a review of symptom specificity and explanatory mechanisms. *Clin Psychol Rev*. 2016;49: 92–105

81. Singham T, Viding E, Schoeler T, et al. Concurrent and longitudinal contribution of exposure to bullying in childhood to mental health: the role of vulnerability and resilience. *JAMA Psychiatry*. 2017;74(11):1112–1119

82. Kelleher I, Keeley H, Corcoran P, et al. Childhood trauma and psychosis in a prospective cohort study: cause, effect, and directionality. *Am J Psychiatry*. 2013;170(7):734–741

83. Thompson AD, Nelson B, Yuen HP, et al. Sexual trauma increases the risk of developing psychosis in an ultra high-risk "prodromal" population. *Schizophr Bull*. 2014;40(3):697–706

84. Newnham EA, Janca A. Childhood adversity and borderline personality disorder: a focus on adolescence. *Curr Opin Psychiatry*. 2014;27(1):68–72

85. Thompson KN, Cavelti M, Chanan AM. Psychotic symptoms in adolescents with borderline personality disorder features. *Eur Child Adolesc Psychiatry*. 2019;28(7):985–992

86. Sengutta M, Gawęda Ł, Moritz S, Karow A. The mediating role of borderline personality features in the relationship between childhood trauma and psychotic-like experiences in a sample of help-seeking non-psychotic adolescents and young adults. *Eur Psychiatry*. 2019;56(1):84–90

87. Carney R, Yung AR, Amminger GP, et al. Substance use in youth at risk for psychosis. *Schizophr Res*. 2017;181: 23–29

88. Oluwoye O, Monroe-DeVita M, Burduli E, et al. Impact of tobacco, alcohol and cannabis use on treatment outcomes among patients experiencing first episode psychosis: data from the national RAISE-ETP study. *Early Interv Psychiatry*. 2019;13(1):142–146

89. Scott JG, Matuschka L, Niemelä S, Miettunen J, Emmerson B, Mustonen A. Evidence of a causal relationship between smoking tobacco and schizophrenia spectrum disorders. *Front Psychiatry*. 2018;9:607

90. Hunter A, Murray R, Asher L, Leonardi-Bee J. The effects of tobacco smoking, and prenatal tobacco smoke exposure, on risk of schizophrenia: a systematic review and meta-analysis. *Nicotine Tob Res*. 2020;22(1):3–10

91. Gurillo P, Jauhar S, Murray RM, MacCabe JH. Does tobacco use cause psychosis? Systematic review and meta-analysis. *Lancet Psychiatry.* 2015;2(8):718–725

92. Volkow ND, Swanson JM, Evins AE, et al. Effects of cannabis use on human behavior, including cognition, motivation, and psychosis: a review. *JAMA Psychiatry.* 2016;73(3):292–297

93. Large M, Sharma S, Compton MT, Slade T, Nielssen O. Cannabis use and earlier onset of psychosis: a systematic meta-analysis. *Arch Gen Psychiatry.* 2011; 68(6):555–561

94. Miettunen J, Törmänen S, Murray GK, et al. Association of cannabis use with prodromal symptoms of psychosis in adolescence. *Br J Psychiatry.* 2008; 192(6):470–471

95. Galvez-Buccollini JA, Proal AC, Tomaselli V, et al. Association between age at onset of psychosis and age at onset of cannabis use in non-affective psychosis. *Schizophr Res.* 2012;139(1–3):157–160

96. The Schizophrenia Commission. *The Abandoned Illness: A Report from the Schizophrenia Commission*. London, England: Rethink; 2012. Available at https://www.rethink.org/media/2637/the-abandoned-illness-final.pdf. Accessed August 26, 2020

97. Di Forti M, Quattrone D, Freeman TP, et al.; EU-GEI WP2 Group. The contribution of cannabis use to variation in the incidence of psychotic disorder across Europe (EU-GEI): a multicentre case-control study. *Lancet Psychiatry.* 2019;6(5):427–436

98. Yeruva RR, Mekala HM, Sidhu M, Lippmann S. Synthetic cannabinoids-"Spice" can induce a psychosis: a brief review. *Innov Clin Neurosci.* 2019; 16(1–2):31–32

99. Graddy R, Buresh ME, Rastegar DA. New and emerging illicit psychoactive substances. *Med Clin North Am.* 2018; 102(4):697–714

100. Starzer MSK, Nordentoft M, Hjorthøj C. Rates and predictors of conversion to schizophrenia or bipolar disorder following substance-induced psychosis. *Am J Psychiatry.* 2018;175(4):343–350

101. Alderson HL, Semple DM, Blayney C, Queirazza F, Chekuri V, Lawrie SM. Risk of transition to schizophrenia following first admission with substance-induced psychotic disorder: a population-based longitudinal cohort study. *Psychol Med.* 2017;47(14):2548–2555

102. Moran LV, Ongur D, Hsu J, Castro VM, Perlis RH, Schneeweiss S. Psychosis with methylphenidate or amphetamine in patients with ADHD. *N Engl J Med.* 2019; 380(12):1128–1138

103. Ross RG. Psychotic and manic-like symptoms during stimulant treatment of attention deficit hyperactivity disorder. *Am J Psychiatry.* 2006;163(7):1149–1152

104. Phalen PL, Rouhakhtar PR, Millman ZB, et al. Validity of a two-item screen for early psychosis. *Psychiatry Res.* 2018;270:861–868

105. Kline E, Wilson C, Ereshefsky S, et al. Psychosis risk screening in youth: a validation study of three self-report measures of attenuated psychosis symptoms. *Schizophr Res.* 2012;141(1): 72–77

106. Brown HE. How to stabilize an acutely psychotic patient. *Curr Psychiatr.* 2012; 11(12):10–16

107. Ballard ED, Cwik M, Van Eck K, et al. Identification of at-risk youth by suicide screening in a pediatric emergency department. *Prev Sci.* 2017;18(2):174–182

108. Posner K, Brown GK, Stanley B, et al. The Columbia-Suicide Severity Rating Scale: initial validity and internal consistency findings from three multisite studies with adolescents and adults. *Am J Psychiatry.* 2011;168(12):1266–1277

109. Carter JL. Visual, somatosensory, olfactory, and gustatory hallucinations. *Psychiatr Clin North Am.* 1992;15(2): 347–358

110. Lewandowski KE, DePaola J, Camsari GB, Cohen BM, Ongür D. Tactile, olfactory, and gustatory hallucinations in psychotic disorders: a descriptive study. *Ann Acad Med Singap.* 2009;38(5): 383–385

111. Freudenreich O, Holt DJ, Cather C, Goff DC. The evaluation and management of patients with first-episode schizophrenia: a selective, clinical review of diagnosis, treatment, and prognosis. *Harv Rev Psychiatry.* 2007; 15(5):189–211

112. Lowther C, Costain G, Baribeau DA, Bassett AS. Genomic disorders in psychiatry-what does the clinician need to know? *Curr Psychiatry Rep.* 2017;19(11):82

113. Mantovani C, Louzada-Junior P, Nunes EA, de Figueiredo FP, Oliveira GR, Del-Ben CM. Antinuclear antibodies testing as a routine screening for systemic lupus erythematosus in patients presenting first-episode psychosis. *Early Interv Psychiatry.* 2012;6(3):322–325

114. Luttrull MD, Boulter DJ, Kirsch CFE, et al.; Expert Panel on Neurological Imaging. ACR appropriateness criteria ® acute mental status change, delirium, and new onset psychosis. *J Am Coll Radiol.* 2019;16(5S):S26–S37

115. Freudenreich O, Schulz SC, Goff DC. Initial medical work-up of first-episode psychosis: a conceptual review. *Early Interv Psychiatry.* 2009;3(1):10–18

116. Manchanda R, Norman R, Malla A, Harricharan R, Northcott S, Richard J. Electroencephalographic abnormalities and 5-year outcome in first-episode psychosis. *Can J Psychiatry.* 2014;59(5): 285–288

117. Hagan JF, Shaw JS, Duncan PM, eds.. *Bright Futures: Guidelines for Health Supervision of Infants, Children, and Adolescents*, 4th ed. Elk Grove Village, IL: American Academy of Pediatrics; 2017

118. Cadenhead KS, Addington J, Cannon T, et al. Treatment history in the psychosis prodrome: characteristics of the North American Prodrome Longitudinal Study Cohort. *Early Interv Psychiatry.* 2010; 4(3):220–226

119. Turkington D, Kingdon D, Weiden PJ. Cognitive behavior therapy for schizophrenia. *Am J Psychiatry.* 2006; 163(3):365–373

120. Hardy K. Cognitive behavioral therapy for psychosis (CBTp). Available at: https://www.nasmhpd.org/sites/default/files/DH-CBTp_Fact_Sheet.pdf. Accessed August 26, 2020

121. Hutton P, Taylor PJ. Cognitive behavioural therapy for psychosis prevention: a systematic review and meta-analysis. *Psychol Med.* 2014;44(3):449–468

122. Devoe DJ, Farris MS, Townes P, Addington J. Attenuated psychotic symptom interventions in youth at risk of psychosis: a systematic review and meta-analysis. *Early Interv Psychiatry.* 2019;13(1):3–17

123. Ising HK, Lokkerbol J, Rietdijk J, et al. Four-year cost-effectiveness of cognitive behavior therapy for preventing first-

episode psychosis: the Dutch early detection intervention evaluation (EDIE-NL) trial. *Schizophr Bull*. 2017;43(2):365–374

124. National Institute for Health and Care Excellence (NICE). *Psychosis and Schizophrenia in Children and Young People (Clinical Guideline 155)*. London, England: National Institute for Health and Care Excellence; 2013. Available at: https://www.nice.org.uk/guidance/cg155. Accessed August 26, 2020

125. Morrison AP. Should people with psychosis be supported in choosing cognitive therapy as an alternative to antipsychotic medication: a commentary on current evidence. *Schizophr Res*. 2019;203:94–98

126. Morrison AP, Turkington D, Pyle M, et al. Cognitive therapy for people with schizophrenia spectrum disorders not taking antipsychotic drugs: a single-blind randomised controlled trial. *Lancet*. 2014;383(9926):1395–1403

127. Lecomte T, Leclerc C, Corbière M, Wykes T, Wallace CJ, Spidel A. Group cognitive behavior therapy or social skills training for individuals with a recent onset of psychosis? Results of a randomized controlled trial. *J Nerv Ment Dis*. 2008; 196(12):866–875

128. Thompson E, Millman ZB, Okuzawa N, et al. Evidence-based early interventions for individuals at clinical high risk for psychosis: a review of treatment components. *J Nerv Ment Dis*. 2015; 203(5):342–351

129. Dixon LB, Dickerson F, Bellack AS, et al.; Schizophrenia Patient Outcomes Research Team (PORT). The 2009 schizophrenia PORT psychosocial treatment recommendations and summary statements. *Schizophr Bull*. 2010;36(1):48–70

130. Correll CU, Galling B, Pawar A, et al. Comparison of early intervention services vs treatment as usual for early-phase psychosis: a systematic review, meta-analysis, and meta-regression. *JAMA Psychiatry*. 2018;75(6):555–565

131. Findling RL, Cavuş I, Pappadopulos E, et al. Ziprasidone in adolescents with schizophrenia: results from a placebo-controlled efficacy and long-term open-extension study. *J Child Adolesc Psychopharmacol*. 2013;23(8):531–544

132. Findling RL, Landbloom RP, Mackle M, et al. Safety and efficacy from an 8 week double-blind trial and a 26 week open-label extension of asenapine in adolescents with schizophrenia. *J Child Adolesc Psychopharmacol*. 2015;25(5):384–396

133. Lee ES, Kronsberg H, Findling RL. Psychopharmacologic treatment of schizophrenia in adolescents and children. *Child Adolesc Psychiatr Clin N Am*. 2020;29(1):183–210

134. Agid O, Kapur S, Arenovich T, Zipursky RB. Delayed-onset hypothesis of antipsychotic action: a hypothesis tested and rejected. *Arch Gen Psychiatry*. 2003; 60(12):1228–1235

135. Leucht S, Busch R, Hamann J, Kissling W, Kane JM. Early-onset hypothesis of antipsychotic drug action: a hypothesis tested, confirmed and extended. *Biol Psychiatry*. 2005;57(12):1543–1549

136. Lieberman JA, Stroup TS, McEvoy JP, et al.; Clinical Antipsychotic Trials of Intervention Effectiveness (CATIE) Investigators. Effectiveness of antipsychotic drugs in patients with chronic schizophrenia. *N Engl J Med*. 2005;353(12):1209–1223

137. Kahn RS, Fleischhacker WW, Boter H, et al.; EUFEST study group. Effectiveness of antipsychotic drugs in first-episode schizophrenia and schizophreniform disorder: an open randomised clinical trial. *Lancet*. 2008;371(9618):1085–1097

138. Sikich L, Frazier JA, McClellan J, et al. Double-blind comparison of first- and second-generation antipsychotics in early-onset schizophrenia and schizo-affective disorder: findings from the treatment of early-onset schizophrenia spectrum disorders (TEOSS) study. *Am J Psychiatry*. 2008;165(11):1420–1431

139. Olfson M, Blanco C, Liu L, Moreno C, Laje G. National trends in the outpatient treatment of children and adolescents with antipsychotic drugs. *Arch Gen Psychiatry*. 2006;63(6):679–685

140. Mueser KT, Penn DL, Addington J, et al. The NAVIGATE program for first-episode psychosis: rationale, overview, and description of psychosocial components. *Psychiatr Serv*. 2015;66(7):680–690

141. Kane JM, Robinson DG, Schooler NR, et al. Comprehensive versus usual community care for first-episode psychosis: 2-year outcomes from the NIMH RAISE Early Treatment Program. *Am J Psychiatry*. 2016;173(4):362–372

142. NAVIGATE. NAVIGATE psychopharmacological treatment manual. Available at: www.navigateconsultants.org/wp-content/uploads/2017/05/Prescribers-Manual.pdf. Accessed August 26, 2020

143. Robinson DG, Schooler NR, Correll CU, et al. Psychopharmacological treatment in the RAISE-ETP study: outcomes of a manual and computer decision support system based intervention. *Am J Psychiatry*. 2018;175(2):169–179

144. Solmi M, Murru A, Pacchiarotti I, et al. Safety, tolerability, and risks associated with first- and second-generation antipsychotics: a state-of-the-art clinical review. *Ther Clin Risk Manag*. 2017;13:757–777

145. Tewksbury A, Olander A. Management of antipsychotic-induced hyperprolactinemia. *Ment Health Clin*. 2016;6(4):185–190

146. Findling RL, Drury SS, Jensen PS, Rapoport JL; American Academy of Child and Adolescent Psychiatry, Committee on Quality Issues. *Practice Parameter for the Use of Atypical Antipsychotic Medications in Children and Adolescents*. Washington, DC: American Academy of Child and Adolescent Psychiatry; 2011

147. Ellingrod V, Connell R, Resch W, Thomas CJ. Recommendations for lab monitoring of atypical antipsychotics. *Curr Psychiatr*. 2013;12(9):51–54

148. Pileggi DJ, Cook AM. Neuroleptic malignant syndrome. *Ann Pharmacother*. 2016;50(11):973–981

149. Ngo V, Guerrero A, Lanum D, et al. Emergent treatment of neuroleptic malignant syndrome induced by antipsychotic monotherapy using dantrolene. *Clin Pract Cases Emerg Med*. 2019;3(1):16–23

150. Sullivan K, George P, Horowitz K. Addressing national workforce shortages by funding child psychiatry access programs. *Pediatrics*. 2021; 147(1):e20194012

151. Correll CU. Antipsychotic use in children and adolescents: minimizing adverse effects to maximize outcomes. *J Am Acad Child Adolesc Psychiatry*. 2008;47(1):9–20

152. Stroup TS, Gray N. Management of common adverse effects of antipsychotic medications. *World Psychiatry*. 2018;17(3):341–356

153. Saljoughian M. Atypical Antipsychotics: Safety and Use in Pediatric Patients. *US Pharm*. 2015;40(5):52-55. Available at: www.uspharmacist.com/article/atypical-antipsychotics-safety-and-use-in-pediatric-patients.0148-4818

154. The Centers for Medicare & Medicaid Services. Atypical Antipsychotic Medications: Use in Pediatric Patients. Available at: www.cms.gov/Medicare-Medicaid-Coordination/Fraud-Prevention/Medicaid-Integrity-Education/Pharmacy-Education-Materials/Downloads/atyp-antipsych-pediatric-factsheet11-14.pdf

COVID-19 Vaccines in Children and Adolescents

- *Policy Statement*

POLICY STATEMENT Organizational Principles to Guide and Define the Child Health Care System and/or Improve the Health of all Children

American Academy of Pediatrics
DEDICATED TO THE HEALTH OF ALL CHILDREN™

COVID-19 Vaccines in Children and Adolescents

Committee on Infectious Diseases

Vaccines are safe and effective in protecting individuals and populations against infectious diseases. New vaccines are evaluated by a long-standing, rigorous, and transparent process through the US Food and Drug Administration and the Centers for Disease Control and Prevention (CDC), by which safety and efficacy data are reviewed before authorization and recommendation.

RECOMMENDATIONS

The American Academy of Pediatrics (AAP) recommends the following related to coronavirus disease 2019 (COVID-19) vaccine in children and adolescents:

- The AAP recommends COVID-19 vaccination for all children and adolescents 12 years of age and older who do not have contraindications using a COVID-19 vaccine authorized for use for their age.
- Any COVID-19 vaccine authorized through Emergency Use Authorization by the US Food and Drug Administration, recommended by the CDC, and appropriate by age and health status can be used for COVID-19 vaccination in children and adolescents.
- Given the importance of routine vaccination and the need for rapid uptake of COVID-19 vaccines, the AAP supports coadministration of routine childhood and adolescent immunizations with COVID-19 vaccines (or vaccination in the days before or after) for children and adolescents who are behind on or due for immunizations (based on the CDC and AAP Recommended Child and Adolescent Immunization Schedule) and/or at increased risk from vaccine-preventable diseases.

COMMITTEE ON INFECTIOUS DISEASES, 2020–2021

Yvonne A. Maldonado, MD, FAAP, Chairperson
Sean T. O'Leary, MD, MPH, FAAP, Vice Chairperson
Ritu Banerjee, MD, PhD, FAAP
James D. Campbell, MD, MS, FAAP

DOI: https://doi.org/10.1542/peds.2021-052336

PEDIATRICS (ISSN Numbers: Print, 0031-4005; Online, 1098-4275).

FINANCIAL DISCLOSURE: The authors have indicated they have no financial relationships relevant to this article to disclose.

FUNDING: No external funding.

POTENTIAL CONFLICT OF INTEREST: The authors have indicated they have no potential conflicts of interest to disclose.

To cite: Committee on Infectious Diseases. COVID-19 Vaccines in Children and Adolescents. *Pediatrics*. 2021;148(2):e2021052336

Mary T. Caserta, MD, FAAP
Jeffrey S. Gerber, MD, PhD, FAAP
Athena P. Kourtis, MD, PhD, MPH, FAAP
Ruth Lynfield, MD, FAAP, *Red Book* Associate Editor
Flor M. Munoz, MD, MSc, FAAP
Dawn Nolt, MD, MPH, FAAP
Adam J. Ratner, MD, MPH, FAAP
Samir S. Shah, MD, MSCE, FAAP
William J. Steinbach, MD, FAAP
Kenneth M. Zangwill, MD, FAAP
Theoklis E. Zaoutis, MD, MSCE, FAAP

EX OFFICIO

David W. Kimberlin, MD, FAAP, *Red Book* Editor
Elizabeth D. Barnett MD, FAAP, *Red Book* Associate Editor
Mark H. Sawyer, MD, FAAP, *Red Book* Associate Editor
Henry H. Bernstein, DO, MHCM, FAAP, *Red Book* Online Associate Editor
H. Cody Meissner, MD, FAAP, Visual *Red Book* Associate Editor

LIAISONS

Amanda C. Cohn, MD, FAAP – *Centers for Disease Control and Prevention*
Karen M. Farizo, MD – *US Food and Drug Administration*
Natasha B. Halasa, MD, MPH, FAAP – *Pediatric Infectious Diseases Society*
David Kim, MD – *US Department of Health and Human Services Office of Infectious Disease and HIV/AIDS Policy*
Eduardo López Medina, MD, MSc – *Sociedad Latinoamericana de Infectologia Pediatrica*
Denee Moore, MD, FAAFP – *American Academy of Family Physicians*
Scot B. Moore, MD, FAAP – *Committee on Practice Ambulatory Medicine*
Lakshmi Panagiotakopoulos, MD, MPH, FAAP – *Centers for Disease Control and Prevention*
Laura Sauvé, MD, FCPS – *Canadian Paediatric Society*
Neil S. Silverman, MD – *American College of Obstetricians and Gynecologists*
Jeffrey R. Starke, MD, FAAP – *American Thoracic Society*
Kay M. Tomashek, MD, MPH, DTM – *National Institutes of Health*

STAFF

Jennifer M. Frantz, MPH

ABBREVIATIONS

AAP: American Academy of Pediatrics
CDC: Centers for Disease Control and Prevention
COVID-19: coronavirus disease 2019

Early Childhood Caries in Indigenous Communities

- *Policy Statement*

POLICY STATEMENT Organizational Principles to Guide and Define the Child Health Care System and/or Improve the Health of all Children

American Academy of Pediatrics

DEDICATED TO THE HEALTH OF ALL CHILDREN®

Early Childhood Caries in Indigenous Communities

Steve Holve, MD,[a] Patricia Braun, MD, MPH,[b,c] James D. Irvine, MD,[d] Kristen Nadeau, MD, MS,[e] Robert J. Schroth, DMD, MSc, PhD,[f,g,h] AMERICAN ACADEMY OF PEDIATRICS COMMITTEE ON NATIVE AMERICAN CHILD HEALTH AND SECTION ON ORAL HEALTH, CANADIAN PAEDIATRIC SOCIETY FIRST NATIONS, INUIT, AND MÉTIS HEALTH COMMITTEE

abstract

The oral health of Indigenous children of Canada (First Nations, Inuit, and Métis) and the United States (American Indian and Alaska native) is a major child health disparity when compared with the general population of both countries. Early childhood caries (ECC) occurs in Indigenous children at an earlier age, with a higher prevalence, and at much greater severity than in the general population. ECC results in adverse oral health, affecting childhood health and well-being, and may result in high rates of costly surgical treatment under general anesthesia. ECC is an infectious disease that is influenced by multiple factors, but the social determinants of health are particularly important. This policy statement includes recommendations for preventive and clinical oral health care for infants, toddlers, preschool-aged children, and pregnant women by primary health care providers. It also addresses community-based health-promotion initiatives and access to dental care for Indigenous children. This policy statement encourages oral health interventions at early ages in Indigenous children, including referral to dental care for the use of sealants, interim therapeutic restorations, and silver diamine fluoride. Further community-based research on the microbiology, epidemiology, prevention, and management of ECC in Indigenous communities is also needed to reduce the dismally high rate of caries in this population.

[a]Tuba City Regional Health Care Corporation, Tuba City, Arizona; [b]Denver Health and Hospital, Denver, Colorado; [c]Anschutz Medical Campus, University of Colorado, Aurora, Colorado [d]University of Saskatchewan, LaRonge, Saskatchewan, Canada; [e]Mentored Scholarly Activity Longitudinal Research Course and Colorado Clinical and Translational Sciences Institute Scientific Advisory and Review Committee, Anschutz Medical Campus, University of Colorado and Children's Hospital Colorado, Aurora, Colorado; [f]Departments of Preventive Dental Science, Pediatrics and Child Health, and Community Health Sciences, Rady Faculty of Health Sciences, University of Manitoba, Winnipeg, Manitoba, Canada; [g]Children's Hospital Research Institute of Manitoba, Winnipeg, Manitoba, Canada; and [h]Section of Pediatric Dentistry, Winnipeg Regional Health Authority, Winnipeg, Manitoba, Canada

Drs Holve and Schroth participated in the planning for this manuscript and writing and editing of the manuscript; Drs Braun, Irvine, and Nadeau participated in the writing and editing of the manuscript; and all authors approved the final manuscript as submitted.

The guidance in this statement does not indicate an exclusive course of treatment or serve as a standard of medical care. Variations, taking into account individual circumstances, may be appropriate.

All policy statements from the American Academy of Pediatrics automatically expire 5 years after publication unless reaffirmed, revised, or retired at or before that time.

To cite: Holve S, Braun P, Irvine JD, et al. AAP AMERICAN ACADEMY OF PEDIATRICS COMMITTEE ON NATIVE AMERICAN CHILD HEALTH AND SECTION ON ORAL HEALTH, CANADIAN PAEDIATRIC SOCIETY FIRST NATIONS, INUIT, AND MÉTIS HEALTH COMMITTEE. Early Childhood Caries in Indigenous Communities. *Pediatrics*. 2021;147(6):e2021051481

INTRODUCTION

Indigenous children of Canada (First Nations [FN], Inuit, and Métis) and the United States (American Indian and Alaska native [AI/AN]) face significant health disparities compared with non-Indigenous populations. The oral health disparities Indigenous children experience exemplify the inequities and major need for oral health promotion, caries prevention, and early, locally available dental care services for them. Although general guidelines on oral health promotion, caries prevention, and risk assessment exist, the severity of dental disease and the barriers to care in Indigenous communities require special consideration.

Early childhood caries (ECC) is defined as tooth decay in any primary tooth in a child younger than age 6 years.[1] Also referred to as early childhood tooth decay or baby-bottle tooth decay, the term ECC better characterizes the disease as complex and involving transmission of infectious bacteria, dietary habits, and oral hygiene. ECC is an infectious disease, with *Streptococcus mutans* being the most commonly recognized causative organism. The causative triad for caries includes cariogenic bacteria, fermentable carbohydrates, and host susceptibility (integrity of tooth enamel). Caries has been described as the most prevalent pediatric infectious disease and the most common chronic disease of children.[2]

Tooth loss as a result of ECC may result in malocclusion and low oral health–related quality of life.[3] Children with ECC are at increased risk of further caries throughout childhood and adolescence.[4,5] The effects of ECC go beyond the oral cavity and influence overall childhood health and well-being, which are already compromised for many Indigenous children.[3,6–8]

Severe early childhood caries (S-ECC) is an aggressive form of ECC and is classified by location of the caries, number of teeth affected, and age.[1] S-ECC commonly requires surgical treatment under general anesthesia (GA).[9] Children with S-ECC experience more nutritional problems, including iron-deficiency anemia, low vitamin D, and overweight or obesity. S-ECC that penetrates the tooth pulp can lead to painful dental infections or abscesses and, rarely, death.[6–8,10]

ORAL HEALTH STATUS IN INDIGENOUS CHILDREN

In 2011, the prevalence of ECC in 3- to 5-year-old FN and Inuit children was 85%, and the prevalence of S-ECC was as high as 25%.[11–13] Oral health surveys performed by the Indian Health Service (IHS) in 2014 revealed that 75% of AI/AN children between the ages of 3 and 5 years had ECC, and in many communities, the caries rate was >90% (5 times greater than that of the general US child population).[14,15] The true burden of ECC in Indigenous children is not only the disparate ECC prevalence but also the disease severity. The average number of decayed or filled teeth in AI/AN children 2 to 5 years old was 5.8, almost 5 times that of the general US preschool population.[15,16]

An important consequence of ECC severity is the need for dental surgery under GA.[9,13,17] Rehabilitative surgery is expensive and carries the potential risks of GA. Overall, the rate of dental surgery to treat ECC under GA in Canada was 7 times higher for children from communities with a high proportion of Indigenous peoples than communities with lower Indigenous populations.[9,17] In the more remote Indigenous regions of Canada, the rates of dental surgery under GA exceed 200 per 1000 children younger than 5 years each year, a rate 15 times higher than the overall annual Canadian rate.[9,17] Exact data on the overall number of AI/AN children undergoing dental surgery for caries are limited, but one study in the Yukon–Kuskokwim Delta of Alaska reported that by 6 years of age, 73% of Alaska native children had undergone dental surgery under GA, a rate at least 50 times that in the general US population.[18]

EPIDEMIOLOGY OF ECC

Indigenous children often develop ECC at earlier ages than other children. The 2014 IHS Oral Health Survey reported that 21% of AI/AN 1-year-olds and 40% of AI/AN 2-year-olds had caries, whereas most dental surveys suggest ECC is rare among US children before 12 months of age, and only 10% of US children younger than 2 years have ECC.[19] The etiology of ECC in Indigenous children is multifactorial. The typical "window of infectivity" for the acquisition of cariogenic microorganisms, including *S mutans*, is between 19 and 31 months. However, 2 recent studies reported that AI/AN children acquire *S mutans* at earlier ages: 37% of 12-month-olds and 60% of 16-month-olds had *S mutans* colonization.[20,21] Additionally, primary teeth erupt at an earlier age in AI/AN infants, which may result in earlier *S mutans* colonization and earlier progression to caries.[22] Authors of a recent review of caries reiterate that newly erupted teeth are much more prone to caries.[23] Additionally, a recent study of Canadian FN children revealed that children with S-ECC had a significantly different plaque microbiome than their caries-free counterparts, with the S-ECC group harboring higher levels of known cariogenic organisms, particularly *S mutans*.[24] The early acquisition of *S mutans* in Indigenous children is likely mediated by factors associated with poverty, including household crowding, family size, nutrition, and other health behaviors.[25] Unfortunately, Indigenous children in the United States and Canada experience poverty at rates 2 to 3 times greater than the general population. For children younger than 5 years, 52% of FN children live in poverty, as do 25% Inuit and 23% of Métis children, compared with 13% of nonracialized Canadian children.[26] More than 37% of AI/AN children in the United States live in poverty, compared with 10% of their white American counterparts.[27]

Other known ECC risk factors are commonly found in Indigenous children. Caries in parents is associated with increased risk in their infants.[28] ECC is also associated with prolonged bottle-feeding, consumption of sugar-containing drinks, high frequency of sugary snacks,[29–33] and exposure to tobacco

smoke.[13,34] Breastfeeding for up to 12 months of age can reduce ECC risk by half, most likely via immune-modulating effects and promotion of a healthy microbiome. Furthermore, a recent study demonstrated that breastfeeding did not provoke a decrease in biofilm pH and, therefore, did not facilitate ECC.[35] If the infant breastfeeds to sleep, the gums and erupting teeth should be wiped to minimize the risk of caries.[36] However, breastfeeding beyond 12 months of age, especially with at-will nighttime feeding, is associated with increased risk of ECC.[37–39] Obesity has also been shown to be associated with ECC, although it is unclear whether this risk occurs independently from dietary factors.[3,10,40–42] In addition, gestational diabetes, which is prevalent in Indigenous populations, may have an effect on early childhood dental development and caries risk.[43–45]

PREVENTION STRATEGIES

Prenatal Oral Health Care

ECC prevention is optimal if initiated prenatally.[46] Given the evidence for transmission of cariogenic bacteria from mother to child, routine dental assessments and preventive dental care, oral hygiene education, optimal prenatal nutrition, and the use of fluoride toothpaste for pregnant women are strategies that may prevent or delay ECC in their children.[46] Recent guidelines conclude that dental care in pregnancy is safe.[47–49]

Fluoride

All major Canadian and American dental and pediatric societies endorse the use of fluorides as safe and effective for caries prevention.[50–54] All of the aforementioned organizations support the use of fluoridated toothpaste twice daily for all children. They recommend that children younger than 3 years have their teeth brushed by an adult with a grain of rice–sized portion of fluoridated toothpaste and that children 3 to 6 years of age be assisted with brushing with a green pea–sized portion of fluoridated toothpaste.[51,52]

Community water fluoridation is safe, effective, and inexpensive and does not require daily adherence.[55,56] Community water fluoridation in AN communities has been associated with a 40% reduction in caries.[57] In North America, there is wide disparity in the access to community water fluoridation. In 2017, 38.7% of Canadians using community water supplies had access to fluoridated water, compared with only 2.3% of FN people.[58] Although 74.4% of US residents had access to fluoridated community water, only 50% of Alaskans received fluoridated community water, with only 5.3% receiving optimal fluoride levels.[18,59]

Topical fluorides have been shown to be effective in preventing caries.[18,59] Studies in Indigenous children in Canada and the United States have shown reduction in caries with fluoride varnish, although the results were not statistically significant.[60,61]

These modestly favorable results for fluoride varnish in AI/AN children are tempered by 2 larger studies with longer follow-up. First, a 5-year IHS program targeting AI/AN children initially resulted in a small decrease in ECC in children younger than 2 years, but these benefits were lost for children 2 to 5 years of age.[62] A second cluster-randomized controlled trial (RCT) testing 4 fluoride varnish applications (and oral health–promotion activities) by trained tribal health workers in Head Start classrooms did not yield a reduction in ECC.[63] These studies suggest that fluoride varnish should be initiated with the first tooth eruption in Indigenous children to achieve maximal benefit. Although the data on fluoride varnish are mixed for Indigenous populations, fluoride varnish is still recommended because the potential benefits far outweigh any risks. Fluoride varnish applications help to enhance both the mineralization of healthy enamel (making it more resistant to caries) and the remineralization of early incipient caries lesions (ie, white spot lesions) in primary and permanent teeth that have not yet progressed to the cavitation (ie, cavity) stage. The American Dental Association still recommends fluoride varnish for all children. However, the challenge is that fluoride varnish is not effective in arresting and remineralizing more advanced lesions that have cavitated through the enamel (ie, cavities), which are known to be more prevalent in young Indigenous children. Therefore, early applications of fluoride varnish to newly erupted teeth, beginning at the eruption of the first primary tooth at the 6-month developmental age milestone, is paramount.

Oral Health Education

Evidence surrounding the effectiveness of conducting dental examinations and provision of parental counseling to prevent ECC in preschool-aged children is mixed.[60,61,64,65] Studies of oral health education in Indigenous families resulted in increased parental knowledge but rarely demonstrate reduction in caries.[63,66] One large RCT of motivational interviewing in parents of AI preschool-aged children reported increased parent and caregiver knowledge but no reduction in ECC.[63] A previous Canadian RCT reported that motivational interviewing was associated with a reduction in the degree of severe caries among Cree children in northern Quebec.[64] Other studies suggest that oral health education for pregnant women and mothers of infants can reduce S-ECC from 32% to 20%.[67–69] Like the early receipt of fluoride varnish, evidence suggests that receiving oral health education at

the time of first tooth eruption is more beneficial.

Community-Based Strategies

Evidence is clear that caries were rare in Indigenous communities until the introduction to European settler diets, including refined sugar and other processed foods.[70–73] In Canada, there are several community-based efforts to reduce ECC, some of which promote traditional Indigenous diets.[74–77] One program in a Cree community encourages breastfeeding and promotes the introduction of traditional first foods instead of processed infant foods.[78] These efforts are promising, but there are no data regarding their effects on ECC.

ASSESSMENT AND TREATMENT STRATEGIES

Caries Risk Assessment

Timely caries risk assessment (CRA) is an important first step to reduce the risk for ECC. Several pediatric and dental organizations have developed easy-to-use CRA tools that can identify a child's risk of developing caries.[79] CRAs also assist nondental primary health care providers in assessing the need for anticipatory guidance, fluoride varnish, and referral for dental evaluation.

Sealants

Pit and fissure dental sealants have traditionally been used on occlusal tooth surfaces of permanent molars to reduce dental caries. Recent reviews concur that in populations at high risk of caries, such as Indigenous children, sealants can be placed on primary molars after eruption.[80,81] Studies suggest that 74% of sealed primary molars remain caries-free and that sealing primary molars is cost-effective in reducing caries progression and the need for operative repair.[82] The American Dental Association recommends sealants on primary molars and fluoride varnish every 3 to 6 months to arrest or reverse noncavitated carious lesions on the occlusal surfaces of primary teeth.[83] However, dental sealants may be challenging to apply on the teeth of infants and toddlers.

Interim Therapeutic Restorations

Minimally invasive dental restorative techniques, such as glass ionomer products, provide a practical option for managing cavitated lesions in young children. Interim therapeutic restorations can be used to restore and prevent caries progression in young and uncooperative children, in children with special health care requirements, and in circumstances in which the placement of traditional restorations is not possible.[84] Interim therapeutic restorations can be provided by midlevel dental professionals, including dental therapists (DTs) and hygienists, in many locales.

Silver Diamine Fluoride

Silver diamine fluoride (SDF) has been used extensively outside North America for caries arrest, with good results.[85,86] SDF is indicated for the arrest of cavitated caries lesions in primary teeth as part of a comprehensive caries management program.[83] SDF will turn the carious lesion hard and black, but this side effect is generally well accepted by parents.[87] At present, the use of SDF in the United States and Canada is limited to the dental profession, because there are no formal guidelines for its use outside of dentistry.

Frank Mendoza, DDS, an IHS dentist, pioneered the use of silver ion products at a tribal health clinic for caries arrest and demonstrated that only 2% of treated patients needed eventual operative repair.[19] Several other IHS and tribal programs now use SDF, with positive results.[88] There is an emerging consensus that SDF may be an important treatment option for children at high risk for progression to severe ECC.[89] If the use of SDF becomes more widespread, primary care health providers will play a critical role in identifying patients for referral and in promoting adherence to treatment. Evidence-based clinical guidelines from the American Dental Association and the American Academy of Pediatric Dentistry for nonrestorative treatment of caries recommend biannual applications of 38% SDF to arrest advanced cavitated lesions on primary teeth, with the recognition that additional applications may occasionally be necessary.[90]

Repair Under GA

Given the prevalence and severity of ECC in Indigenous children, operative repair is often required. However, because ECC is largely preventable, each child requiring operative repair is a costly failure of our preventive and treatment systems. Operative repair is expensive, and prevention is more cost-effective, less painful, and less time-consuming for the patient.[9,91] Furthermore, the acute risks associated with anesthesia and the evidence that GA in young children may have potential cognitive effects are additional reasons to avoid this consequence of ECC.[92,93]

Authors of a cost-effectiveness review of preventive interventions such as water fluoridation, fluoride varnish, tooth brushing with fluoride toothpaste, and use of sealants concluded that these interventions are collectively relatively inexpensive and cost-saving and, if fully used, could reduce S-ECC requiring operative repair.[18] The major benefit of increased use of SDF is the arrest of the progression of already established caries and a subsequent reduction in the need for operative repair with GA.

ACCESS TO EARLY ORAL HEALTH CARE

Severe dental workforce shortages in Indigenous communities contribute to the high rates of untreated caries in

Indigenous children. The 2014 Oral Health Survey reported the ratio of dentists per person was 1:2800 for AI/AN communities compared with the US average of 1:1500[16] and that 45% of 5-year-old AI/AN children had untreated caries compared with 19% of US children.[15]

All major Canadian and American dental and pediatric societies have called for comprehensive dental health care from dentists for children by 12 months of age: the "age-one dental visit."[94,95] The chronic shortage of dentists in Indigenous communities suggests we look to expanded roles of other dental providers (eg, DTs and hygienists) and other nondental providers to increase access to oral health care, with an emphasis on preventive services.

In the 1970s, Health Canada supported the use of DTs for FN communities, and many began practice in the northern communities of Canada.[96] DTs are midlevel dental providers who work under the supervision of a dentist. Reviews of DTs in more than 50 countries reported that DTs expand access to dental care in a safe and effective manner.[97] Unfortunately, over time, an increasing number of Canadian DTs chose to work in urban settings rather than rural communities. The urban migration of DTs and the ongoing opposition by professional dental societies led the Canadian federal government to discontinue funding DT training programs in 2011.[98]

As Canada was reducing its support for the training of DTs, the Alaska Native Tribal Health Consortium began a dental health aide therapist (DHAT) program. The Alaska DHAT program has been linked to better oral health access and outcomes in remote villages and has been well received by health care providers and community members.[99–101] DHAT programs also have been implemented in tribal clinics in the states of Washington and Minnesota. The National Indian Health Board champions the use of DHATs as a strategy to increase access to oral health and a legitimate exercise of tribal sovereignty.[102] The Department of Indigenous Services Canada and the Canadian Dental Hygienists Association have recently proposed the reestablishment of a training program for dental therapy that would see dental hygienists complete an extra year of education to be able to provide expanded oral health services.[103]

Primary care providers (pediatricians, family physicians, nurse practitioners, community health nurses, physician assistants, and dietitians) in Indigenous communities in North America are in unique positions to complement the work of dental health professionals. These nondental providers provide early and frequent care to children before they see a dental provider. In many Indigenous communities, well-infant, infant health, and immunization clinics are provided on a regular basis through community health nurses and physicians. These nondental providers have an opportunity to assess children's risk for caries and promote oral health as part of their overall health-promotion activities. In addition, they can provide oral health screening for infants and young children, provide fluoride varnish, and coordinate referrals to dental health professionals. Moreover, because of the high rates of obesity and type 2 diabetes mellitus in Indigenous populations, Indigenous youth may undergo dietary assessments and may be seen by dietitians. These visits provide opportunities for collaboration between primary care and dentistry to encourage limited consumption of sugars, a shared risk factor for both obesity and caries.

ORAL HEALTH RECOMMENDATIONS FOR INDIGENOUS COMMUNITIES

Caries prevention interventions that have worked well in the general population have been less effective in Indigenous children; therefore, the prevention and treatment recommendations described here should be informed by what is known of ECC epidemiology in Indigenous children. Indigenous children acquire *S mutans* colonization at an earlier age, develop caries at an earlier age, and commonly experience severe ECC. The health care community needs to recognize that "two is too late" for preventive interventions in Indigenous children to be successful and that new strategies with earlier intervention are needed to reduce this health disparity.

Community-Based Promotion Initiatives

- Promote changes in Indigenous communities to reduce frequent consumption of sugar-containing drinks and sugary snacks through education and improved access to healthy foods in communities.
- Emphasize the importance of oral health for the pregnant woman and her infant(s) through community-based activities.
- Promote exclusive breastfeeding for the first 6 months and breastfeeding until 12 months of age.
- Ensure that Indigenous communities benefit from community water fluoridation and know the fluoridation level of their water supply.
- Promote collaboration between oral health and obesity and type 2 diabetes mellitus prevention efforts for Indigenous communities.

Clinical Care Recommendations

- Consider early childhood oral health as an integral part of overall childhood health and well-being.

- Ensure that Indigenous women receive preconception and prenatal screening for oral health, anticipatory guidance for oral health and hygiene, and referral for dental care.
- Discuss oral health during well-child care visits with a CRA and anticipatory guidance on oral hygiene and diet, starting with the first tooth eruption.
- Recommend the establishment of a dental home by 12 months of age.
- Promote supervised twice-daily use of fluoridated toothpaste for all Indigenous children beginning with the eruption of the first tooth (rice grain–sized portion of toothpaste for children <36 months of age and a green pea–sized portion for children ≥36 months of age).
- Provide fluoride varnish by either dental or nondental health care providers in primary care settings and by trained lay workers in other settings starting with the first tooth eruption (and then every 3–6 months thereafter).
- Promote the incorporation of SDF into caries management protocols for Indigenous children with ECC to decrease or arrest caries progression and reduce or avoid the reliance on GA to facilitate operative repair.
- Consider promoting the incorporation of interim therapeutic restoration into caries management protocols.
- Consider promoting the use of sealants on primary molars to prevent caries and the need for operative repair.

Workforce and Access

- Provide early access to dental health professionals by 12 months of age to establish a dental home with the full range of oral health–promotion and interceptive disease-prevention services.
- Consider roles that DTs, dental hygienists, and primary health care providers can assume in areas where it is difficult to recruit and retain a sufficient number of dentists to provide early oral health services.
- Ensure that dentists, dental hygienists, DTs, and assistants working in Indigenous communities receive education to practice in a culturally appropriate manner.

Advocacy

- Advocate for an adequate dental workforce that can include the training and use of midlevel professionals such as DTs.
- Advocate for increased representation of Indigenous people in oral health professions.
- Advocate for regular and sustained ambulatory dental care in or near Indigenous communities.

Research

- Support further community-based participatory research on the epidemiology, prevention, management, and microbiology of ECC and ECC-prevention projects in Indigenous communities.

RECOMMENDED RESOURCES

- American Academy of Pediatric Dentistry. *Best Practice on Fluoride Therapy.* Chicago, IL: American Academy of Pediatric Dentistry; 2018. Available at: http://www.aapd.org/media/Policies_Guidelines/BP_FluorideTherapy.pdf.
- American Academy of Pediatric Dentistry. *Clinical Practice Guideline on Use of Silver Diamine Fluoride for Dental Caries Management in Children and Adolescents, Including Those with Special Health Care Needs.* Chicago, IL: American Academy of Pediatric Dentistry; 2017. Available at: http://www.aapd.org/media/Policies_Guidelines/G_SDF.pdf.
- American Academy of Pediatric Dentistry. *Best Practice on Caries-Risk Assessment and Management for Infants, Children, and Adolescents.* Chicago, IL: American Academy of Pediatric Dentistry; 2014. Available at: http://www.aapd.org/media/Policies_Guidelines/BP_CariesRiskAssessment.pdf.
- American Academy of Pediatrics, Section on Oral Health. Protecting All Children's Teeth (PACT): a pediatric oral health training program. Available at: https://www.aap.org/en-us/advocacy-and-policy/aap-health-initiatives/Oral-Health/Pages/Protecting-All-Childrens-Teeth.aspx.
- American Academy of Pediatrics, Section on Oral Health. Maintaining and improving the oral health of young children. *Pediatrics.* 2014; 123(6):1224–1229. Available at: www.pediatrics.org/cgi/doi/10.1542/peds.2014-2984.
- American Academy of Pediatrics, Section on Oral Health. Oral Health Advocacy Toolkit. Available at: https://www.aap.org/en-us/advocacy-and-policy/aap-health-initiatives/Oral-Health/Pages/Oral-Health-Advocacy-Toolkit.aspx.
- American Academy of Pediatrics, Section on Oral Health. Campaign for Dental Health/Community Water Fluoridation Resource. Available at: https://ilikemyteeth.org/.
- American Academy of Pediatrics, Section on Oral Health. Fluoride use in caries prevention in the primary care setting. *Pediatrics.* 2014; 134(3):626–633. Available at: http://pediatrics.aappublications.org/content/134/3/626.
- American Academy of Pediatrics. Caries Risk Assessment Tool. Available at: https://www.aap.org/en-us/Documents/oralhealth_RiskAssessmentTool.pdf.
- Casamassimo P, Holt K, eds; National Maternal and Child Oral Health Resource Centre. *Bright Futures in Practice: Oral Health Pocket Guide.* 3rd ed. Washington, DC: Georgetown University; 2016. Available at: https://www.

mchoralhealth.org/PDFs/BFOHPocketGuide-booklet.pdf.

- Indian Health Service. IHS Early Childhood Caries Collaborative. Available at: https://www.ihs.gov/doh/index.cfm?fuseaction=ecc.display.
- Oral Health and the Aboriginal Child. Knowledge transfer site. Available at: http://oralhealth.circumpolarhealth.org.
- Winnipeg Regional Health Authority. Early childhood tooth decay. Healthy Smile Happy Child pamphlets and other resources. Available at: https://wrha.mb.ca/oral-health/early-childhood-tooth-decay/.
- Smiles for Life: A National Oral Health Curriculum. Available at: https://www.smilesforlifeoralhealth.org/buildcontent.aspx?tut=555&pagekey=62948&cbreceipt=0.
- Canadian Caries Risk Assessment Tool (< 6 years). Available at: http://umanitoba.ca/CRA_Tool_ENG_Version.pdf.

LEAD AUTHORS

Steve Holve, MD
Patricia Braun, MD, MPH
James D. Irvine, MD
Kristen Nadeau, MD, MS
Robert J. Schroth, DMD, MSc, PhD

AMERICAN ACADEMY OF PEDIATRICS COMMITTEE ON NATIVE AMERICAN CHILD HEALTH, 2018–2019

Shaquita L. Bell, MD, Chairperson
Daniel J. Calac, MD
Allison Empey, MD
Kristen J. Nadeau, MD, MS
Jane A. Oski, MD, MPH
(Ret) CAPT Judith K. Thierry, DO, MPH
Ashley Weedn, MD

LIAISONS

Joseph T. Bell, MD – *Association of American Indian Physicians*
Angela Kueck, MD – *American College of Obstetricians and Gynecologists*
Rebecca S. Daily – *American Academy of Child and Adolescent Psychiatry*
Radha Jetty, MD – *Canadian Paediatric Society*
Melanie Mester, MD – *American Academy of Pediatrics Section on Pediatric Trainees*
Nelson Branco, MD – *American Academy of Pediatrics Indian Health Special Interest Group Chairperson*

CONSULTANTS

Diana Dunnigan, MD

STAFF

Madra Guinn Jones, MPH

AMERICAN ACADEMY OF PEDIATRICS SECTION ON ORAL HEALTH EXECUTIVE COMMITTEE, 2018–2019

Patricia Braun, MD, MPH, Chairperson
Susan Fisher-Owens, MD, MPH
Qadira Huff, MD, MPH
Jeffrey Karp, DMD, MS
Anupama Tate, DMD
John Unkel, MD, DDS, MS
David Krol, MD, MPH, Immediate Past Chairperson

STAFF

Ngozi Onyema-Melton, MPH

CANADIAN PAEDIATRIC SOCIETY, FIRST NATIONS, INUIT, AND MÉTIS COMMITTEE

Radha Jetty, MD, Chairperson
Roxanne Goldade, MD, Board Representative
Brett Schrewe, MD
Véronique Pelletier, MD
Ryan J.P. Giroux, MD
Margaret Berry, MD
Leigh Fraser-Roberts, MD

LIAISONS

Patricia Wiebe, MD, MPH – *Indigenous Services Canada, First Nations and Inuit Health Branch**
Laura Mitchell, BA, MA – *Indigenous Services Canada, First Nations and Inuit Health Branch**
Shaquita Bell, MD – *American Academy of Pediatrics Committee on Native American Child Health*
Melanie Morningstar – *Assembly of First Nations*
Karen Beddard – *Inuit Tapiriit Kanatami*
Marilee Nowgesic, RN – *Indigenous Nurses Association of Canada*
Vides Eduardo, MD – *Métis National Council*
Lisa Monkman, MD – *Indigenous Physicians Association of Canada*

CONSULTANTS

James Irvine, MD
Kent Saylor, MD

ACKNOWLEDGMENTS

This position statement has been reviewed by the Community Paediatrics, Drug Therapy and Hazardous Substances, Infectious Diseases and Immunization Committees, and the Paediatric Oral Health Section Executives of the Canadian Paediatric Society. This document has also been reviewed by representatives from the First Nations and Inuit Health Branch, Indigenous Services Canada* and the Canadian Dental Association.

ABBREVIATIONS

AI/AN: American Indian and Alaska native
CRA: caries risk assessment
DHAT: dental health aide therapist
DT: dental therapist
ECC: early childhood caries
FN: First Nations
GA: general anesthesia
IHS: Indian Health Service
RCT: randomized controlled trial
SDF: silver diamine fluoride
S-ECC: severe early childhood caries

* The views expressed in this article/publication or information resource do not necessarily represent the positions, decisions, or policies of the First Nations and Inuit Health Branch liaisons or their organization.

This policy statement was developed collaboratively between the American Academy of Pediatrics and the Canadian Pediatric Society and is published simultaneously in *Pediatrics* and *Pediatrics & Child Health*.

DOI: https://doi.org/10.1542/peds.2021-051481

Address correspondence to Steve Holve, MD. E-mail: sholve55@gmail.com

PEDIATRICS (ISSN Numbers: Print, 0031-4005; Online, 1098-4275).

FINANCIAL DISCLOSURE: Dr Schroth received compensation from the Canadian Dental Association for his role as Chair of the Committee on Clinical and Scientific Affairs; the other authors have indicated they have no financial relationships relevant to this article to disclose.

FUNDING: No external funding.

POTENTIAL CONFLICT OF INTEREST: Dr Schroth serves as the Chair of the Committee on Clinical and Scientific Affairs for the Canadian Dental Association and is Co-Chair of the Canada–US Chapter of the Alliance for a Cavity-Free Future; the other authors have indicated they have no potential conflicts of interest to disclose.

REFERENCES

1. American Academy of Pediatric Dentistry. Policy on early childhood caries (ECC): classifications, consequences, and preventive strategies. *Pediatr Dent*. 2017;39(6): 59–61
2. US Department of Health and Human Services. *Oral Health in America: A Report of the Surgeon General*. Rockville, MD: US Department of Health and Human Services; 2000
3. Schroth RJ, Harrison RL, Moffatt ME. Oral health of indigenous children and the influence of early childhood caries on childhood health and well-being. *Pediatr Clin North Am*. 2009;56(6): 1481–1499
4. Almeida AG, Roseman MM, Sheff M, Huntington N, Hughes CV. Future caries susceptibility in children with early childhood caries following treatment under general anesthesia. *Pediatr Dent*. 2000;22(4):302–306
5. Peretz B, Ram D, Azo E, Efrat Y. Preschool caries as an indicator of future caries: a longitudinal study. *Pediatr Dent*. 2003;25(2):114–118
6. Schroth RJ, Levi JA, Sellers EA, Friel J, Kliewer E, Moffatt ME. Vitamin D status of children with severe early childhood caries: a case-control study. *BMC Pediatr*. 2013;13:174
7. Schroth RJ, Levi J, Kliewer E, Friel J, Moffatt ME. Association between iron status, iron deficiency anaemia, and severe early childhood caries: a case-control study. *BMC Pediatr*. 2013;13(1): 22
8. Deane S, Schroth RJ, Sharma A, Rodd C. Combined deficiencies of 25-hydroxyvitamin D and anemia in preschool children with severe early childhood caries: a case-control study. *Paediatr Child Health*. 2018;23(3): e40–e45
9. Schroth RJ, Quiñonez C, Shwart L, Wagar B. Treating early childhood caries under general anesthesia: a national review of Canadian data. *J Can Dent Assoc*. 2016;82:g20
10. Davidson K, Schroth RJ, Levi JA, Yaffe AB, Mittermuller BA, Sellers EAC. Higher body mass index associated with severe early childhood caries. *BMC Pediatr*. 2016;16:137
11. Health Canada. *Inuit Oral Health Survey Report 2008-2009*. Ottawa, Canada: Health Canada; 2011
12. The First Nations Information Governance C.. *Report on the Findings of the First Nations Oral Health Survey (FNOHS) 2009-10*. Ottawa, Canada: The First Nations Information Governance Centre; 2012
13. Schroth RJ, Halchuk S, Star L. Prevalence and risk factors of caregiver reported Severe Early Childhood Caries in Manitoba First Nations children: results from the RHS Phase 2 (2008-2010). *Int J Circumpolar Health*. 2013;72
14. Batliner T, Wilson AR, Tiwari T, et al. Oral health status in Navajo Nation Head Start children. *J Public Health Dent*. 2014;74(4):317–325
15. Phipps K, Ricks TL. *The Oral Health of American Indian and Alaska Native Children Aged 1-5 Years: Results of the 2014 IHS Oral Health Survey*. Rockville, MD: Indian Health Service; 2015
16. Indian Health Service. *An Oral Health Survey of American Indian and Alaska Native Dental Patients. Findings, Regional Differences and National Comparisons*. Rockville, MD: Indian Health Service; 1999
17. Canadian Institute for Health Information. *Treatment of Preventable Dental Cavities in Preschoolers: A Focus on Day Surgery Under General Anesthesia*. Ottawa, ON: Canadian Institute for Health Information; 2013
18. Thomas TK, Schroth RJ. Promising efforts to improve the oral health of indigenous children. In: 8th International Meeting on Indigenous Child Health; March 22–24, 2019; Calgary, Alberta
19. Robertson LD. The Warm Springs Model: a successful strategy for children at very high risk for dental caries. *CDA J*. 2018;46(2):8
20. Lynch DJ, Villhauer AL, Warren JJ, et al. Genotypic characterization of initial acquisition of Streptococcus mutans in American Indian children. *J Oral Microbiol*. 2015;7:27182

21. Warren JJ, Kramer KW, Phipps K, et al. Dental caries in a cohort of very young American Indian children. *J Public Health Dent*. 2012;72(4):265–268
22. Dawson DV, Blanchette DR, Douglass JM, et al. Evidence of early emergence of the primary dentition in a Northern Plains American Indian population. *JDR Clin Trans Res*. 2018;3(2):161–169
23. Pitts NB, Zero DT, Marsh PD, et al. Dental caries. *Nat Rev Dis Primers*. 2017;3: 17030
24. Agnello M, Marques J, Cen L, et al. Microbiome associated with severe caries in Canadian First Nations children. *J Dent Res*. 2017;96(12): 1378–1385
25. Gibson S, Williams S. Dental caries in pre-school children: associations with social class, toothbrushing habit and consumption of sugars and sugar-containing foods. Further analysis of data from the National Diet and Nutrition Survey of children aged 1.5-4.5 years. *Caries Res*. 1999;33(2):101–113
26. Macdonald D, Wilson D. *Shameful Neglect. Indigenous Child Poverty in Canada*. Ottawa, Canada: Canadian Centre for Policy Alternatives; 2016
27. US Census Bureau. American Community Survey, poverty status in past 12 months by sex and age. Available at: https://www.census.gov/acs/www/data/data-tables-and-tools/american-factfinder/. Accessed April 15, 2021
28. Mattila ML, Rautava P, Sillanpää M, Paunio P. Caries in five-year-old children and associations with family-related factors. *J Dent Res*. 2000;79(3):875–881
29. Smith PJ, Moffatt ME. Baby-bottle tooth decay: are we on the right track? *Int J Circumpolar Health*. 1998;57(suppl 1): 155–162
30. Lawrence HP, Romanetz M, Rutherford l, Cappel L, Binguis D, Rodgers JB. Effects of a community-based prenatal nutrition program on the oral health of Aboriginal preschool children in northern Ontario. *Probe*. 2004;38(4): 172–190
31. Tsubouchi J, Tsubouchi M, Maynard RJ, Domoto PK, Weinstein P. A study of dental caries and risk factors among Native American infants. *ASDC J Dent Child*. 1995;62(4):283–287
32. Weinstein P, Troyer R, Jacobi D, Moccasin M. Dental experiences and parenting practices of Native American mothers and caretakers: what we can learn for the prevention of baby bottle tooth decay. *ASDC J Dent Child*. 1999; 66(2):120–126, 85
33. Schroth RJ, Smith PJ, Whalen JC, Lekic C, Moffatt ME. Prevalence of caries among preschool-aged children in a northern Manitoba community. *J Can Dent Assoc*. 2005;71(1):27
34. Aligne CA, Moss ME, Auinger P, Weitzman M. Association of pediatric dental caries with passive smoking. *JAMA*. 2003;289(10):1258–1264
35. Neves PA, Ribeiro CC, Tenuta LM, et al. Breastfeeding, dental biofilm acidogenicity, and early childhood caries. *Caries Res*. 2016;50(3):319–324
36. Wong JP, Venu I, Moodie RG, et al. Keeping caries at bay in breastfeeding babies. *J Fam Pract*. 2019;68(3):E1–E4
37. Tham R, Bowatte G, Dharmage SC, et al. Breastfeeding and the risk of dental caries: a systematic review and meta-analysis. *Acta Paediatr*. 2015;104(467): 62–84
38. American Dental Association. Statement on early childhood caries. 2000. Available at: https://www.ada.org/en/about-the-ada/ada-positions-policies-and-statements/statement-on-early-childhood-caries. Accessed February 7, 2020
39. Wong PD, Birken CS, Parkin PC, et al.; TARGet Kids! Collaboration. Total breast-feeding duration and dental caries in healthy urban children. *Acad Pediatr*. 2017;17(3):310–315
40. Hooley M, Skouteris H, Boganin C, Satur J, Kilpatrick N. Body mass index and dental caries in children and adolescents: a systematic review of literature published 2004 to 2011. *Syst Rev*. 2012;1:57
41. Li LW, Wong HM, Peng SM, McGrath CP. Anthropometric measurements and dental caries in children: a systematic review of longitudinal studies. *Adv Nutr*. 2015;6(1):52–63
42. Vázquez-Nava F, Vázquez-Rodríguez EM, Saldívar-González AH, Lin-Ochoa D, Martinez-Perales GM, Joffre-Velázquez VM. Association between obesity and dental caries in a group of preschool children in Mexico. *J Public Health Dent*. 2010;70(2):124–130
43. Boone MR, Hartsfield JK, Avery DR, Dean JA, Sanders BJ, Ward RE. Maternal diabetes and its effect on dental development [abstract]. *Int J Paediatr Dent*. 2003;13(suppl 1):29
44. Grahnén H, Edlund K. Maternal diabetes and changes in the hard tissues of primary teeth. I. A clinical study. *Odontol Revy*. 1967;18(2):157–162
45. Grahnén H, Möller EB, Bergstrom AL. Maternal diabetes and changes in the hard tissues of primary teeth. 2. A further clinical study. *Caries Res*. 1968; 2(4):333–337
46. American Academy of Pediatric Dentistry. Perinatal and infant oral health care. 2016. Available at: www.aapd.org/media/Policies_Guidelines/BP_PerinatalOralHealthCare.pdf. Accessed February 7, 2020
47. California Dental Association Foundation. *Oral Health During Pregnancy & Early Childhood. Evidence-Based Guidelines for Health Professionals*. Sacramento, CA: California Dental Association Foundation; 2010
48. Oral Health Care During Pregnancy Expert W.. *Oral Health Care During Pregnancy: A National Consensus Statement*. Washington, DC: National Maternal and Child Oral Health Resource Centre; 2012
49. New York State Department of Health. *Oral Health Care During Pregnancy and Early Childhood: Practice Guidelines*. Albany, NY: New York State Department of Health; 2006
50. American Dental Association. ADA fluoridation policy. American Dental Association supports fluoridation. 2018. Available at: https://www.ada.org/en/public-programs/advocating-for-the-public/fluoride-and-fluoridation/ada-fluoridation-policy. Accessed February 7, 2020
51. American Academy of Pediatric Dentistry. Policy on use of fluoride. 2018. Available at: www.aapd.org/media/Policies_Guidelines/P_FluorideUse.pdf. Accessed February 7, 2020
52. Canadian Dental Association. CDA position fluoride. 2012. Available at:

www.cda-adc.ca/en/about/position_statements/fluoride/. Accessed February 7, 2020

53. Section on Pediatric Dentistry and Oral Health. Preventive oral health intervention for pediatricians. *Pediatrics*. 2008;122(6):1387–1394

54. Godel J. The use of fluoride in infants and children. *Paediatr Child Health*. 2002;7(8):569–582

55. Riley JC, Lennon MA, Ellwood RP. The effect of water fluoridation and social inequalities on dental caries in 5-year-old children. *Int J Epidemiol*. 1999;28(2):300–305

56. McLaren L, Emery JC. Drinking water fluoridation and oral health inequities in Canadian children. *Can J Public Health*. 2012;103(7, suppl 1):eS49-eS56

57. Centers for Disease Control and Prevention (CDC). Dental caries in rural Alaska Native children–Alaska, 2008. *MMWR Morb Mortal Wkly Rep*. 2011;60(37):1275–1278

58. Public Health Agency of Canada. *The State of Community Water Fluoridation Across Canada*. Ottawa, Canada: Public Health Agency of Canada; 2017

59. Alaska Department of Health and Social Services. *Complete Health Indicator Report of Water - Fluoridated Drinking Water (HA2020 Leading Health Indicator: 20)*. Anchorage, AK: Alaska Department of Health and Social Services; 2018

60. Petti S. Why guidelines for early childhood caries prevention could be ineffective amongst children at high risk. *J Dent*. 2010;38(12):946–955

61. Garcia R, Borrelli B, Dhar V, et al. Progress in early childhood caries and opportunities in research, policy, and clinical management. *Pediatr Dent*. 2015;37(3):294–299

62. Ricks TL, Phipps KR, Bruerd B. The Indian Health Service Early Childhood Caries Collaborative: a five-year summary. *Pediatr Dent*. 2015;37(3):275–280

63. Braun PA, Quissell DO, Henderson WG, et al. A cluster-randomized, community-based, tribally delivered oral health promotion trial in Navajo Head Start children. *J Dent Res*. 2016;95(11):1237–1244

64. Harrison RL, Veronneau J, Leroux B. Effectiveness of maternal counseling in reducing caries in Cree children. *J Dent Res*. 2012;91(11):1032–1037

65. Ismail AI, Ondersma S, Jedele JM, Little RJ, Lepkowski JM. Evaluation of a brief tailored motivational intervention to prevent early childhood caries. *Community Dent Oral Epidemiol*. 2011;39(5):433–448

66. Naidu R, Nunn J, Irwin JD. The effect of motivational interviewing on oral healthcare knowledge, attitudes and behaviour of parents and caregivers of preschool children: an exploratory cluster randomised controlled study. *BMC Oral Health*. 2015;15:101

67. Feldens CA, Giugliani ER, Duncan BB, Drachler ML, Vítolo MR. Long-term effectiveness of a nutritional program in reducing early childhood caries: a randomized trial. *Community Dent Oral Epidemiol*. 2010;38(4):324–332

68. Kay E, Locker D. A systematic review of the effectiveness of health promotion aimed at improving oral health. *Community Dent Health*. 1998;15(3):132–144

69. Bader JD, Rozier RG, Lohr KN, Frame PS. Physicians' roles in preventing dental caries in preschool children: a summary of the evidence for the U.S. Preventive Services Task Force. *Am J Prev Med*. 2004;26(4):315–325

70. Steggerda MH, Hill TJ. Incidence of dental caries among Maya and Navajo Indians. *J Dent Res*. 1935;15(5):10

71. Collins H. Caries and crowding of teeth of the living Alaska Eskimo. *Am J Phys Anthropol*. 1932;16(4):12

72. Parfitt GJ. A survey of the oral health of Navajo Indian children. *Arch Oral Biol*. 1960;1:193–205

73. Levin A, Sokal-Gutierrez K, Hargrave A, Funsch E, Hoeft KS. Maintaining traditions: a qualitative study of early childhood caries risk and protective factors in an indigenous community. *Int J Environ Res Public Health*. 2017;14(8):e907

74. Harrison R, White L. A community-based approach to infant and child oral health promotion in a British Columbia First Nations community. *Can J Community Dent*. 1997;12:7–14

75. Harrison RL, MacNab AJ, Duffy DJ, Benton DH. Brighter Smiles: service learning, inter-professional collaboration and health promotion in a First Nations community. *Can J Public Health*. 2006;97(3):237–240

76. Schroth RJ, Edwards JM, Brothwell DJ, et al. Evaluating the impact of a community developed collaborative project for the prevention of early childhood caries: the Healthy Smile Happy Child project. *Rural Remote Health*. 2015;15(4):3566

77. Schroth RJ, Wilson A, Prowse S, et al. Looking back to move forward: understanding service provider, parent, and caregiver views on early childhood oral health promotion in Manitoba, Canada. *Can J Dent Hyg*. 2014;48(3):99–108

78. Cidro J, Zahayko L, Lawrence H, McGregor M, McKay K. Traditional and cultural approaches to childrearing: preventing early childhood caries in Norway House Cree Nation, Manitoba. *Rural Remote Health*. 2014;14(4):2968

79. American Academy of Pediatric Dentistry. Caries-Risk Assessment and Management for Infants, Children, and Adolescents. In: *The Reference Manual of Pediatric Dentistry*. Chicago, IL: American Academy of Pediatric Dentistry; 2020:243–247

80. Azarpazhooh A, Main PA. Pit and fissure sealants in the prevention of dental caries in children and adolescents: a systematic review. *J Can Dent Assoc*. 2008;74(2):171–177

81. Beauchamp J, Caufield PW, Crall JJ, et al.; American Dental Association Council on Scientific Affairs. Evidence-based clinical recommendations for the use of pit-and-fissure sealants: a report of the American Dental Association Council on Scientific Affairs. *J Am Dent Assoc*. 2008;139(3):257–268

82. Akinlotan M, Chen B, Fontanilla TM, Chen A, Fan VY. Economic evaluation of dental sealants: a systematic literature review. *Community Dent Oral Epidemiol*. 2018;46(1):38–46

83. Slayton RL, Urquhart O, Araujo MWB, et al. Evidence-based clinical practice guideline on nonrestorative treatments for carious lesions: a report from the American Dental Association. *J Am Dent Assoc*. 2018;149(10):837–849.e19

84. American Academy of Pediatric Dentistry. Policy on interim therapeutic restorations (ITR). *Pediatr Dent*. 2018; 40(6):58–59

85. Rosenblatt A, Stamford TC, Niederman R. Silver diamine fluoride: a caries "silver-fluoride bullet". *J Dent Res*. 2009; 88(2):116–125

86. Peng JJ, Botelho MG, Matinlinna JP. Silver compounds used in dentistry for caries management: a review. *J Dent*. 2012;40(7):531–541

87. Clemens J, Gold J, Chaffin J. Effect and acceptance of silver diamine fluoride treatment on dental caries in primary teeth. *J Public Health Dent*. 2018;78(1): 63–68

88. Robertson LD. *Early Childhood Caries in American Indian Children: Looking Beyond the Usual Causes*. Ottawa, Canada: Canadian Dental Association; 2018

89. Horst JA, Ellenikiotis H, Milgrom PL. UCSF protocol for caries arrest using silver diamine fluoride: rationale, indications and consent. *J Calif Dent Assoc*. 2016;44(1):16–28

90. Crystal YO, Marghalani AA, Ureles SD, et al. Use of silver diamine fluoride for dental caries management in children and adolescents, including those with special health care needs. *Pediatr Dent*. 2017;39(5):135–145

91. Schroth RJ, Morey B. Providing timely dental treatment for young children under general anesthesia is a government priority. *J Can Dent Assoc*. 2007;73(3):241–243

92. Casamassimo PS, Hammersmith K, Gross EL, Amini H. Infant oral health: an emerging dental public health measure. *Dent Clin North Am*. 2018;62(2):235–244

93. Lee H, Milgrom P, Huebner CE, et al. Ethics rounds: death after pediatric dental anesthesia: an avoidable tragedy? *Pediatrics*. 2017;140(6): e20172370

94. Canadian Dental Association. CDA position on first visit to the dentist. 2012. Available at: www.cda-adc.ca/_files/position_statements/firstVisit.pdf. Accessed January 7, 2020

95. Hale KJ; American Academy of Pediatrics Section on Pediatric Dentistry. Oral health risk assessment timing and establishment of the dental home. *Pediatrics*. 2003;111(5 pt 1): 1113–1116

96. Canada H. *First Nations and Inuit Health Program Compendium 2011/2012*. Ottawa, Canada: Health Canada; 2012

97. Nash DA, Friedman JW, Mathu-Muju KR, et al. A review of the global literature on dental therapists. *Community Dent Oral Epidemiol*. 2014;42(1):1–10

98. Leck V, Randall GE. The rise and fall of dental therapy in Canada: a policy analysis and assessment of equity of access to oral health care for Inuit and First Nations communities. *Int J Equity Health*. 2017;16(1):131

99. Chi DL, Lenaker D, Mancl L, Dunbar M, Babb M. *Dental Utilization for Communities Served by Dental Therapists in Alaska's Yukon Kuskokwim Delta: Finding from an Observational Quantitative Study*. Seattle, WA: University of Washington; 2017

100. Chi DL, Lenaker D, Mancl L, Dunbar M, Babb M. Dental therapists linked to improved dental outcomes for Alaska Native communities in the Yukon-Kuskokwim Delta. *J Public Health Dent*. 2018;78(2):175–182

101. Chi DL, Hopkins S, Zahlis E, et al. Provider and community perspectives of dental therapists in Alaska's Yukon-Kuskokwim Delta: a qualitative programme evaluation. *Community Dent Oral Epidemiol*. 2019;47(6):502–512

102. Cladoosby BS. Indian Country leads national movement to knock down barriers to oral health equity. *Am J Public Health*. 2017;107(S1):S81–S84

103. Canadian Dental Hygienists Association. *The Canadian Dental Hygienists Association 2017-2018 Annual Report*. Ottawa, Canada: Canadian Dental Hygienists Association; 2018

Ethical Considerations in Pediatricians' Use of Social Media

- *Clinical Report*

CLINICAL REPORT Guidance for the Clinician in Rendering Pediatric Care

American Academy of Pediatrics

DEDICATED TO THE HEALTH OF ALL CHILDREN®

Ethical Considerations in Pediatricians' Use of Social Media

Robert Macauley, MD, FAAP,[a] Nanette Elster, JD, MPH,[b] Jonathan M. Fanaroff, MD, JD, FAAP,[c] COMMITTEE ON BIOETHICS, COMMITTEE ON MEDICAL LIABILITY AND RISK MANAGEMENT

Increasing use of social media by patients and clinicians creates opportunities as well as dilemmas for pediatricians, who must recognize the inherent ethical and legal complexity of these communication platforms and maintain professionalism in all contexts. Social media can be a useful tool in the practice of medicine by educating both physicians and patients, expanding access to health care, identifying high-risk behaviors, contributing to research, promoting networking and online support, enhancing advocacy, and nurturing professional compassion. At the same time, there are confidentiality, privacy, professionalism, and boundary issues that need to be considered whenever potential interactions occur between physicians and patients via social media. This clinical report is designed to assist pediatricians in identifying and navigating ethical issues to harness the opportunities and avoid the pitfalls of social media.

INTRODUCTION

Increasing use of social media by patients and clinicians creates opportunities as well as dilemmas for pediatricians, who must recognize the inherent ethical and legal complexity of these communication platforms and maintain professionalism in all contexts. This clinical report is designed to assist pediatricians in identifying and navigating ethical issues to harness the opportunities and avoid the pitfalls of social media. As Parikh et al[1] rightly observe, "Connectivity need not come at the price of professionalism." In fact, striking a proper balance may be considered an ethical imperative, with the goal that social media (to the extent that it is used) augment in-person care rather than take the place of it.

More than 300 million people in the United States now use the Internet,[2] with more than 90% of them also using e-mail to communicate.[3] With the creation of social media outlets (also known as Web 2.0) at the dawn of the 21st century, the capacity for sharing information among huge numbers of people with little or no time lag reached new heights. "Social media" refer to Web-based services that allow users to create personal

abstract

[a]Department of Pediatrics, Oregon Health and Science University, Portland, Oregon; [b]Neiswanger Institute for Bioethics, Stritch School of Medicine, Loyola University Chicago, Chicago, Illinois; and [c]Department of Pediatrics, School of Medicine, Case Western Reserve University and Rainbow Center for Pediatric Ethics and Division of Neonatology, University Hospitals Rainbow Babies and Children's Hospital, Cleveland, Ohio

Drs Macauley and Elster drafted the article; and all authors participated in conception and design of the report, data collection, analysis, and interpretation, and critical revision of the article and approved the final manuscript as submitted.

DOI: https://doi.org/10.1542/peds.2020-049685

Address correspondence to Robert Macauley, MD. E-mail: macauler@ohsu.edu

To cite: Macauley R, Elster N, Fanaroff JM, AAP COMMITTEE ON BIOETHICS, COMMITTEE ON MEDICAL LIABILITY AND RISK MANAGEMENT. Ethical Considerations in Pediatricians' Use of Social Media. *Pediatrics.* 2021;147(3):e2020049685

profiles and post content[4] as well as "articulate a list of other users with whom they share a connection."[5] E-mail and other forms of electronic communication specifically designed to be used between a single user and another, such as electronic patient portals, are not considered social media[6] and are not the focus of this report. Seventy-two percent of Americans, including 90% of teenagers, engage in social media,[7–9] with Facebook among the best known and most frequently used by adults. Others include Instagram, Twitter, LinkedIn, Tumblr, Snapchat, and Pinterest. Newer social media options are being created regularly as public needs and demands shift.[10] Social channels are evolving and changing with time, allowing for instant and disappearing messages, back-channel connections, live video streaming, and one-to-many communications. Some social channels have been specifically designed for physician communication, either with peers, patients, or the public.

Because of social media's ubiquity and ease of use, a high percentage of patients want or expect to use it to communicate with their physician. In a recent Harris Poll survey conducted on behalf of the American Osteopathic Association, it was found that "more than half of millennials (54%) and more than four out of 10 (42%) adults are or would like to be friends with or follow their health care providers on social media."[11] Research reveals that patients who do not currently use social media would consider doing so to improve physician-patient communication.[12] This is particularly true of pediatric patients, who as "digital natives" (ie, people born or raised in the age of digital technology[13]) are more familiar with communicating with and expressing themselves through social media than are many adults.[14]

Pediatricians, however, are, depending on their generation and experience, a blend of digital natives and "digital immigrants" (defined as people born before 1980) and, thus, have varying understanding and facility with social media.[13] This relative unfamiliarity, coupled with reports of violations of online professionalism (which more than 90% of state medical boards have received, leading to sanctions ranging from suspension to revocation of the physician's license[15]), may cause some pediatricians to be reluctant to engage with social media.

Avoiding social media, however, sacrifices opportunities for communication, education, and advocacy with patients and families. As Parsi and Elster[16] note, "If we fail to engage this technology constructively, we will lose an important opportunity to expand the application of medical professionalism within contemporary society." Both the potential benefits and risks of social media need to be considered to appropriately incorporate it into one's clinical practice.

POTENTIAL BENEFITS OF SOCIAL MEDIA

Professional Education and Collaboration

Faced with multiple competing obligations and rigorous productivity expectations, physicians may need to consult with colleagues about challenging cases or research current evidence quickly. Social networking sites can help close this gap, as long as they are compliant with privacy requirements of the Health Insurance Portability and Accountability Act (HIPAA) (which would include identity verification and sufficient encryption). Physician-to-physician communication can also occur on public channels such as Twitter, through which groups of physicians congregate and "follow" each other for information sharing, thought leadership, and advocacy in pediatric public health. The American Academy of Pediatrics (AAP), for example, maintains a list of more than 700 tweeting AAP members, known as "Tweetiatricians."[17]

Overall, 90% of physicians today use social media for professional purposes, including finding and reading relevant medical information.[18] Social media are especially popular with early-career pediatricians who may be more familiar with digital technology, have received mentoring in its use during training, or attend conferences in which tweeting is encouraged to ask questions or provide feedback. Social media allow learners to express their opinions and ask questions without fear of embarrassment and has been observed to "flatten the hierarchy" of medicine by giving each person an equal voice.[19]

Patient Education and Advocacy

Studies have revealed that 8 in 10 Internet users go online for health information,[20] and more than half of these people get medical information specifically from social media.[21] Social media tools can be used to share relevant and important public health topics and to guide the public, patients, and families who follow a physician's channels to creditable resources that have been reviewed by physicians (such as online media articles, blogs, journal articles, or important recall or safety information). Communication may range from general advice, such as encouragement to get the seasonal influenza immunization, to broad-ranging notifications about public health emergencies.

Beyond mere ease and scope, education via social media may be preferable for patients who have moved beyond the model of acquiring knowledge from a medical professional in the clinical workspace. Some patients prefer "disintermediation," or gathering information directly from online sources. Recognizing that not every such source is trustworthy, physicians

can encourage a middle ground. The so-called "apomediary model" allows physicians to guide patients to reliable information that they can access independently before turning to their physician for consultation and clarification.[22]

Social media can also be used to implement advocacy initiatives to enhance public health. Examples include appeals to contact elected officials to advocate for policies and legislation that improve the health of children and their families and the promotion of public and community health via immunization campaigns. Recent polls suggest that fully two-thirds of Americans believe that social media are important for getting elected officials to pay attention to issues and that social media platforms are "at least somewhat important for creating sustained movements for social change."[23]

These social media opportunities are widely accessible to, and can be used to influence, public opinion, as recent interference in US elections attests.[24] Opponents of certain medical recommendations or public policies can provide conflicting or inaccurate information that may trigger discussions and debate.[25] Although currently only 9% of physicians use social media to comment on posts or participate in group discussions or online chats,[18] physicians participating in social media may help prevent misconceptions from dominating online discussions.

Social media can help patients and families understand the range of expertise of a given practice and learn of additional resources in their community. In some cases, with patient authorization, social media can permit the transmission of personalized information (such as appointment or medication refill reminders), which can help improve adherence to treatment regimens.[26]

Social media can also benefit patients by increasing awareness of community health needs. For instance, appeals for voluntary blood donation on social media can help to mitigate acute shortages. Organ donation recruitment has also increased in response to Facebook appeals.[27]

Patient Empowerment

Social media have made the world smaller and have provided a global community to support patients with special needs and chronic health conditions as well as individuals who may be experiencing social isolation or discrimination. Peer-to-peer health care affords patients the opportunities to develop a support network, share experiences, and learn about new opportunities for research or treatment.[28] Many private companies,[29,30] including some focused on pediatrics,[31] have such online communities for patients to connect with each other and work to systematically improve their health outcomes. Facebook[32] and Twitter[33] have both allowed the creation of "supportive disease subcultures." As one patient noted, "The internet has made our small disease larger and we are able to educate many more people now."[34]

In addition to fostering community and providing education, social media also hold the promise of improved diagnostics. Patients (and their advocates) can now share reports online of unusual symptom complexes that have stumped local physicians. These disclosures may be similar to diagnostic dilemmas among other patients and provide physicians with diagnostic clues.[26] Identifying groups of patients with a common condition can also spur further research on that disease's pathophysiology and treatment.[35,36] This process has been likened to crowdsourcing, or bringing together the collective wisdom of diverse groups of patients and physicians.[22]

Increased Patient Access

In regions with inadequate infrastructure to support optimal telemedicine, social media sites, such as Facebook, have been used instead.[37] Ideally, social media should not replace face-to-face encounters with physicians, but social media may supplement those encounters by creating virtual clinics, thus allowing a more rapid response to an urgent health care situation.

Clinical Research and Recruitment

Social media can expand research opportunities and connect researchers to peers, novel ideas, and potential human subjects or study participants. Social media tools are not only used to broadcast ideas; they can also be used to search for information, opinions, and ideas or simply to listen. Such tools allow researchers to contact patients with rare conditions and locate research subjects lost to follow-up as well as reach out to younger patients who might otherwise not learn about or become interested in participating in research.[38] Social media can inform researchers about patient responses to treatment and adverse drug effects and trigger modifications in treatment plans.[39]

Use of social media in research is ethically complex, however. Whereas most research studies are developed by experienced researchers and approved by their organization's institutional review board or human subjects committee, studies involving social media may bypass this review process because social media use is seen as public, thus calling into question whether it is necessary to obtain the participants' informed consent.[40] Protection of human subjects is critical, however, and researchers who use social media in their studies should continue to follow the policies of their institution's ethics committee or institutional review board. Investigators should disclose that

a research study is being considered, be clear about the risks and benefits of the research, and, if possible, obtain consent from potential study subjects before proceeding with the study rather than merely lurking to obtain data.[38] Without such transparency, potential subjects might post personal items on social media that they would have kept private if they had been aware of the research taking place (from a practical viewpoint, there should be no expectation of privacy for information voluntarily posted online[41]).

Identification of and Counseling for High-risk Behaviors

As digital natives, most pediatric patients expect to communicate through social media. Adolescents, in particular, spend a great deal of time online[42] and may feel more at ease sharing personal information in that context rather than in face-to-face conversation. Teenagers may also be more open to health-related messages and advice communicated through social media.[43] Social media can, therefore, be used to identify self-disclosed high-risk behaviors and explore ways of mitigating risk and accessing appropriate resources.[44,45] Such conversations are more straightforward when the pediatric patient has specifically granted the physician access to material posted on social media, although such communication itself raises issues related to blurring of appropriate boundaries (as discussed below). Greater discretion is required regarding social media information that is in the public domain.

Acquisition of Important Information

In rare cases, social media have been used to obtain specific and important information relevant to patient care. For instance, the authors of one case study describe how a Facebook search allowed a medical team to locate the family of a patient with amnesia.[46] Taken too far, however, indiscriminate queries (sometimes referred to as "patient-targeted googling") present significant ethical complexity and concerns, which will be addressed below.

Nurturing Compassion Through Narrative

Medical practice today can be challenging and exhausting. Sharing inspirational anonymized patient stories can nurture compassion among health professionals, reminding them about why they chose the profession in the first place.[47] Humor has also been shown to prevent burnout,[48] and so-called "collective venting" can be cathartic.[49]

By the same token, because social media are publicly accessible, insufficiently anonymized patient narratives (and even sufficiently anonymized ones that are written in a negative venting tone) may reflect negatively on the authoring physician. Even deidentified patient information holds the potential to be hurtful, both to that specific patient and to other patients who might fear that their private information could be shared in a similar manner. Denigrating language is inherently personal and reflects poorly on the physician and the profession of medicine itself.[50] There is evidence that sharing dehumanizing narratives and language begins early in medical training, with medical students shown to frequently express themselves in this way online.[51] A majority of medical schools now report unprofessional online conduct.[48] For precisely this reason, schools are starting to put forth policies regarding social media expression.[52]

Even when details are deidentified and a patient narrative is expressed in respectful terms, a majority of medical educators still believe that discussing it on social media requires explicit patient consent.[53,54] Given the abundance of readily accessible information, nondisclosure of names, addresses, or other traditionally verifiable information is not a guarantee that one's identity will remain anonymous.

POTENTIAL RISKS OF SOCIAL MEDIA

Inappropriate Self-Disclosure

Despite the potential benefits of social media, significant risks remain. One important risk is inappropriate personal self-disclosure by physicians online, which can negatively impact a physician-patient relationship or one's employment. Even if an inappropriate posting on social media is entirely unrelated to one's medical practice, it nevertheless reflects on one's professionalism.[55] As the American Medical Association Code of Ethics states, "The ethical obligations of physicians are not suspended when a physician assumes a position that does not directly involve patient care."[56] This includes online disclosures, and all professionals, not just physicians, are judged by how they comport themselves online.[57]

By its very nature, social media invite inappropriate posting because "anonymity can breed disinhibition."[58] Some posts are clearly inappropriate, such as selfies of grinning clinicians posing with weapons during a humanitarian mission[59] or uncivil microblog posts (eg, tweets).[60] Some posts may be more ambiguous but in the absence of nonverbal cues can easily be misinterpreted. Comments addressing patients, as well as those regarding one's employer or clinical setting, reflect negatively on both the subject, the poster, and the professional, potentially leading to disciplinary action or even termination. Tweeting or posting from work, especially if excessive, may be perceived as not paying attention to clinical duties and may violate institutional policy.[61]

There are permanent implications to such disclosure, too, because despite

subsequent attempts to purge one's online profile, what goes online stays online. Unflattering social media content may affect a clinician's future employment opportunities.[62] Despite this risk, one study revealed that only one-third of medical students set their Facebook pages to private.[63] This may be significant given that some institutions may consider social media and the content of postings in promotion and tenure.[64]

From a specifically pediatric perspective, poor digital citizenship undermines a pediatrician's important duty to serve as a role model for patients and families using social media. The AAP has previously encouraged pediatricians "to increase their knowledge of digital technology so that they can have a more educated frame of reference for the tools their patients and families are using, which will aid in providing timely anticipatory media guidance as well as diagnosing media-related issues should they arise."[42]

To prevent inappropriate disclosure, it is best to pause before posting by taking a moment to reflect on the potential impact of a post should it be seen by one's colleagues, patients, or families. It is in a physician's best interest to consider separating their personal and professional social media presence and efforts. The professional platforms can have public settings and content for education and advocacy, and the personal platforms can be set to private. Restricting access to one's private social media accounts may be beneficial in light of reports of a few patients using social media to stalk their physicians.[65] It is also wise to remember that online postings are discoverable in legal proceedings. Facebook's privacy policy clearly states that they may "access, preserve and share your information…in response to a legal request (like a search warrant, court order, or subpoena) if [they] have a good faith belief that the law requires [them] to do so."[66]

Simply having a presence on Facebook could permit a process called tagging. Tagging involves a facial recognition algorithm that identifies an individual from photographs posted online. An unprofessional pose from a friend's party could end up appearing on one's own Facebook feed. To prevent being tagged, Facebook settings can be modified.

Unfortunately, tagging may also occur from many social media platforms through comments and tweets. Even if a pediatrician were to elect not to have a social media presence at all, others are able to post information and photographs about the physician, including videos recorded and photographs taken without the physician's knowledge or consent. For this reason, routinely monitoring and curating one's online presence is recommended. Pediatricians can get a sense of their online "footprint," as well as their online "fingerprint" generated by their online work and advocacy, by regularly searching their online presence.

Blurring Relationship Boundaries

As stated above, a recent poll found that most millennials and nearly half of adults want to follow or connect with a health care provider on social media.[11] In one study, nearly 20% of adult patients attempted to communicate with their physician through Facebook.[67] Accepting this type of relationship can be problematic, however. "Friending" blurs the boundaries of the professional relationship, not only heightening the possibility of inappropriate physician self-disclosure[68] but also introducing a level of mutuality that can undermine a patient's privacy and patient-physician interactions. For example, if a physician discovers something on a patient's Facebook page that is not consistent with the patient's self-report, should the physician raise this issue with the patient directly? How might that discussion impact the patient's perception of privacy? Accepting a friend request may also raise expectations of off-duty availability or that clinical questions will be answered via less secure social media.

Recognizing this ethical challenge, 75% of physicians decline friend requests from patients[18] and only 5% have ever initiated one.[7] More than 80% of medical educators believe that it is never or rarely acceptable to become social networking friends with patients.[53,54] The American College of Physicians,[69] American Medical Association,[26] British Medical Association,[70] and Federation of State Medical Boards[15] all discourage accepting (and certainly initiating) friend requests with current or former patients, although the recent American College of Obstetrics and Gynecology statement permits some measure of discretion in this area.[71] Additionally, some employers prohibit friending patients.

This question becomes more complex in a pediatric context given the reliance of pediatric patients on social media as a forum for expression and communication. It is generally inadvisable for pediatricians to accept friend requests from current patients (and certainly to initiate them). However, declining a friend request might seem like it could compromise communication or even give offense to the requestor. If so, the physician should meet face to face and talk with the requestor and discuss with them why a dual relationship is not wise or in the patient's best interest. An alternative way to maintain communication would be to redirect the requestor to the pediatrician's professional site or a separate platform on which no other personal or professional posts are made.

Unlike in other specialties, pediatric patients "age out" of the therapeutic relationship with their physicians. Social media present a way for pediatricians to stay in contact with former patients. When not doing so is felt to represent a significant mutual loss, it is up to the pediatrician's discretion whether to remain in touch with former patients via social media.

Becoming social media friends with the parent of one's patient is also not without ethical complexity given that that the parent is usually tasked with making decisions for the patient and may be unduly influenced in the decision-making by the friend relationship. Such friending may also create an avenue of communication that could lead to an unintended disclosure of identifiable health information to the patient and family. Ethical issues in this friendship may become even more complicated if the social media relationship continues once the pediatric patient reaches the age of majority and the parent is no longer responsible for making decisions for the patient. It is, therefore, problematic to engage in social media contact with parents of patients if social media are the only basis of the relationship.

In some instances, however (such as small communities or areas in which the physician and the parent have other mutual interests), such contact can be a normal expression of friendship. Once again, it is imperative to maintain proper boundaries by reserving clinical discussions for separate forums.

Up to this point the discussion has been focused on established patients attempting to become friends on Facebook, but the reverse process (ie, friends on Facebook becoming patients) has also occurred. Generally speaking, a physician-patient relationship consists of a patient seeking assistance in a health-related matter and the physician agreeing to undertake diagnosis and treatment.[72] This does not require an in-person meeting and could conceivably occur online. Although specific requirements vary from state to state, it is likely that, regarding social media, the broadest notion of what constitutes a physician-patient relationship could be adopted.[71] Clinical questions posed through social media could, therefore, potentially create a professional obligation with documentation and follow-up requirements similar to those of an office visit as well as a potential liability risk, which may not be covered by malpractice insurance. What began as a kind-spirited attempt to offer general assistance could ultimately result in medicolegal obligations (and liability), underscoring the need for physicians to be extremely cautious about health care communications with personal friends and about posting anything that could be construed as representing a diagnosis or treatment.

Conflict of Interest

As noted above, social media provides valuable opportunities for health advocacy and patient education but can also raise the possibility of conflict of interest. For example, 11% of physician-written health care blogs include named products.[73] Tweets may involve "suspect promotions."[74] Because using social media is relatively easy, many more clinicians may be tempted to consider a paid promotion without understanding the ethical and legal implications of such conflicts of interest if promulgated without appropriate disclosure. Such arrangements have also occurred in traditional media and violate journalistic and educational ethics (not to mention Federal Trade Commission regulations[75]) if not publicly disclosed. Even an individual message on Twitter (a tweet) allows pediatricians to include a conflict of interest statement despite the 280-character limit. Employment relationships should be revealed in online profiles and biographies whenever possible.

Confidentiality

The Hippocratic Oath states, "I will respect the privacy of my patients, for their problems are not disclosed to me that the world may know." The HIPAA Privacy Rule, which covers "individually identifiable health information" based on 18 possible identifiers, including "full-face photographic images (and any comparable images),"[76] also applies to social media, as do state privacy laws.[50] Physicians have an ethical and legal obligation to keep protected health information confidential. Despite this duty, there have been reports of physicians sharing details about patients or inadequately deidentifying facts and photographs[77,78] because even blocked-out faces in photographs may still be identifiable. Social media postings that reference a medical encounter with a specific time and date could be seen by patients and damage trust in the physician-patient relationship and likely violate HIPAA.

To facilitate appropriate use of such digital communication, several legal issues need to be addressed. These include licensure across state lines or international borders,[79] adequate malpractice insurance coverage, reimbursement for telecare (if available), and maintaining confidentiality (because HIPAA also applies to social media communications). When a physician is communicating about health care or rendering advice directly to patients or families, HIPAA compliance requires the use of a secure site with encryption. Removing any identifiable patient details preserves the patient's anonymity and underscores the practice's compliance with state and federal law. The option of 24/7 patient communication also demands appropriate attention to the physician's own work-life balance.

Impact on Professional Reputation

A significant number of patients use online rating sites to choose their physician. Given the impact of one's online presence on professional reputation, it is advisable for physicians to monitor the status of their online identity.[80] Although most physician ratings are positive,[71,81,82] there have been reports of ratings sabotage (ie, fabricated negative reviews) by competing professionals or disgruntled patients.[81] Given the anonymity of many reviews, such a situation may be difficult to remedy.[83]

Responding thoughtfully and positively to critical reviews can be helpful. Physicians must remember that patients can post whatever they want about a situation, but the physician remains bound by confidentiality obligations. Responses must always be generalized, not specific to an individual. It is important to recall that HIPAA regulations prevent physicians from disclosing any protected health information about the patient, including acknowledging that the person is or was a physician's patient.

Unfair or potentially fabricated reviews can be reported to the rating Web site or, depending on one's work context, to the public relations division of one's employer. Another solution can be to optimize search engine results so that one's own practice site comes up first, before any potentially negative reviews. Encouraging more patients to review the practice online will likely provide a balanced and generally positive view.

The American Medical Association Code of Ethics not only mandates ethical behavior on the part of physicians but also requires physicians to report unprofessional behavior on the part of their peers.[56] This mandate extends to the unprofessional use of social media by other physicians. Difficulties inherent in such reporting, which include having to determine what content crosses the line and not wanting a colleague to get in trouble, may explain why few other codes include this requirement, although it is frequently included in social media guidelines written by hospitals, academic centers, and other health care employers.

Given these concerns, pediatric practices and other health care organizations may wish to formulate social media policies for their employees, which can clarify expectations, provide valuable tools and information, and ultimately protect patient confidentiality and privacy. These policies may also include expectations and standards for communicating with patients through social media, such as response time and documentation.[84]

Inappropriate Acquisition of Information via Social Media

As noted above, there may be instances in which social media can be used to obtain specific and relevant information about patients (such as the example of locating the family of a patient with amnesia through Facebook). This practice has become increasingly common. In one study, 1 of 6 pediatric trainees had conducted Internet or social media searches for more information about a patient, and a similar percentage of faculty believed they would do so if that might help in patient care.[85]

This practice could, however, expand to indiscriminate searches for information about patients.[86] So-called patient-targeted googling can be motivated by a genuine desire to understand more about one's patients and perhaps gauge their adherence to treatment plans. But it can also stem from "curiosity, voyeurism, and habit."[15]

Patient-targeted googling can generate 2 types of information, the first coming from the patient directly. Physicians may understandably be unsure how to use information gathered from social media sources.[54] For example, if an adolescent patient denies drinking alcohol but has posted on social media about drinking to excess, should the pediatrician confront the patient with this newfound information? To do so might compromise trust, but not doing so might preclude thoughtful intervention.

The other type of information patient-targeted googling may generate comes from third-party sources, ranging from news articles to posts from someone other than the patient. Such non–user-generated Internet content presents a different set of challenges. First, there is no guarantee that the information is accurate. Even if it is, acquiring knowledge about a patient that the patient did not directly provide (and may not be aware that the physician is in possession of) threatens to compromise trust. Uncertainty remains as to whether to reveal one's knowledge of this information to the patient, either to confirm its veracity or engage in discussion about its content.

Before pediatricians engage in patient-targeted googling, it is important to identify the information they are seeking to acquire and determine if it is of sufficient importance to justify such a search. Clinton et al[87] suggest 6 questions to consider before engaging in patient-targeted googling:

- "Why do I want to conduct this search?"
- "Would my search advance or compromise the treatment?"
- "Should I obtain informed consent from the patient prior to searching?"
- "Should I share the results of the search with the patient?"
- "Should I document the findings of the search in the medical record?"
- "How do I monitor my motivations and the ongoing risk-benefit profile for searching?"[87]

It is generally advisable to disclose any relevant patient information discovered through the Internet or social media to the patient so that everyone is working with the same set of facts. This disclosure is especially important before entering any information gleaned through that route into the patient record.[88]

CONCLUSIONS

Social media can be a useful tool in the practice of medicine by educating both physicians and patients, expanding access to health care, identifying high-risk behaviors, contributing to research, promoting networking and online support, enhancing advocacy, and nurturing professional compassion. At the same time, there are confidentiality, privacy, professionalism, and boundary issues that need to be considered whenever potential interactions occur between physicians and patients via social media. The following recommendations can help pediatricians use social media appropriately and effectively.

RECOMMENDATIONS

1. Pediatricians who choose to use social media should have separate personal and professional social media pages, with patients and their parents directed to the professional page.
2. A pediatrician's personal page should have adequate privacy settings to prevent unauthorized access. Professional pages should be set to prevent tagging.
3. It is wise to pause before posting, given that information posted online can exist in perpetuity and can be captured and redisseminated by viewers before it can be deleted.
4. Pediatricians should follow state and federal privacy and confidentiality laws as well as the social media policies of their health care organization and any professional society to which they belong.
5. Independent practitioners should develop social media policies for their practices to protect patients and clarify expectations. These policies should be in writing and widely distributed to all staff and clinicians. If restrictions on communicating with patients are in place in such policies, this should be shared with patients. Given advances in technology, these policies should be reviewed regularly and updated as needed.
6. Conflicts of interest, including in tweets, blog postings, and media appearances by pediatricians, should be disclosed.
7. Pediatricians should use a HIPAA-compliant secure site with encryption when communicating about health care or rendering advice directly to patients or families. Individually identifiable protected health information should not be shared through social media without documented authorization from the patient or guardian.
8. Before posting on social media, protected health information should be deidentified (and clearly noted to be so) and presented respectfully.
9. Professional boundaries should be maintained in the use of social media. Accepting (and certainly initiating) friend requests from current patients is discouraged. It is up to the pediatrician's discretion whether to accept such requests from former patients. It may be appropriate to accept a friend request from a patient's parent if the physician's relationship to that person extends beyond the clinical environment.
10. Searching for patient information through the Internet or social media should have a specific purpose with clear clinical relevance. Any information obtained through this route should be shared directly with the patient to maximize transparency and before recording any such information in the patient's chart.
11. Pediatricians should monitor their online profile to protect against inaccurate postings. Negative online reviews warrant a thoughtful response that honors confidentiality requirements, including the fact that the reviewer is or was the physician's patient.
12. Pediatricians should recognize that providing specific medical advice to an individual through social media may create a physician-patient relationship that may have documentation, follow-up, state licensing, and liability implications.

LEAD AUTHORS

Robert Macauley, MD, FAAP
Nanette Elster, JD, MPH
Jonathan M. Fanaroff, MD, JD, FAAP

COMMITTEE ON BIOETHICS, 2019–2020

Robert Macauley, MD, FAAP, Chairperson
Ratna Basak, MD, FAAP
Gina Marie Geis, MD, FAAP
Naomi Tricot Laventhal, MD, FAAP
Douglas J. Opel, MD, MPH, FAAP
Mindy B. Statter, MD, FAAP

LIAISONS

Mary Lynn Dell, MD, DMin – *American Academy of Child and Adolescent Psychiatry*
Douglas S. Diekema, MD, MPH, FAAP – *American Board of Pediatrics*
David Shalowitz, MD – *American College of Obstetricians and Gynecologists*
Nanette Elster, JD, MPH – *Legal Consultant*

STAFF

Florence Rivera, MPH

ABBREVIATIONS

AAP: American Academy of Pediatrics
HIPAA: Health Insurance Portability and Accountability Act

PEDIATRICS (ISSN Numbers: Print, 0031-4005; Online, 1098-4275).

FINANCIAL DISCLOSURE: The authors have indicated they have no financial relationships relevant to this article to disclose.

FUNDING: No external funding.

POTENTIAL CONFLICT OF INTEREST: The authors have indicated they have no potential conflicts of interest to disclose.

REFERENCES

1. Parikh SM, Liu E, White CB. Connectivity need not come at the expense of professionalism. *Acad Med*. 2010;85(6):930
2. Statista. Internet usage in the United States - statistics & facts. 2018. Available at: https://www.statista.com/topics/2237/internet-usage-in-the-united-states/. Accessed February 14, 2019
3. Statista. E-mail usage penetration in the United States from 2013 to 2019. 2019. Available at: https://www.statista.com/statistics/462159/usa-email-usage-reach/. Accessed February 14, 2019
4. Obar JA, Wildman S. Social media definition and the governance challenge: an introduction to the special issue. *Telecomm Policy*. 2015;39(9):745–750
5. Boyd DM, Ellison NB. Social network sites: definition, history, and scholarship. *J Comput Mediat Commun*. 2007;13(1):210–230
6. Spooner SA; Council on Clinical Information Technology, American Academy of Pediatrics. Special requirements of electronic health record systems in pediatrics. *Pediatrics*. 2007;119(3):631–637
7. Bosslet GT, Torke AM, Hickman SE, Terry CL, Helft PR. The patient-doctor relationship and online social networks: results of a national survey. *J Gen Intern Med*. 2011;26(10):1168–1174
8. Pew Internet Project. Social media fact sheet. 2019. Available at: www.pewinternet.org/fact-sheets/social-networking-fact-sheet. Accessed October 16, 2016
9. Lenhart A. Mobile access shifts social media use and other online activities. 2015. Available at: https://www.pewresearch.org/internet/2015/04/09/mobile-access-shifts-social-media-use-and-other-online-activities/. Accessed January 20, 2021
10. Smith A, Anderson M. Social media use in 2018. 2018. Available at: www.pewinternet.org/2018/03/01/social-media-use-in-2018/. Accessed February 18, 2019
11. American Osteopathic Association. Survey finds patients want to be friends with their physicians on social media. 2018. Available at: https://osteopathic.org/2018/05/14/survey-finds-patients-want-to-be-friends-with-their-physicians-on-social-media/. Accessed May 17, 2019
12. Fisher J, Clayton M. Who gives a tweet: assessing patients' interest in the use of social media for health care. *Worldviews Evid Based Nurs*. 2012;9(2):100–108
13. Prensky M. *Teaching Digital Natives: Partnering for Real Learning*. Thousand Oaks, CA: Corwin Press; 2010
14. Margaryan A, Littlejohn A, Vojt G. Are digital natives a myth or reality? University students' use of digital technologies. *Comput Educ*. 2011;56(2):429–440
15. Federation of State Medical Boards. *Model Guidelines for the Appropriate Use of Social Media and Social Networking in Medical Practice*. Washington, DC: Federation of State Medical Boards; 2012
16. Parsi KP, Elster N. Why can't we be friends? A case-based analysis of ethical issues with social media in health care. *AMA J Ethics*. 2015;17(11):1009–1018
17. American Academy of Pediatrics. Tweetiatricans. 2019. Available at: https://twitter.com/AmerAcadPeds/lists/tweetiatricians. Accessed February 15, 2019
18. Modahl M, Tompsett L, Moorhead T. *Doctors, Patients, and Social Media*. Waltham, MA: QuantiaMD; 2011
19. Hillman T, Sherbino J. Social media in medical education: a new pedagogical paradigm? *Postgrad Med J*. 2015;91(1080):544–545
20. Fox S. Health information is a popular pursuit online. 2011. Available at: https://www.pewresearch.org/internet/2011/02/01/health-information-is-a-popular-pursuit-online/. Accessed January 20, 2021
21. ReferralMD. 24 outstanding statistics & figures on how social media has impacted the health care industry. 2017. Available at: https://getreferralmd.com/2013/09/healthcare-

social-media-statistics/. Accessed August 17, 2017

22. Eysenbach G. From intermediation to disintermediation and apomediation: new models for consumers to access and assess the credibility of health information in the age of Web2.0. *Stud Health Technol Inform*. 2007;129(pt 1): 162–166

23. Anderson M, Toor S, Rainie L, Smith A. Public attitudes toward political engagement on social media. 2018. Available at: www.pewinternet.org/2018/07/11/public-attitudes-toward-political-engagement-on-social-media/. Accessed February 14, 2019

24. Lucas R. New reports detail expansive Russia disinformation scheme targeting US. 2018. Available at: https://www.npr.org/2018/12/17/677390345/new-reports-detail-expansive-russia-disinformation-scheme-targeting-u-s. Accessed February 18, 2019

25. Burki T. Vaccine misinformation and social media. *Lancet Digital Health*. 2019;1(6):e258-e259. Available at: https://www.thelancet.com/journals/landig/article/PIIS2589-7500(19)30136-0/fulltext. Accessed January 20, 20212589-7500

26. Shore R, Halsey J, Shah K, Crigger BJ, Douglas SP; AMA Council on Ethical and Judicial Affairs (CEJA). Report of the AMA Council on Ethical and Judicial Affairs: professionalism in the use of social media. *J Clin Ethics*. 2011;22(2): 165–172

27. Healy M, Molina B. New Facebook feature encourages organ donation. *USA Today*. May 1, 2012. Available at: http://rss.tmsfeatures.com/websvc-bin/rss_story_read.cgi?resid=201205012045GANNETT_GANNETTN_New-Facebook-feature-encourages-organ-donation. Accessed January 20, 2021

28. Fox S. Peer-to-peer healthcare. 2011 Available at: https://www.pewresearch.org/internet/2011/05/12/peer-to-peer-healthcare-2/. Accessed January 20, 2021

29. PatientsLikeMe. Patients like me. 2019. Available at: https://www.patientslikeme.com/. Accessed February 15, 2019

30. Smart Patients. Smart patients. 2019. Available at: https://www.smartpatients.com/. Accessed February 15, 2019

31. Improve Care Now. Improve care now. 2019. Available at: https://www.improvecarenow.org/. Accessed February 15, 2019

32. Greene JA, Choudhry NK, Kilabuk E, Shrank WH. Online social networking by patients with diabetes: a qualitative evaluation of communication with Facebook. *J Gen Intern Med*. 2011;26(3): 287–292

33. Pagoto S. Refer patients to Twitter for weight loss. 2012. Available at: www.kevinmd.com/blog/2012/03/refer-patients-twitter-weight-loss. Accessed October 16, 2016

34. Fox S. The social life of health information. 2014. Available at: https://www.pewresearch.org/fact-tank/2014/01/15/the-social-life-of-health-information/. Accessed January 20, 2021

35. Mnookin S. One of a kind: what do you do if your child has a condition that is new to science? *The New Yorker*. July 14, 2014. Available at: https://www.newyorker.com/magazine/2014/07/21/one-of-a-kind-2. Accessed January 20, 2021

36. Wazny K, Chan KY; Crowdsourcing CHNRI Collaborators. Identifying potential uses of crowdsourcing in global health, conflict, and humanitarian settings: an adapted CHNRI (Child Health and Nutrition Initiative) exercise. *J Glob Health*. 2018;8(2):020704

37. Garcia-Romero MT, Prado F, Dominguez-Cherit J, Hojyo-Tomomka MT, Arenas R. Teledermatology via a social networking web site: a pilot study between a general hospital and a rural clinic. *Telemed J E Health*. 2011;17(8): 652–655

38. Gelinas L, Pierce R, Winkler S, Cohen IG, Lynch HF, Bierer BE. Using social media as a research recruitment tool: ethical issues and recommendations. *Am J Bioeth*. 2017;17(3):3–14

39. Powell GE, Seifert HA, Reblin T, et al. Social media listening for routine post-marketing safety surveillance. *Drug Saf*. 2016;39(5):443–454

40. Swirsky ES, Hoop JG, Labott S. Using social media in research: new ethics for a new meme? *Am J Bioeth*. 2014; 14(10):60–61

41. People v Harris, 36 Misc 3d 868 (NY City Crim Ct 2012)

42. O'Keeffe GS, Clarke-Pearson K; Council on Communications and Media. The impact of social media on children, adolescents, and families. *Pediatrics*. 2011;127(4):800–804

43. Selkie EM, Benson M, Moreno M. Adolescents' views regarding uses of social networking websites and text messaging for adolescent sexual health education. *Am J Health Educ*. 2011; 42(4):205–212

44. Vyas AN, Landry M, Schnider M, Rojas AM, Wood SF. Public health interventions: reaching Latino adolescents via short message service and social media. *J Med Internet Res*. 2012;14(4):e99

45. Radovic A, Gmelin T, Stein BD, Miller E. Depressed adolescents' positive and negative use of social media. *J Adolesc*. 2017;55:5–15

46. Ben-Yakov M, Snider C. How Facebook saved our day!. *Acad Emerg Med*. 2011; 18(11):1217–1219

47. Johna S, Rahman S. Humanity before science: narrative medicine, clinical practice, and medical education. *Perm J*. 2011;15(4):92–94

48. Chretien KC, Greysen SR, Chretien JP, Kind T. Online posting of unprofessional content by medical students. *JAMA*. 2009;302(12):1309–1315

49. Hayter CR. Medicine's moment of misrule: the medical student show. *J Med Humanit*. 2006;27(4):215–229

50. Pow H. Doctors caught revealing secret patient information in Facebook posts. 2010. Available at: https://www.news.com.au/technology/doctors-caught-revealing-secret-information-on-facebook/news-story/879b335aa08ba13d8a1a0a7b9decf7a4. Accessed January 20, 2021

51. Yoder v University of Louisville, 526 F. App'x 537 (6th Cir 2013)

52. Northwestern University Feinberg School of Medicine Office of Communications. Social media guidelines. Available at: https://www.feinberg.northwestern.edu/communications/guidelines/social-media.html. Accessed January 20, 2021

53. Chretien KC, Farnan JM, Greysen SR, Kind T. To friend or not to friend? Social networking and faculty perceptions of online professionalism. *Acad Med*. 2011; 86(12):1545–1550

54. Kind T, Greysen SR, Chretien KC. Pediatric clerkship directors' social networking use and perceptions of online professionalism. *Acad Pediatr*. 2012;12(2):142–148

55. Gabbard GO, Kassaw KA, Perez-Garcia G. Professional boundaries in the era of the Internet. *Acad Psychiatry*. 2011; 35(3):168–174

56. American Medical Association. *Code of Medical Ethics: Current Opinions with Annotations*, 2002–2003 ed ed. Chicago, IL: American Medical Association Press; 2012

57. Greysen SR, Kind T, Chretien KC. Online professionalism and the mirror of social media. *J Gen Intern Med*. 2010; 25(11):1227–1229

58. Chretien KC, Kind T. Social media and clinical care: ethical, professional, and social implications. *Circulation*. 2013; 127(13):1413–1421

59. Valencia N, Fernandez B, Deaton J. Photos of drinking, grinning aid mission doctors cause uproar. *CNN*. February 3, 2010. Available at: www.cnn.com/2010/WORLD/americas/01/29/haiti.puerto.rico.doctors/. Accessed October 16, 2016

60. Vartabedian B. Unprofessional physician behavior on Twitter. 2011. Available at: https://33charts.com/unprofessional-physician-behavior-twitter/. Accessed October 16, 2016

61. Kitsis EA, Milan FB, Cohen HW, et al. Who's misbehaving? Perceptions of unprofessional social media use by medical students and faculty. *BMC Med Educ*. 2016;16:67

62. Du W. Job candidates getting tripped up by Facebook. 2007. Available at: www.nbcnews.com/id/20202935/ns/business-school_inc_/t/job-candidates-getting-tripped-facebook/#.WaRnF8iGM2w. Accessed August 27, 2017

63. Thompson LA, Dawson K, Ferdig R, et al. The intersection of online social networking with medical professionalism. *J Gen Intern Med*. 2008;23(7):954–957

64. Cabrera D, Vartabedian BS, Spinner RJ, Jordan BL, Aase LA, Timimi FK. More than likes and tweets: creating social media portfolios for academic promotion and tenure. *J Grad Med Educ*. 2017;9(4):421–425

65. Campbell D. Infatuated patients use Facebook to stalk doctors. *The Guardian*. October 27, 2012. Available at: https://www.theguardian.com/society/2012/oct/28/lovesick-patients-stalk-doctors-online. Accessed January 20, 2021

66. Facebook. Data policy. Available at: https://www.facebook.com/policy.php. Accessed October 16, 2016

67. Lee JL, Choudhry NK, Wu AW, Matlin OS, Brennan TA, Shrank WH. Patient use of email, Facebook, and physician websites to communicate with physicians: a national online survey of retail pharmacy users. *J Gen Intern Med*. 2016;31(1):45–51

68. Guseh JS II, Brendel RW, Brendel DH. Medical professionalism in the age of online social networking. *J Med Ethics*. 2009;35(9):584–586

69. Farnan JM, Snyder Sulmasy L, Worster BK, Chaudhry HJ, Rhyne JA, Arora VM; American College of Physicians Ethics, Professionalism and Human Rights Committee; American College of Physicians Council of Associates; Federation of State Medical Boards Special Committee on Ethics and Professionalism*. Online medical professionalism: patient and public relationships: policy statement from the American College of Physicians and the Federation of State Medical Boards. *Ann Intern Med*. 2013;158(8):620–627

70. British Medical Association. *Using Social Media: Practical and Ethical Guidance for Doctors and Medical Students*. London, United Kingdom: British Medical Association; 2011

71. American College of Obstetricians and Gynecologists. *Professional Use of Digital and Social Media*. Washington, DC: American College of Obstetricians and Gynecologists; 2015

72. Federation of State Medical Boards. *Model Guidelines for the Appropriate Use of the Internet in Medical Practice*. Washington, DC: Federation of State Medical Boards; 2002

73. Lagu T, Kaufman EJ, Asch DA, Armstrong K. Content of weblogs written by health professionals. *J Gen Intern Med*. 2008; 23(10):1642–1646

74. Chretien KC, Azar J, Kind T. Physicians on Twitter. *JAMA*. 2011;305(6):566–568

75. Federal Trade Commission. FTC staff reminds influencers and brands to clearly disclose relationship. 2017. Available at: https://www.ftc.gov/news-events/press-releases/2017/04/ftc-staff-reminds-influencers-brands-clearly-disclose. Accessed February 15, 2019

76. Health Insurance Portability and Accountability Act, 45 CFR §160.103 (1996)

77. Boston.com. RI doctor reprimanded over Facebook post. 2011. Available at: http://archive.boston.com/news/local/rhode_island/articles/2011/04/18/ri_doctor_reprimanded_over_facebook_post/. Accessed October 16, 2016

78. Stickney R. Hospital will fire workers in Facebook scandal. 2010. Available at: www.nbcsandiego.com/news/health/Hospital-Fires-Emps-in-Facebook-Scandal-95794764.html. Accessed October 16, 2016

79. Taylor HA, Kuwana E, Wilfond BS. Ethical implications of social media in health care research. *Am J Bioeth*. 2014; 14(10):58–59

80. Pho K, Gay S. *Establishing, Managing, and Protecting Your Online Reputation: A Social Media Guide for Physicians and Medical Practices*. Phoenix, MD: Greenbranch Publishing; 2013

81. Kadry B, Chu LF, Kadry B, Gammas D, Macario A. Analysis of 4999 online physician ratings indicates that most patients give physicians a favorable rating. *J Med Internet Res*. 2011;13(4): e95

82. Lagu T, Hannon NS, Rothberg MB, Lindenauer PK. Patients' evaluations of health care providers in the era of social networking: an analysis of physician-rating websites. *J Gen Intern Med*. 2010;25(9):942–946

83. American Medical Association. Negative online reviews leave doctors with little recourse. *American Medical News*. October 4, 2010. Available at: www.amednews.com/article/20101004/profession/310049938/5/. Accessed October 16, 2016

84. Lonzer J, Lonzer D, Medina M, Piedimonte G. Social media in pediatrics: a call for guidelines. *J Pediatr*. 2015;166(3):511–512

85. Jent JF, Eaton CK, Merrick MT, et al. The decision to access patient information from a social media site: what would you do? *J Adolesc Health*. 2011;49(4): 414–420

86. Warraich HJ. When doctors 'Google' their patients. *The New York Times*. January 6, 2014. Available at: https://well.blogs.nytimes.com/2014/01/06/when-doctors-google-their-patients-2/. Accessed January 20, 2021

87. Clinton BK, Silverman BC, Brendel DH. Patient-targeted googling: the ethics of searching online for patient information. *Harv Rev Psychiatry*. 2010; 18(2):103–112

88. National Association of Social Workers. Read the code of ethics. 2017. Available at: https://www.socialworkers.org/About/Ethics/Code-of-Ethics/Code-of-Ethics-English. Accessed July 9, 2019

Half Century Since SIDS: A Reappraisal of Terminology

- *Clinical Report*

CLINICAL REPORT Guidance for the Clinician in Rendering Pediatric Care

American Academy of Pediatrics
DEDICATED TO THE HEALTH OF ALL CHILDREN™

Half Century Since SIDS: A Reappraisal of Terminology

Carrie K. Shapiro-Mendoza, PhD, MPH,[a] Vincent J. Palusci, MD, MS, FAAP,[b] Benjamin Hoffman, MD, FAAP,[c] Erich Batra, MD, FAAP,[d] Marc Yester, MD, FAAP,[e] Tracey S. Corey, MD,[f] Mary Ann Sens, MD, PhD[g]
AAP TASK FORCE ON SUDDEN INFANT DEATH SYNDROME, COUNCIL ON CHILD ABUSE AND NEGLECT, COUNCIL ON INJURY, VIOLENCE, AND POISON PREVENTION, SECTION ON CHILD DEATH REVIEW AND PREVENTION, NATIONAL ASSOCIATION OF MEDICAL EXAMINERS

After a sudden infant death, parents and caregivers need accurate and open communication about why their infant died. Communicating tragic news about a child's death to families and caregivers is difficult. Shared and consistent terminology is essential for pediatricians, other physicians, and nonphysician clinicians to improve communication with families and among themselves. When families do not have complete information about why their child died, pediatricians will not be able to support them through the process and make appropriate referrals for pediatric specialty and mental health care. Families can only speculate about the cause and may blame themselves or others for the infant's death. The terminology used to describe infant deaths that occur suddenly and unexpectedly includes an assortment of terms that vary across and among pediatrician, other physician, or nonphysician clinician disciplines. Having consistent terminology is critical to improve the understanding of the etiology, pathophysiology, and epidemiology of these deaths and communicate with families. A lack of consistent terminology also makes it difficult to reliably monitor trends in mortality and hampers the ability to develop effective interventions. This report describes the history of sudden infant death terminology and summarizes the debate over the terminology and the resulting diagnostic shift of these deaths. This information is to assist pediatricians, other physicians, and nonphysician clinicians in caring for families during this difficult time. The importance of consistent terminology is outlined, followed by a summary of progress toward consensus. Recommendations for pediatricians, other physicians, and nonphysician clinicians are proposed.

BACKGROUND

Tremendous progress has been made since sudden infant death syndrome (SIDS) was first defined in 1969.[1] Substantial reductions in

abstract

[a]Division of Reproductive Health, Centers for Disease Control and Prevention, Atlanta, Georgia; [b]Department of Pediatrics, Grossman School of Medicine, New York University, New York, New York; [c]Department of Pediatrics, School of Medicine, Oregon Health & Science University, Portland, Oregon; [d]Departments of Pediatrics and Family and Community Medicine, College of Medicine, Pennsylvania State University, Hershey, Pennsylvania; [e]Department of Pediatrics, Children's Hospital of Pittsburgh, Pittsburgh, Pennsylvania; [f]Florida Districts 5 & 24 Medical Examiner's Office, Leesburg, Florida; and [g]Department of Pathology, School of Medicine and Health Sciences, University of North Dakota, Grand Forks, North Dakota

Dr Shapiro-Mendoza contributed to the concept and content of this clinical report and wrote the first draft and revised subsequent drafts with substantial input of all coauthors and reviewers; Drs Palusci, Hoffman, Batra, Yester, Corey, and Sens contributed to the concept and content of this clinical report; and all authors approved the final manuscript as submitted.

To cite: Shapiro-Mendoza CK, Palusci VJ, Hoffman B, et al. Half Century Since SIDS: A Reappraisal of Terminology. *Pediatrics*. 2021;148(4):e2021053746

sudden infant deaths have been largely attributable to the promotion of safe sleeping environments, especially supine sleep position.[2] Yet, every year in the United States, approximately 3500 infants still die suddenly and unexpectedly, and further declines in these deaths have slowed considerably since 1999.[3] Although death-scene evidence and witness accounts may help provide some clues about why and how deaths occur, these deaths are often unobserved or unwitnessed events, and the lack of standardized death-scene investigation and autopsy practices means that many remain a mystery.

To determine the cause and manner of a sudden unexpected infant death (SUID), a formal case investigation should be undertaken, examining medical, social, and other factors that might have played a role. Because there is no biological marker to conclusively diagnose suffocation, whether intentional or unintentional, information from the scene investigation, together with witnessed accounts of the events leading to the death, are critical for establishing cause. Without a thorough case investigation, child abuse, unsafe products and environments, and other threats to public health cannot be identified, and effective intervention strategies cannot be implemented.

Ideally, the investigation includes a scene investigation with caregiver and witness interviews, a doll reenactment, documentation and photographs describing the sleep environment and other environmental characteristics, a review of the child's clinical history, and a full postmortem examination and testing.[4–7] Information about the circumstances and events surrounding the death is dependent on the quality and depth of the death-scene investigation and documentation from first responders, law enforcement, medicolegal death investigators, and other health and social service providers. Standardized scene investigation[8] and autopsy protocol[9,10] guidance exists but is not followed universally.[11] In addition, many medical examiner and coroner offices lack sufficient training and resources to conduct thorough, consistent case investigations.[12] Even when sophisticated tools, such as genetic testing, are available, the extent that a neurologic condition or cardiac defect may have contributed to a SUID may not be known.[13–15] It is not often possible to determine if a specific condition or defect caused the death or whether the condition or defect was an unrelated finding.

Consider a common sudden death scenario: a healthy infant is placed to sleep in an adult bed with pillows and blankets, and an exhausted caregiver falls asleep next to the infant. The caregiver awakens hours later and finds the infant unresponsive and unable to be resuscitated. Although the infant was asleep in an unsafe sleep environment, the events leading to the death were unobserved. Evidence to substantiate that the infant was overlaid or the infant's airway had been obstructed by soft bedding is not available. There are no biological markers to differentiate suffocation from a possible natural cause.[4] If the cause of death cannot be determined after a thorough scene investigation, it will be considered a result of indeterminable cause.

What should these deaths be called? How should they be classified? The terminology used to classify these infant deaths varies among US death certifiers (medical examiners and coroners) and includes a variety of terms and acronyms, including undetermined, unexplained, and unknown cause as well as SIDS, SUID, and accidental suffocation or asphyxia in an unsafe sleeping environment.[16,17] This report describes the history of SIDS terminology and summarizes the debate over the terminology and its resulting diagnostic shift. The importance of consistent terminology is outlined, followed by a summary of progress toward consensus. Recommendations for pediatricians, other physicians, and nonphysician clinicians to facilitate consensus are proposed. Because terminology and clinical guidance for brief resolved unexplained events (formerly, apparent life-threatening events) was published by the American Academy of Pediatrics (AAP) in 2016, this subject is not addressed in this report.[18]

HISTORY OF SIDS TERMINOLOGY

SIDS was first coined and defined by Dr Bruce Beckwith in 1969.[1,19] Beckwith defined SIDS as "the sudden death of any infant or young child, which is unexpected by history, and in which a thorough post-mortem examination fails to demonstrate an adequate cause for death"[1] (Table 1). Sudden refers to the fact that death comes without warning, and unexpected means that there was no preexisting condition known that could have reasonably predicted it. When the definition was first introduced, it established a common term, focusing attention on this group of infant deaths, and helped to address the stigma associated with these deaths. The term SIDS and its definition were subsequently adopted internationally,[20,21] allowing researchers and policymakers to establish a scientific research agenda to explore its epidemiology and etiology. However, even with wide acceptance, SIDS remains a diagnosis of exclusion without clearly defined objective criteria. The use of the term SIDS and how it

TABLE 1 Selected Terminology and Definition or Criteria to Classify Unexplained Sudden Deaths in Infants and Accidental Asphyxiation

Terminology	Case Definition
Beckwith, 1969[1]	
Sudden Infant Death Syndrome (SIDS)	"The sudden death of any infant or young child, which is unexpected by history, and in which a thorough post-mortem examination fails to demonstrate an adequate cause for death."
Willinger et al, 1989[6]	
Sudden Infant Death Syndrome (SIDS)	"The sudden death of an infant under one year of age, which remains unexplained after a thorough case investigation, including performance of a complete autopsy, examination of the death scene, and review of the clinical history."
Undetermined or unexplained cause	"Cases that are autopsied and carefully investigated, but which remain unresolved may be designated as 'undetermined,' 'unexplained,' or the like. 'Unresolved' cases are those for which the history, investigation, or autopsy reveals information that places death outside the SIDS category but does not explain the cause of death. Examples of the latter, are suspected cases of abuse, neglect, or accidental suffocation; cases with episodes of vomiting or diarrhea in 24 hours prior to death without pathologic evidence of infection; or cases in which the information regarding death is not reliable."
Krous et al, 2004[5]	
General definition: Sudden Infant Death Syndrome (SIDS)	"Sudden unexpected death of an infant less than 1 year of age, with onset of the fatal episode apparently occurring during sleep, that remains unexplained after a thorough investigation, including performance of a complete autopsy and review of the circumstances of death and the clinical history."
Category IA SIDS: classic features of SIDS present and completely documented	"Infant deaths that meet the requirements of the general definition and also all of the following requirements. Clinical • More than 21 days and <9 months of age. • Normal clinical history, including term pregnancy (gestational age of ≥37 weeks). • Normal growth and development. • No similar deaths among siblings, close genetic relatives (uncles, aunts, or first-degree cousins), or other infants in the custody of the same caregiver. Circumstances of Death • Investigation of the various scenes where incidents leading to death might have occurred and determination that they do not provide an explanation for the death. • Found in a safe sleeping environment, with no evidence of accidental death. Autopsy • Absence of potentially fatal pathologic findings. Minor respiratory system inflammatory infiltrates are acceptable; intrathoracic petechial hemorrhage is a supportive but not obligatory or diagnostic finding. • No evidence of unexplained trauma, abuse, neglect, or unintentional injury. • No evidence of substantial thymic stress effect (thymic weight of <15 g and/or moderate/severe cortical lymphocyte depletion). Occasional 'starry sky' macrophages or minor cortical depletion is acceptable. • Negative results of toxicological, microbiologic, radiologic, vitreous chemistry, and metabolic screening studies."
Category IB SIDS: classic features of SIDS present but incompletely documented	"Infant deaths that meet the requirements of the general definition and also meet all of the criteria for category IA except that investigation of the various scenes where incidents leading to death might have occurred was not performed and/or 1 of the following analyses was not performed: toxicological, microbiologic, radiologic, vitreous chemistry, or metabolic screening studies."
Category II SIDS	"Infant deaths that meet category I criteria except for ≥1 of the following: Clinical • Age range outside that of category IA or IB (ie, 0–21 days or 270 days [9 months] through first birthday). • Similar deaths among siblings, close relatives, or other infants in the custody of the same caregiver that are not considered suspect for infanticide or recognized genetic disorders. • Neonatal or perinatal conditions (for example, those resulting from preterm birth) that have resolved by the time of death. Circumstances of Death • Mechanical asphyxia or suffocation caused by overlaying not determined with certainty. Autopsy

TABLE 1 Continued

Terminology	Case Definition
	• Abnormal growth and development not thought to have contributed to death. • Marked inflammatory changes or abnormalities not sufficient to be unequivocal causes of death."
Unclassified sudden infant death	"Infant deaths that do not meet the criteria for category I or II SIDS but for which alternative diagnoses of natural or unnatural conditions are equivocal, including cases for which autopsies were not performed."
Goldstein et al, 2019[15]	
Unexplained sudden death in infancy or Sudden Infant Death Syndrome	"The sudden unexpected death of an apparently healthy infant under one year of age that remains unexplained after a thorough case investigation, including performance of a complete autopsy with ancillary testing, examination of the death scene, and review of the clinical history." Special note: "Infant deaths with adequate death scene investigation and autopsy, with a history of bed/sleep surface sharing, soft bedding, or non-supine sleep, and without physical evidence of asphyxia, may be more appropriately certified as unexplained sudden death in infancy or sudden infant death syndrome."
Other ill-defined or unspecified causes of death (undetermined)	"The investigation, death scene examination, or autopsy was substantially limited, incomplete or insufficient (eg, legal/religious restrictions, delayed report of death that limits scene investigation, or decomposition)." Or "The investigation, death scene examination, or autopsy had inconsistent accounts or other findings raise competing conclusions about the cause of death."
Unintentional threat to breathing (accidental asphyxia): certification of asphyxia	"Adequate evidence must be documented to substantiate asphyxiation, given the decedent's age and stage of development. There cannot be a reasonable competing cause of death after a complete autopsy with ancillary testing, examination of the death scene (with a doll re-enactment when appropriate), and review of the clinical history. Bed/sleep surface sharing, soft bedding, or prone sleep, without adequate evidence for airway obstruction or chest wall compression, are insufficient to certify a death as due to asphyxia. These deaths may be more appropriately certified as unexplained sudden death or SIDS. The use of 'possible' or 'probable' asphyxia will result in the death being classified as asphyxia."
National Association of Medical Examiners Panel on Sudden Unexpected Death in Pediatrics, 2020[10,14]	
Unexplained sudden death (no identified intrinsic or extrinsic factors)	"Infant less than one year of age in apparent good health that dies suddenly and unexpectedly. • For Sleep-related Deaths: o Placed alone, supine, in infant-specific sleep environment (eg, crib, bassinet, portable crib, play pen) with flat, firm sleep surface, uncluttered by objects, and without potential areas of entrapment. o Found unresponsive or dead, in the same sleep environment, with no obstruction of the nose and/or mouth or compression of neck/chest to cause asphyxia given the developmental abilities of the infant, as described by finder and demonstrated by doll reenactment. • The infant was not overly dressed or bundled for the environmental temperature. • Competent caregiver not impaired by drugs or alcohol. • Physical findings on body and at scene consistent with history provided by caregiver. • Completion of scene investigation and doll reenactment unless caregiver declines. • Review of child medical records and family health history. • Complete autopsy with histology, comprehensive toxicology testing (including vitreous chemistries if possible), and skeletal survey. • No anatomic, metabolic, toxicological, chemical, historical, or external cause of death identified. Genetic testing is recommended but not required for this certification. • No extrinsic or intrinsic risk factors are identified."
Unexplained sudden death (intrinsic factors identified)[a]	• "A cause of death cannot be determined and criteria for Unexplained Sudden Death (No Identified Intrinsic or Extrinsic Factors) are not met due to o intrinsic/natural abnormalities that are either known risk factors for sudden death (including, but not limited to, low birth weight, preterm birth, small for gestational age, concurrent non-lethal illness, febrile seizures) o or are of unknown significance (including, but not limited, to mutations of unknown significance). • Trauma and other unnatural etiologies are sufficiently excluded."

TABLE 1 Continued

Terminology	Case Definition
Unexplained sudden death (extrinsic factors identified)[b]	"A cause of death cannot be determined and criteria for Unexplained Sudden Death (No Identified Intrinsic or Extrinsic Factors) are not met due to the presence of unintentional extrinsic factors that increase risk for unnatural death. This may include, but is not limited to, non-lethal injuries or injuries of unknown significance, nonlethal toxicological findings of unknown significance, or circumstances otherwise concerning for unnatural death."
Unexplained sudden death (intrinsic and extrinsic factors identified)[a,b]	"A cause of death cannot be determined and criteria for Unexplained Sudden Death (No Identified Intrinsic or Extrinsic Factors) are not met due to a combination of intrinsic and extrinsic factors as described above."
Undetermined (not further specified)	"A cause of death cannot be determined due to circumstances or findings that make the above classifications inapplicable. Examples may include: Inconsistent histories and/or other evidence that raise uncertainty about manner of death, and competing causes of death. Cases which remain undetermined but were not sudden."
Undetermined (insufficient data)	"A cause of death cannot be determined because investigation, death scene examination, or autopsy were substantially limited, incomplete, or insufficient. Examples may include legal/religious restrictions, delayed report of death that limits scene investigation, and/or decomposition."
Asphyxia	"The case must have a complete/full autopsy. Toxicology, histology, vitreous electrolytes, cultures, and review of medical history are to be performed, as necessary as determined by investigation and autopsy. The infant must have obstruction of both nose and mouth or compression of the neck or chest, that is reliably witnessed or demonstrated by doll reenactment, or other reliable evidence of overlay or entrapment. Asphyxiation must be probable given infant's age and stage of development. There cannot be a reasonable competing cause of death."

[a] "Intrinsic factors are: natural conditions or risk factors associated with abnormal physiology or anatomy that are concerning as contributors to death but are insufficient as a cause (eg, low birth weight, preterm birth, small for gestational age, concurrent non-lethal illness, history of febrile seizures), or natural conditions of unknown significance (eg, cardiac channelopathy or seizure gene variants of unknown significance)."

[b] "Extrinsic factors are: conditions in the child's immediate environment that are a potential threat to life but cannot be deemed the cause of death with reasonable certainty (eg, side or prone sleep if unable to roll to supine, over-bundling without documented hyperthermia, objects in immediate sleep environment, sleep environment not specifically designed for infant sleep, soft or excessive bedding, and sleep surface sharing), injuries or toxicologic findings that are either non-lethal or of unknown lethality, or circumstances/findings otherwise concerning for unnatural death."

should be labeled and defined are controversial and complex topics that remain debated.[16,17,19] Many classifications and definitions exist, but none have been accepted universally.[1,5,6,10,15,22–26]

In 1989, 20 years after SIDS was first defined, the National Institutes of Health (NIH) convened a multidisciplinary panel of 12 experts to update the original SIDS definition (Table 1).[6] The panel described SIDS as "the sudden death of an infant under one year of age, which remains unexplained after a thorough case investigation, including performance of a complete autopsy, examination of the death scene, and review of the clinical history" (Table 1). Although similar to the 1969 definition, the revised definition limited SIDS to infants younger than 1 year and required a review of the history and examination of the death scene. The explicit requirement of a scene investigation was in part because of the recognition of the investigation's value in identifying specific causes of death.[6,27] Ultimately, this requirement led to the 1996 creation and adoption of recommended standards on how to conduct a scene investigation for these infants, which included the Centers for Disease Control and Prevention's Sudden Unexplained Infant Death Investigation Reporting Form, investigation guidelines, and national training.[8,28]

In 2004, an international group of SIDS experts met in San Diego, California, to again refine the SIDS definition.[5] The expert group of 10 pediatric pathologists, forensic pathologists, and pediatricians included Dr Beckwith and was led by Dr Henry Krous. The group agreed on a revised general definition and series of subcategory definitions for sudden infant deaths (Table 1).[5] The revised definition, often referred to as the "San Diego definition," characterized SIDS as the "sudden unexpected death of an infant less than 1 year of age, with onset of the fatal episode apparently occurring during sleep, that remains unexplained after a thorough investigation, including performance of a complete autopsy and review of the circumstances of death and the clinical history." This revised definition, like previous iterations, emphasized that SIDS was a diagnosis of exclusion. New to the definition was identifying that these

deaths occurred during sleep. Furthermore, subcategories of sudden infant death were introduced: category IA SIDS (classic features of SIDS present and completely documented); category IB SIDS (classic features of SIDS present but incompletely documented); category II SIDS; and unclassified sudden infant death (Table 1). The unclassified sudden infant death category was intended to capture cases in which "alternative diagnoses of natural or unnatural conditions are equivocal, including cases for which autopsies were not performed." Of note, the 1989 NIH panel had similarly recommended that cases lacking a postmortem examination and that remained "unresolved" after a thorough case investigation be classified as undetermined or unexplained cause and not as SIDS.[6] Examples of unresolved cases were "suspected cases of abuse, neglect, or accidental suffocation; cases with episodes of vomiting or diarrhea in 24 hours before death without pathologic evidence of infection; or cases in which the information regarding death is not reliable."

TERMINOLOGY DEBATE

Even with periodic revisions and updates to the 1969 SIDS definition, vigorous debate continues regarding the labeling and classification of sudden unexplained infant deaths. SIDS is the favored term for many academic and clinical researchers because it was the term used most often in published etiologic and observational risk factor studies during the 1970s–1990s. However, in the US forensic medicine community, many medical examiners and coroners have discontinued using the term SIDS and often use other designations, such as undetermined cause, sudden unexplained infant death, and other terms that reflect a possible accidental suffocation in an unsafe sleep environment.[16] There is also disagreement among US medical examiners and coroners as to whether infant deaths meeting the SIDS definitions could constitute a "syndrome"[4,17]: a term that refers to a disease or condition with a common group of signs and symptoms.[5] These sudden deaths occur in apparently healthy infants with no identified medical conditions or disease; therefore, many argue against the use of the word syndrome.[5,17] Others argue that the term SIDS conveys a certainty of diagnosis, although the underlying cause of SIDS remains unknown.[5,17] Others believe that SIDS is a diagnosis of exclusion, and, although a natural or unnatural cause may or may not exist, the degree of uncertainty precludes a more definitive cause determination.[10,17]

Because there is no universally accepted standard procedure regarding classification of sudden infant deaths, variable terms and acronyms have been used in scientific, practice, and policy documents. Frequently used acronyms and terms include SIDS, SUID, "SUDI," unexplained, unexpected, and undetermined causes. SUID has become an umbrella term to describe sudden infant deaths, including those deaths previously called SIDS.[15,29,30] The "U" in SUID can refer either to unexpected or unexplained. SUID terms are frequently used interchangeably, often without careful reflection as to what the "U" signifies. In the United Kingdom, Europe, Australia, and New Zealand, "SUDI" is often used in place of SUID, referring to sudden unexpected death in infancy or sudden unexplained death in infancy. Most would agree, however, that before investigation, when an immediate cause is not obvious, deaths are both unexpected and unexplained. After investigation, the death is either explained or remains unexplained. Because these deaths commonly occur in an unsafe sleeping environment, they are increasingly referred to as sleep-related infant deaths. The AAP has acknowledged terms other than SIDS, including SUID and sleep-related infant deaths, in their clinical reports "SIDS and Other Sleep-Related Infant Deaths: Evidence Base for Updated 2016 Recommendations for a Safe Infant Sleeping Environment"[2] and "Identifying Child Abuse Fatalities During Infancy."[7]

For the forensic medicine community, evidence at the death scene may point to a possible asphyxiation caused by caregiver overlay or soft bedding, but the unobserved and unwitnessed nature of most of these deaths and lack of conclusive findings indicating a medical condition at autopsy can prevent the death certifier from attributing a specific cause. For example, some cases interpreted as SIDS may be an intentional smothering, but smothering, like drowning and many other asphyxia related conditions, may have no demonstrable findings at autopsy. Given this conundrum, some medical examiners and coroners may prefer to classify infant deaths occurring in an unsafe sleep environment as undetermined cause or possible or probable accidental asphyxiation in an unsafe sleep environment. Some medical examiners and coroners will be comfortable certifying these deaths as accidental suffocation or asphyxiation. Factors contributing to explained suffocation deaths, such as shared sleep surface and soft bedding in the sleep environments, are also risk factors for, but not necessarily causes of, SIDS.[4,31] Classification decisions may be influenced by office policies,[32] personal beliefs and biases,[33]

previous training,[4] and diagnostic preferences.[16]

DIAGNOSTIC SHIFT

Inconsistent reporting practices, lack of consensus on terminology, and changes in understanding why these deaths occurred have resulted in a diagnostic shift among medical examiners and coroners.[3,34,30] As previously noted, US death certifiers have moved away from reporting SIDS and toward reporting other designations, such as undetermined cause and accidental suffocation and strangulation in bed.[3,16] This diagnostic shift, which has also been observed in other countries such as New Zealand and Australia,[35,36] affects both surveillance and epidemiological and etiologic research. Importantly, for surveillance and research that rely on death certificate data, the diagnostic shift has resulted in variability in attribution of cause, making it difficult to accurately differentiate explained causes (ie, accidental suffocation and strangulation in bed) from unexplained causes (ie, SIDS and other undetermined causes). These explained and unexplained causes share risk factors, but the level of evidence used to determine the cause is inconsistent among death certifiers.[16]

The diagnostic shift and difficulty in differentiating causes of death is compounded by mortality coding rules in the *International Statistical Classification of Diseases and Related Health Problems* (ICD).[20,21] ICD codes are applied to cause-of-death determinations used to certify sudden infant deaths, but the codes applied do not always reflect the certifier's intent.[15,16] By law, the official cause of death for these cases must be determined and reported by the medicolegal death investigation system (ie, medical examiner) and not by the pediatrician. Codes in the *International Statistical Classification of Diseases and Related Health Problems*, *10th Revision*, (ICD-10)[21] differ from those in the *International Statistical Classification of Diseases and Related Health Problems*, *10th Revision*, *Clinical Modification*, (ICD-10-CM).[37] The *ICD-10-CM* was adapted from the *ICD-10* for classifying and reporting diseases and other morbidities in US health care settings. The *ICD-10*, not the *ICD-10-CM*, is used for official reporting of mortality statistics in the United States and other nations.

For mortality surveillance that relies on ICD coding from death certificates, it has become customary in the United States to group sudden infant death causes into 1 of 3 categories: SIDS (ICD-10 code R95), unknown or unspecified causes (ICD-10 code R99), and accidental suffocation and strangulation in bed (ICD-10 code W75). These 3 causes are included in the larger category called SUID.[3,29,30] This larger category allows for consistent monitoring of mortality trends and comparisons across jurisdictions and includes deaths from both explained (ie, accidental suffocation and strangulation in bed) and unexplained causes (ie, SIDS, unknown and unspecified causes). For research purposes, this categorization may be reasonable if the goal is to capture all SUIDs initially and then, after a careful examination and assessment, further categorize deaths to meet a study's case definition of an unexplained or explained cause.

IMPORTANCE OF CONSISTENT TERMINOLOGY

When an infant dies, shared and consistent terminology is essential to help pediatricians, other physicians, and nonphysician clinicians (eg, family physicians, obstetricians, nurses, social workers, and home visitors) improve communication with families and among themselves. A lack of consistent practices and consensus on terminology, including the use of acronyms, creates confusion for and possibly alienation of stakeholders and partners: including parents, caregivers, pediatricians, program prevention planners, and other medical and scientific professionals. The current use of inconsistent terminology can lead to communication errors and unnecessary misunderstandings. It can affect the development of public policies designed to reduce sleep-related infant deaths, including child product safety legislation and regulation focused on promoting safe sleep environments. Inconsistent terminology may also have unintended consequences for prevention messages and interventions for parents and caregivers. In addition, it can negatively affect the bereavement response and support being provided after a sudden infant death.

HOW TO SENSITIVELY COMMUNICATE WITH PARENTS

After an infant death, pediatricians, other physicians, and nonphysician clinicians (especially hospital-based physicians) are often the ones who first speak to grieving parents about possible causes of death. Shared consistent terminology during these interactions with families is necessary for effective communication. Pediatricians, other physicians, and nonphysician clinicians serving the infant's family members continue their support of families through counseling and assessment of surviving siblings for potential shared congenital or genetic conditions. Increasingly, they participate in multidisciplinary child death reviews, consult with forensic medical specialists, and help support families through the investigation process, providing resources and referrals after the death. These physicians and nonphysician clinicians, especially pediatricians,

are crucial and trusted sources of information for families and communities, facilitating the adoption of safe sleep practices and other strategies to reduce the risk of infant sleep-related deaths.[7]

It is important, when communicating with families after an infant death, to not assign blame to the family or incite feelings of guilt, while at the same time acknowledging potentially unsafe behaviors or hazards in the environment to effectively message how risks in the prenatal period or unsafe sleep practices may continue to pose a risk to surviving or subsequent children. The appropriate ethical medical professional response to every child death must be compassionate, empathic, supportive, and nonaccusatory, even if child abuse is suspected.

Concerns about unsafe sleep and bed-sharing as possible contributors to a child's death should be shared with parents as appropriate at some time during the investigation. Several resources have been developed to facilitate this sensitive communication. The AAP and others have identified key principles and resources to assist pediatricians, other physicians, and nonphysician clinicians and families during investigation. Recommendations for these discussions for families include saying things like "I am so sorry for your loss," "I am here to help," and "I have some resources that might be of help. They have been helpful to others." It is important for pediatricians, other physicians, and nonphysician clinicians to be truthful and sensitive, while sharing their willingness to help the family understand the death, the status of the investigation, and what steps, if any, should be taken to help surviving family members, including but not limited to evaluations for potential underlying conditions or referrals to pediatric specialists and mental health professionals.[38–45]

PROGRESS ON REACHING CONSENSUS

There are implications in reaching consensus on terminology to consider, including historical convention, uncertainty regarding circumstances at the time of death, geographical variations in practice, training of death-scene investigators and death certifiers, and caregiver guilt and shame. In addition, several perspectives must be addressed. First, it is essential for the forensic community and health care professionals to incorporate terminology that avoids placing blame or increasing feelings of guilt on the part of a caregiver suffering a tragic loss and objectively and accurately describes the circumstances around an infant's death. Second, the medical examiner or coroner needs to effectively communicate investigation and autopsy findings and explain why the conclusions about cause of death may be inconclusive. Third, the forensic, pediatric, and public health communities need consistent communication tools to allow them to acknowledge unsafe behaviors (eg, bed-sharing) or the presence of hazards in the environment (eg, crib bumpers or soft bedding) without assigning blame or inciting feelings of guilt. Finally, pediatricians, other physicians, and nonphysician clinicians must effectively message how risks identified in the prenatal period (eg, smoking and drinking during pregnancy) or unsafe sleep practices may continue to pose a risk to surviving children. The goal of this careful communication is to prevent from assigning blame or increasing feelings of guilt of any party. It is important that the facts and potential contributing factors to a death be fully shared. In sharing this information, it is important to provide accurate information regarding the deceased but also to identify and address any preventable risk factors for future children or circumstances.

Although there is agreement that all infant deaths are tragic events with precious lives lost, there is a need to consistently classify these sudden infant deaths for which the cause remains undetermined or unexplained. Consensus is also needed on how to classify accidental suffocation deaths that occur in an unsafe sleep environment: that is, what evidence is needed to classify a death as an explained suffocation in the absence of a biological marker to determine the cause. Current terminology and acronyms may exacerbate confusion. Consistency in describing these deaths should be a key goal. In 2017, a group of US experts came together to find common ground for classifying sudden infant deaths.[10] The group, the National Association of Medical Examiners (NAME) Panel on Sudden Unexpected Death in Pediatrics, included forensic pathologists representing NAME, pediatricians representing the AAP, and federal liaisons from the Centers for Disease Control and Prevention and NIH. In addition, in November 2018, an international expert panel (forensic pathologists, pediatricians, emergency physicians, family physicians, researchers, epidemiologists, and parents) met to discuss the terminology and nomenclature for sudden infant and child deaths at Radcliffe College, making ICD coding recommendations to the World Health Organization (WHO) for *International Statistical Classification of Diseases and Related Health Problems, 11th Revision* (*ICD-11*).[15] Many participants from the Radcliffe Congress meeting also participated in the NAME Panel. Both groups acknowledged that the forensic pathology experts had moved away

from calling these deaths "SIDS" and had rejected the idea that the etiology of these deaths satisfied the definition of a syndrome. Regardless, researchers at the Radcliffe meeting, many with 30 to 40 years of SIDS experience, still preferred the term "SIDS." Forensic pathologists at the Radcliffe Congress agreed with other participants that the title of the code in ICD-11 should include both unexplained sudden death in infancy and SIDS, to reflect that both certifications could be classified under the same code (Table 1). This recommendation was echoed by the NAME Panel in its 2019 publication.[10] In addition, the NAME Panel recommended that certifiers use "unexplained sudden death" (and not SIDS) and specify whether intrinsic and extrinsic risk factors (Table 1) were identified in the cause-of-death statement for unexplained sudden pediatric (infants <1 year and children 1 year old and older) deaths, including those that meet the current definition of SIDS (Table 1). Both groups also identified a set of criteria for determining accidental suffocation as a cause in sleep-related deaths.

PRACTICAL CONSIDERATIONS

The lack of consistency in how sudden infant deaths are categorized or described across the United States has created confusion and has had unintended consequences for bereaved families, pediatricians, other physicians, nonphysician clinicians, and policymakers. In addition, inaccurate and inconsistent classification of sudden infant deaths has affected our ability to: (1) reliably and accurately monitor mortality trends; (2) understand the pathophysiology and epidemiology of sudden infant deaths; and (3) develop effective data-driven public health and preventive messages.[3,10,15] It remains to be seen whether the WHO will accept the changes proposed by the Radcliffe Congress for ICD classification and coding of unexplained sudden deaths; as of August 2021, this proposal is under review. The *ICD-11* will officially go into effect among WHO member states in January 2022. It is also too early to determine to what extent the forensic community will adopt the NAME Panel's recommendations and use of the phrase "unexplained sudden death."

Because pediatricians, other physicians, and nonphysician clinicians are often the conduit of information between bereaved families and medical examiners, coroners, and death-scene investigators, it is important for these health care professionals to be cognizant of the terminology used and its implications to enable them to help families, review deaths, and prevent further fatalities. In response, the AAP recommends the following:

- Advocating for the rapid adoption of the NAME Panel's terminology because the terminology is definitive and positioned to aid surveillance monitoring activities and epidemiological analysis.[10,14] Increased understanding of mortality trends, etiology, and risk factors can inform effective interventions and guide future research, ultimately reducing future fatalities.
- If the proposal of the Radcliffe Congress for changing the ICD classification and coding of unexplained sudden deaths is approved by the WHO, encouraging adaption of ICD-11 coding by the United States and other WHO member states by January 2022.
- Advocating that state child protective service agencies use the NAME Panel's terminology in their assessments.
- NAME, in collaboration with the AAP, should develop an algorithm to lead a medical examiner, through consideration of the history, the findings at the scene, and possible intrinsic and extrinsic contributing factors, to the final adjudication of cause of death.
- Encouraging the medical examiner to have a formal reporting mechanism back to the primary care pediatrician, other physician, or nonphysician clinician. The pediatrician, other physician, or nonphysician clinician should, in turn, offer the family a chance to meet and review the findings of any investigation, including discussing possible contributing or confounding factors that may have played a role in the infant's death and possibly be used to prevent future deaths and providing any needed referrals for pediatric specialist or mental health care.
- Training for physicians, nonphysician clinicians, and the forensic community about effective communication practices that prioritize empathy and sensitivity in sudden infant death and all fatality investigations.
- Affirmation that when child abuse is eliminated, other risk factors such as sleeping environment, drug or alcohol use of caregivers, prenatal exposures, and poverty are matters of public health and family health. The mere presence of risk factors should not support legal charges.

LEAD AUTHORS

Carrie K. Shapiro-Mendoza, PhD, MPH
Vincent J. Palusci, MD, MS, FAAP
Benjamin Hoffman, MD, FAAP
Erich Batra, MD, FAAP
Marc Yester, MD, FAAP
Tracey S. Corey, MD
Mary Ann Sens, MD, PhD

AAP TASK FORCE ON SUDDEN INFANT DEATH SYNDROME

Rachel Y. Moon, MD, FAAP, Chairperson
Michael H. Goodstein, MD, FAAP
Elie Abu Jawdeh, MD, PhD, FAAP

Rebecca Carlin, MD, FAAP
Jeffrey Colvin, MD, JD, FAAP
Sunah Susan Hwang, MD, FAAP
Fern R. Hauck, MD, MS

CONSULTANTS AND LIAISONS

Elizabeth Bundock, MD, PhD – *National Association of Medical Examiners*
Lorena Kaplan, MPH – *Eunice Kennedy Shriver National Institute of Child Health and Human Development*
Sharyn E. Parks, PhD, MPH – *Centers for Disease Control and Prevention*
Marion Koso-Thomas, MD, MPH – *Eunice Kennedy Shriver National Institute of Child Health and Human Development*
Carrie K. Shapiro-Mendoza, PhD, MPH – *Centers for Disease Control and Prevention*

STAFF

Jim Couto, MA

AAP COUNCIL ON CHILD ABUSE AND NEGLECT EXECUTIVE COMMITTEE, 2019–2020

Suzanne B. Haney, MD, MS, FAAP, Chairperson
Andrew P. Sirotnak, MD, FAAP, Immediate Past Chairperson
Andrea G. Asnes, MD, MSW, FAAP
CAPT Amy R. Gavril, MD, MSCI, FAAP
Rebecca Greenlee Girardet, MD, FAAP
Amanda Bird Hoffert Gilmartin, MD, FAAP
Nancy D. Heavilin, MD, FAAP
Antoinette Laskey, MD, MPH, MBP, FAAP
Stephen A. Messner, MD, FAAP
Bethany A. Mohr, MD, FAAP
Shalon Marie Nienow, MD, FAAP
Norell Rosado, MD, FAAP

LIAISONS

Heather C. Forkey, MD, FAAP – *Council on Foster Care, Adoption and Kinship Care*
Brooks Keeshin, MD, FAAP – *American Academy of Child and Adolescent Psychiatry*
Jennifer Matjasko, PhD – *Centers for Disease Control and Prevention*
Heather Edward, MD – *Section on Pediatric Trainees*
Elaine Stedt, MSW, ACSW – *Administration for Children, Youth and Families, Office on Child Abuse and Neglect*

STAFF

Müge Chavdar, MPH

AAP COUNCIL ON INJURY, VIOLENCE, AND POISON PREVENTION, 2019–2020

Benjamin Hoffman, MD, FAAP, Chairperson
Phyllis F. Agran, MD, MPH, FAAP
Michael Hirsh, MD, FAAP
Brian Johnston, MD, MPH, FAAP
Sadiqa Kendi, MD, CPST, FAAP
Lois K. Lee, MD, MPH, FAAP
Kathy Monroe, MD, FAAP
Judy Schaechter, MD, MBA, FAAP
Milton Tenenbein, MD, FAAP
Mark R. Zonfrillo, MD, MSCE, FAAP
Kyran Quinlan, MD, MPH, FAAP, Immediate Past Chairperson

LIAISONS

Lynne Janecek Haverkos, MD, MPH, FAAP – *National Institute of Child Health and Human Development*
Jonathan D. Midgett, PhD – *Consumer Product Safety Commission*
Bethany Miller, MSW, MEd – *Health Resources and Services Administration*
Judith Qualters, PhD, MPH – *Centers for Disease Control and Prevention*
Alexander W. (Sandy) Sinclair – *National Highway Traffic Safety Administration*
Richard Stanwick, MD, FAAP – *Canadian Pediatric Society*

STAFF

Bonnie Kozial

SECTION ON CHILD DEATH REVIEW AND PREVENTION, 2019–2020

Erich Batra, MD, FAAP, Chairperson
Kirsten A. Bechtel, MD, FAAP
Carol D. Berkowitz, MD, FAAP
Howard W. Needelman, MD, FAAP
Vincent J. Palusci, MD, MS, FAAP

LIAISON

Abby Collier, MS – *National Center for Fatality Review and Prevention*

STAFF

Bonnie Kozial

ABBREVIATIONS

AAP: American Academy of Pediatrics
ICD: *International Statistical Classification of Diseases and Related Health Problems*
ICD-10: *International Statistical Classification of Diseases and Related Health Problems, 10th Revision*
ICD-10-CM: *International Statistical Classification of Diseases and Related Health Problems, 10th Revision, Clinical Modification*
ICD-11: *International Statistical Classification of Diseases and Related Health Problems, 11th Revision*
NAME: National Association of Medical Examiners
NIH: National Institutes of Health
SIDS: sudden infant death syndrome
SUID: sudden unexpected infant death
WHO: World Health Organization

The findings and conclusions in this article are those of the authors and do not necessarily represent the official position of the Centers for Disease Control and Prevention.

DOI: https://doi.org/10.1542/peds.2021-053746

Address correspondence to Carrie K. Shapiro-Mendoza, PhD, MPH. E-mail: CShapiroMendoza@cdc.gov

PEDIATRICS (ISSN Numbers: Print, 0031-4005; Online, 1098-4275).

FINANCIAL DISCLOSURE: The authors have indicated they have no financial relationships relevant to this article to disclose.

FUNDING: No external funding.

POTENTIAL CONFLICT OF INTEREST: The authors have indicated they have no potential conflicts of interest to disclose.

REFERENCES

1. Beckwith JB. The sudden infant death syndrome. *Curr Probl Pediatr.* 1973;3(8):1–36
2. Moon RY; Task Force on Sudden Infant Death Syndrome. SIDS and other sleep-related infant deaths: evidence base for 2016 Updated Recommendations for a Safe Infant Sleeping Environment. *Pediatrics.* 2016;138(5):e20162940
3. Erck Lambert AB, Parks SE, Shapiro-Mendoza CK. National and state trends in sudden unexpected infant death: 1990-2015. *Pediatrics.* 2018;141(3):e20173519
4. Corey TS, Hanzlick R, Howard J, Nelson C, Krous H; NAME Ad Hoc Committee on Sudden Unexplained Infant Death. A functional approach to sudden unexplained infant deaths. *Am J Forensic Med Pathol.* 2007;28(3):271–277
5. Krous HF, Beckwith JB, Byard RW, et al. Sudden infant death syndrome and unclassified sudden infant deaths: a definitional and diagnostic approach. *Pediatrics.* 2004;114(1):234–238
6. Willinger M, James LS, Catz C. Defining the sudden infant death syndrome (SIDS): deliberations of an expert panel convened by the National Institute of Child Health and Human Development. *Pediatr Pathol.* 1991;11(5):677–684
7. Palusci VJ, Kay AJ, Batra E, et al; Council on Child Abuse and Neglect; Section on Child Death Review and Prevention; Task Force on Sudden Infant Death Syndrome; National Association of Medical Examiners. Identifying child abuse fatalities during infancy. *Pediatrics.* 2019;144(3):e20192076
8. Centers for Disease Control and Prevention. Sudden unexplained infant death investigation reporting form. Available at: www.cdc.gov/sids/SUIDIRF.htm. Accessed August 23, 2021
9. Krous HF. The International Standardised Autopsy Protocol for sudden unexpected infant death. In: Rognum TO, ed. *Sudden Infant Death Syndrome: New Trends in the Nineties.* Oslo, Norway: Scandinavian University Press; 1995:81–95
10. Bundock EA, Corey TS, eds. *Unexplained Pediatric Deaths: Investigation, Certification, and Family Needs.* San Diego, CA: Academic Forensic Pathology International; 2019
11. Erck Lambert AB, Parks SE, Camperlengo L, et al. Death scene investigation and autopsy practices in sudden unexpected infant deaths. *J Pediatr.* 2016;174:84–90.e1
12. Cottengim C, Parks S, Rhoda D, et al. Protocols, practices, and needs for investigating sudden unexpected infant deaths. *Forensic Sci Med Pathol.* 2020;16(1):91–98
13. Kaltman JR, Thompson PD, Lantos J, et al. Screening for sudden cardiac death in the young: report from a National Heart, Lung, and Blood Institute working group. *Circulation.* 2011;123(17):1911–1918
14. National Association of Medical Examiners Panel on Sudden Unexpected Death in Pediatrics. Key points for certification of unexplained infant deaths. Available at: https://sudpeds.com/wp-content/uploads/2020/02/SUDP-Keypoints-for-Infant-Certification_2.16.20.pdf. Accessed May 12, 2020
15. Goldstein RD, Blair PS, Sens MA, et al; 3rd International Congress on Sudden Infant and Child Death. Inconsistent classification of unexplained sudden deaths in infants and children hinders surveillance, prevention and research: recommendations from the 3rd International Congress on Sudden Infant and Child Death. *Forensic Sci Med Pathol.* 2019;15(4):622–628
16. Shapiro-Mendoza CK, Parks SE, Brustrom J, et al. Variations in cause-of-death determination for sudden unexpected infant deaths. *Pediatrics.* 2017;140(1):e20170087
17. Nashelsky MB, Pinckard JK. The death of SIDS. *Acad Forensic Pathol.* 2011;1(1):92–99
18. Tieder JS, Bonkowsky JL, Etzel RA, et al; Subcommittee on Apparent Life Threatening Events. Brief resolved unexplained events (formerly apparent life-threatening events) and evaluation of lower-risk infants: executive summary. *Pediatrics.* 2016;137(5):e20160591
19. Beckwith JB. Defining the sudden infant death syndrome. *Arch Pediatr Adolesc Med.* 2003;157(3):286–290
20. World Health Organization. *International Statistical Classification of Diseases and Related Health Problems, Ninth Revision.* Geneva, Switzerland: World Health Organization; 1979
21. World Health Organization. *International Statistical Classification of Diseases and Related Health Problems, Tenth Revision.* Geneva, Switzerland: World Health Organization; 1992
22. Fleming PJ, Blair PS, Sidebotham PD, Hayler T. Investigating sudden

unexpected deaths in infancy and childhood and caring for bereaved families: an integrated multiagency approach. *BMJ.* 2004;328(7435):331–334

23. Randall BB, Wadee SA, Sens MA, et al. A practical classification schema incorporating consideration of possible asphyxia in cases of sudden unexpected infant death. *Forensic Sci Med Pathol.* 2009;5(4):254–260
24. Blair PS, Byard RW, Fleming P. Proposal for an international classification of SUDI. *Scandinavian Journal of Forensic Science.* 2009;2009(1):6–9
25. Blair PS, Byard RW, Fleming PJ. Sudden unexpected death in infancy (SUDI): suggested classification and applications to facilitate research activity. *Forensic Sci Med Pathol.* 2012;8(3):312–315
26. Randall B, Donelan K, Koponen M, Sens MA, Krous HF. Application of a classification system focusing on potential asphyxia for cases of sudden unexpected infant death. *Forensic Sci Med Pathol.* 2012;8(1):34–39
27. Bass M, Kravath RE, Glass L. Death-scene investigation in sudden infant death. *N Engl J Med.* 1986;315(2):100–105
28. Camperlengo LT, Shapiro-Mendoza CK, Kim SY. Sudden infant death syndrome: diagnostic practices and investigative policies, 2004. *Am J Forensic Med Pathol.* 2012;33(3):197–201
29. Mathews TJ, MacDorman MF. Infant mortality statistics from the 2009 period linked birth/infant death data set. *Natl Vital Stat Rep.* 2013;61(8):1–27
30. Shapiro-Mendoza CK, Tomashek KM, Anderson RN, Wingo J. Recent national trends in sudden, unexpected infant deaths: more evidence supporting a change in classification or reporting. *Am J Epidemiol.* 2006;163(8):762–769
31. Shapiro-Mendoza CK, Kimball M, Tomashek KM, Anderson RN, Blanding S. US infant mortality trends attributable to accidental suffocation and strangulation in bed from 1984 through 2004: are rates increasing? *Pediatrics.* 2009;123(2):533–539
32. Pasquale-Styles MA, Regensburg M, Bao R. Sudden unexpected infant death certification in New York City: intra-agency guideline compliance and variables that may influence death certification. *Acad Forensic Pathol.* 2017;7(4):536–550
33. Randall B, Thompson P, Wilson A. Racial differences within subsets of sudden unexpected infant death (SUID) with an emphasis on asphyxia. *J Forensic Leg Med.* 2019;62:52–55
34. Malloy MH, MacDorman M. Changes in the classification of sudden unexpected infant deaths: United States, 1992-2001. *Pediatrics.* 2005;115(5):1247–1253
35. Shapiro-Mendoza CK, Parks S, Lambert AE, Camperlengo L, Cottengim C, Olson C. The epidemiology of sudden infant death syndrome and sudden unexpected infant deaths: diagnostic shift and other temporal changes. In: Duncan JR, Byard RW, eds. *SIDS Sudden Infant and Early Childhood Death: The Past, the Present and the Future.* Adelaide, Australia: University of Adelaide Press; 2018
36. Taylor BJ, Garstang J, Engelberts A, et al. International comparison of sudden unexpected death in infancy rates using a newly proposed set of cause-of-death codes. *Arch Dis Child.* 2015;100(11):1018–1023
37. National Center for Health Statistics. International classification of diseases, 10th revision, clinical modification (ICD-10-CM). Hyattsville, MD. Available at: https://www.cdc.gov/nchs/icd/icd10cm.htm. Accessed August 22, 2021
38. American Academy of Pediatrics Committee on Pediatric Emergency Medicine; American College of Emergency Physicians Pediatric Emergency Medicine Committee; Emergency Nurses Association Pediatric Committee. Death of a child in the emergency department. *Pediatrics.* 2014;134(1):198–201
39. Palusci VJ, Devinsky O, Drake SA, et al. Family needs and follow-up care after the sudden, unexpected death of a child. In Bundock EA, Corey TS, eds. *Unexplained Pediatric Deaths: Investigation, Certification, and Family Needs.* San Diego, CA: Academic Forensic Pathology International; 2019; 177–202
40. Levetown M; American Academy of Pediatrics Committee on Bioethics. Communicating with children and families: from everyday interactions to skill in conveying distressing information. *Pediatrics.* 2008;121(5). Available at: www.pediatrics.org/cgi/content/full/121/5/e1441
41. Wender E; Committee on Psychosocial Aspects of Child and Family Health. Supporting the family after the death of a child. *Pediatrics.* 2012;130(6):1164–1169
42. American Academy of Pediatrics Committee on Psychosocial Aspects of Child and Family Health. The pediatrician and childhood bereavement. *Pediatrics.* 2000;105(2):445–447
43. Scientific Working Group for Medicolegal Death Investigation. *Principles for Communicating with Next of Kin During Medicolegal Death Investigations.* Washington, DC: National Institute of Justice; 2012. Available at: http://swgmdi.org/images/nokguidelinesforcommunicationwithnok6.14.12%202.pdf. Accessed May 10, 2021
44. Garstang J, Griffiths F, Sidebotham P. Rigour and Rapport: a qualitative study of parents' and professionals' experiences of joint agency infant death investigation. *BMC Pediatr.* 2017;17(1):48
45. Bergeron J, Davis G, Denton J, Garland J, Wood J. *American Medical Association Guidelines for Communication Between Hospitals, Medical Examiners, and Next of Kin Following Unexplained or Unexpected Deaths in the Hospital.* Chicago, IL: American Medical Association; 2019

Health Disparities in Tobacco Use and Exposure: A Structural Competency Approach

• *Clinical Report*

CLINICAL REPORT Guidance for the Clinician in Rendering Pediatric Care

American Academy of Pediatrics

DEDICATED TO THE HEALTH OF ALL CHILDREN®

Health Disparities in Tobacco Use and Exposure: A Structural Competency Approach

Jyothi Marbin, MD, FAAP,[a] Sophie J. Balk, MD, FAAP,[b] Valerie Gribben, MD, FAAP,[a] Judith Groner, MD, FAAP,[c] SECTION ON TOBACCO CONTROL

abstract

Fourteen percent of US adults use tobacco products. Because many of those who use tobacco are parents and/or caregivers, children are disproportionately exposed to tobacco smoke. People who use tobacco products often become addicted to nicotine, resulting in tobacco dependence, a chronic, relapsing disease. Tobacco use and exposure are more likely to occur in vulnerable and marginalized groups, including those living in poverty. Although some view tobacco use as a personal choice, evidence suggests that structural forces play an important role in tobacco uptake, subsequent nicotine addiction, and perpetuation of use. Viewing tobacco use and tobacco dependence through a structural competency lens promotes recognition of the larger systemic forces perpetuating tobacco use, including deliberate targeting of groups by the tobacco industry, lack of enforcement of age-for-sale laws, inferior access to health insurance and health care, poor access to cessation resources, and economic stress. Each of these forces perpetuates tobacco initiation and use; in turn, tobacco use perpetuates the user's adverse health and economic conditions. Pediatricians are urged to view family tobacco use as a social determinant of health. In addition to screening adolescents for tobacco use and providing resources and treatment of tobacco dependence, pediatricians are encouraged to systematically screen children for secondhand smoke exposure and support family members who smoke with tobacco cessation. Additionally, pediatricians can address the structural issues perpetuating tobacco use by becoming involved in policy and advocacy initiatives.

[a]University of California, San Francisco, San Francisco, California; [b]Albert Einstein College of Medicine and Children's Hospital at Montefiore, Bronx, New York; and [c]College of Medicine, The Ohio State University and Nationwide Children's Hospital, Columbus, Ohio

Clinical reports from the American Academy of Pediatrics benefit from expertise and resources of liaisons and internal (AAP) and external reviewers. However, clinical reports from the American Academy of Pediatrics may not reflect the views of the liaisons or the organizations or government agencies that they represent.

Dr Marbin framed the overriding theme of the manuscript, conceptualized the manuscript, wrote a significant amount of content for the manuscript, and reviewed the manuscript; Drs Balk, Gribben, and Groner conceptualized the manuscript, wrote a significant amount of content for the manuscript, and reviewed the manuscript; and all authors approved the final manuscript as submitted.

The guidance in this report does not indicate an exclusive course of treatment or serve as a standard of medical care. Variations, taking into account individual circumstances, may be appropriate.

All clinical reports from the American Academy of Pediatrics automatically expire 5 years after publication unless reaffirmed, revised, or retired at or before that time.

DOI: https://doi.org/10.1542/peds.2020-040253

Address correspondence to Jyothi Marbin, MD, FAAP. E-mail: jyothi.marbin@ucsf.edu

PEDIATRICS (ISSN Numbers: Print, 0031-4005; Online, 1098-4275).

FINANCIAL DISCLOSURE: The authors have indicated they do have no financial relationships relevant to this article to disclose.

To cite: Marbin J, Balk SJ, Gribben V, et al.; AAP SECTION ON TOBACCO CONTROL. Health Disparities in Tobacco Use and Exposure: A Structural Competency Approach. *Pediatrics*. 2021;147(1):e2020040253

BACKGROUND

Tobacco use results in exposure to nicotine, a powerfully addictive substance, often leading to tobacco dependence. Tobacco dependence is considered a pediatric disease because most tobacco use and subsequent

addiction begin in adolescence.[1,2] Tobacco dependence is a chronic disease,[3] and users are prone to relapse and remission.[4] People who use tobacco suffer consequences, including disease and premature death. Their children suffer from the direct impact of parental tobacco use, including prenatal, secondhand smoke (SHS), and thirdhand smoke (THS) exposure, as well as the economic and social consequences of family tobacco use. Most tobacco users want to quit, and many make multiple quit attempts. People who smoke are more likely to quit when they receive treatment from clinicians.[4]

Although the overall use of combustible tobacco products is declining,[5] tobacco use and exposure continue to affect marginalized* populations disproportionately. These groups include people living in poverty, people suffering from mental illness, and people with lower educational attainment. Other groups are highlighted in Table 1. The consequences of tobacco use and exposure are more concentrated in people already more likely to face greater health and economic challenges.[6]

The same children who are exposed to SHS are exposed to THS, or the "residues left behind by smoking," which can include chemicals that "remain, react, re-emit, and/or are resuspended long after active smoking ends."[11] Children are uniquely exposed to THS because of home exposure, dermal uptake from crawling, and increased respiratory rates compared with adults. However, distinguishing health effects of THS from SHS is challenging. For the purpose of this clinical report, the term SHS exposure is used, understanding that this designation may refer to both SHS and THS.

Although combustible tobacco use has declined in the United States, electronic cigarette (e-cigarette), vaping, or Juuling usage has accelerated, reaching epidemic proportions among youth[12]; more than 20% of high school students now vape.[13] The American Academy of Pediatrics (AAP) policy statement "E-Cigarettes and Similar Devices" details the clear links between e-cigarette companies' coordinated, targeted advertising to youth and subsequent rapid increase in e-cigarette initiation among youth. That report also highlights research showing that adolescents and young adults who vape are 3.6 times more likely to progress to traditional cigarettes than those who never vaped, paving the way for new cycles of addiction.[14] Although it is clear that e-cigarette use is rapidly changing the landscape of tobacco use and nicotine addiction, a comprehensive review of disparities related to e-cigarette use is beyond the scope of this clinical report. This report will focus on disparities related to combustible tobacco, recognizing the need for a separate report on disparities related to e-cigarette uptake and use.

This report proposes interventions to reduce disparities in combustible tobacco use and exposure using a structural competency framework. Pediatricians treating children whose parents or other caregivers use tobacco (and adolescents using tobacco) are urged to offer consistent cessation advice and tobacco-dependence treatment. Parents who have a primary care provider should also be advised to seek additional counseling and support from that clinician. If caregivers are unable to stop smoking, pediatricians should advise maintaining smoke-free clothing, homes, and cars.[1] Pediatricians may feel frustrated when counseling patients and caregivers who continue to smoke despite discussions about cessation[15,16]; however, pediatricians who gain a deeper understanding of structural factors perpetuating tobacco dependence may be better able to help families break the cycle of tobacco use. Viewing family tobacco use as a social determinant of health (SDH), systematically screening for tobacco exposure, and offering tobacco-dependence treatment to caregivers who smoke are ways to overcome structural barriers to smoking cessation. Advocacy steps and policy changes are also recommended to address structural inequalities reinforcing tobacco use.

STRUCTURAL ISSUES PERPETUATING DISPARITIES IN TOBACCO USE

Why Use a Structural Competency Framework?

Although some see tobacco use as a personal choice among adult informed decision-makers, looking at tobacco use through a structural competency framework calls attention to the larger societal forces that lead people to use tobacco. The structural competency approach frames health inequities "in relation to the institutions and social conditions that determine health related resources" and is focused on structural changes to address upstream causes of health disparities.[17] The structural competency framework adds to the SDHs approach by acknowledging that social injustice and power dynamics underlie health inequity.[18] Although the structural competency approach is used in social work and public health, it may be a new paradigm for clinicians focused on the care of individual patients.

Many structural issues perpetuate tobacco initiation and use on both a global and domestic scale. The

* The authors use the term "marginalized" to include social groups that are intentionally excluded from mainstream society through social and political oppression. The authors recognize that it is the social processes (and not any characteristic intrinsic to the people themselves) that lead to health disparities.[104]

TABLE 1 Effects of Tobacco Use and Exposure on Marginalized Populations

High-risk Group[a]	Smoking Rate	Coexisting Challenges (Examples)	Comments
Black or African American people[7]	Black or African American people usually smoke fewer cigarettes and start smoking at older ages compared with white people.	Black or African American people are more likely to die of smoking-related diseases than are white people.	Black or African American children and adults are more likely to be exposed to SHS than other racial or ethnic groups.
Hispanic people[b]	Cigarette smoking prevalence generally is lower than for most other US racial or ethnic groups, but rates are significantly higher for men compared with women.	Acculturation plays a role: smoking prevalence is higher among Hispanic people born in the United States.	Current prevalence is higher among Puerto Rican adults compared with Cuban, Mexican, and Central or South American adults.
Immigrants and refugees[c]	Smoking rates among immigrants to the United States (especially female immigrants) generally are lower than rates in US populations.	Smokers from these groups have vulnerability compounded by economic disadvantage, preimmigration experiences, attitudes toward smoking, and sociocultural and/or language barriers influencing access to care, including smoking cessation.	Research is limited because studies have been focused mainly on Mexican, other Hispanic, and Asian populations. More research is needed to investigate tobacco exposure in these and other immigrant populations.
Incarcerated people[d]	Smoking prevalence is approximately 4 times higher in criminal justice populations than in the general population.	Characteristics often found in individuals who are incarcerated, (eg, history of substance abuse, mental illness, poverty, low educational attainment) also increase likelihood of tobacco use.	The United States has the highest rate in the world of incarcerating adults. People of racial and ethnic minority groups are disproportionately affected; Black men are incarcerated at higher rates than non-Hispanic white men and Hispanic men.
LGBTQ people[e]	Of lesbian, gay, and bisexual adults, 20.5% smoke cigarettes, versus 15.3% of straight adults; 30.7% of transgender individuals smoke.	Gay men have high rates of HPV infection; coupled with tobacco use, this increases risk for anal and/or other cancers; LGBTQ individuals are less likely to have health insurance, which may affect cessation treatment options.	The tobacco industry targets LGBTQ individuals.
American Indian people[f]	The American Indian population has the highest cigarette smoking rates compared with other US racial or ethnic groups.	More American Indian women smoke during the last 3 mo of pregnancy compared with all other groups.	Some American Indian populations use tobacco for religious, ceremonial, or medicinal reasons. It is important to distinguish traditional versus commercial use. In addition, casino smoke exposure is difficult to regulate because of jurisdictional issues on reservations.
People of low socioeconomic status[g]	Adults below the poverty level are approximately 2 times more likely to use cigarettes, cigars, and smokeless tobacco as adults who live at greater than twice the poverty level.	There are higher lung cancer rates in those living in poverty compared with affluent groups; there is also less access to health care; therefore, tobacco-related conditions are diagnosed at later stages.	Low-income neighborhoods have a higher concentration of tobacco retailers.
People with mental illness and substance use disorders[8]	Approximately 25% of US adults have some form of mental illness or substance use disorder; these adults consume approximately 40% of all cigarettes smoked by adults.	People with mental illness more likely to have stressful living conditions, have low annual household income, and have inferior access to health insurance, health care, and help with quitting.	The tobacco industry perpetuates idea that it is impossible for these individuals to stop smoking.
People living in Tobacco Nation[9]	Twenty-two percent of Tobacco Nation's adults smoke, compared with 15% of adults in the rest of the United States. Those in Tobacco Nation smoke many more cigarettes per capita annually (66.6 packs) than those in the rest of the United States (40.6 packs).	Residents of Tobacco Nation earn 20% less than those in the rest of the United States. There are 12% fewer doctors in Tobacco Nation, meaning that accessing primary care can be more challenging.	Compared with the rest of the country, Tobacco Nation has fewer smoke-free laws and tobacco-control policies, measures which have been proven to protect the public, deter youth smoking, and encourage cessation.
People living in rural communities[10]	The prevalence of cigarette smoking among US adults is highest among those living in rural areas (28.5%).	The health of people living in rural areas is affected by tobacco more than the health of those living in urban and metropolitan areas, in part because of socioeconomic factors and lack of health care options.	Adolescents in rural regions begin smoking cigarettes earlier in life. Thirty-five percent of children in rural areas live in a household where someone smokes.

HPV, human papillomavirus.

[a] These groups may not represent all of the high-risk groups. See text for other examples.

[b] Centers for Disease Control and Prevention. Burden of cigarette use in the U.S. Available at: https://www.cdc.gov/tobacco/campaign/tips/resources/data/cigarette-smoking-in-united-states.html#by_race. Accessed November 17, 2020.

[c] Bosdriesz JR, Lichthart N, Witvliet MI, Busschers WB, Stronks K, Kunst AE. Smoking prevalence among migrants in the US compared to the US-born and the population in countries of origin. *PLoS One.* 2013;8(3):e58654. Available at: https://www.ncbi.nlm.nih.gov/pmc/articles/PMC3592805/. Accessed November 17, 2020.

[d] Valera P, Reid A, Acuna N, Mackey D. The smoking behaviors of incarcerated smokers. *Health Psychol Open.* 2019;6(1):2055102918819930. Available at: https://www.ncbi.nlm.nih.gov/pmc/articles/PMC6328956/. Accessed November 17, 2020.

[e] Centers for Disease Control and Prevention. Lesbian, gay, bisexual, and transgender persons and tobacco use. Available at: https://www.cdc.gov/tobacco/disparities/lgbt/index.htm. Accessed November 17, 2020.

[f] Centers for Disease Control and Prevention. American Indians/Alaska Natives and tobacco use. Available at: https://www.cdc.gov/tobacco/disparities/american-indians/index.htm. Accessed November 17, 2020.

[g] Centers for Disease Control and Prevention. Cigarette smoking and tobacco use among people of low socioeconomic status. Available at: https://www.cdc.gov/tobacco/disparities/low-ses/index.htm. Accessed November 17, 2020.

tobacco industry aggressively targets vulnerable and marginalized groups, including children. People who smoke often have poor access to health insurance and health care, lack access to cessation resources, and live in poverty, all of which, in addition to other factors, perpetuate tobacco use and dependence. The lack of effective enforcement of age-for-sale laws means that too often youth have unregulated access to tobacco products.[19,20] Tobacco dependence and exposure reinforces existing health disparities, and these health disparities perpetuate tobacco dependence, creating a cycle of intergenerational tobacco dependence, poverty, and poor health (Fig 1). Pediatricians can continue to engage and support individuals in cessation attempts while also recognizing and addressing economic, social, and political structures that reinforce tobacco dependence and exposure. Adding a structural competency approach to individual clinical interventions will help pediatricians recognize and address some of the structural factors promoting tobacco dependence and will allow pediatricians to push back against a cycle of addiction and disadvantage that reinforces its use.

Structural Barriers: The Tobacco Industry

Targeting vulnerable populations is a well-established tactic used by the tobacco industry to recruit new smokers and maintain current smokers. Children, the most vulnerable group, have long been targeted and tasked to serve as "replacement smokers" by the tobacco industry.[21] The rapidly developing adolescent brain is uniquely susceptible to nicotine addiction,[22] and 90% of adults who smoke started smoking before 19 years of age,[23] thus giving tobacco companies great incentive to recruit youth smokers. Documents reveal that the tobacco industry has clearly recognized this opportunity. Philip Morris executives noted, "Today's teenager is tomorrow's potential customer..."[24] The 2014 US Surgeon General's report acknowledged that "the root cause of the smoking epidemic is evident: the tobacco industry aggressively markets and promotes lethal and addictive products, and continues to recruit youth and young adults as new consumers of these products."[2] Although tobacco companies deny intentional marketing to children, they continue to advertise tobacco in outlets designed to reach children.[25]

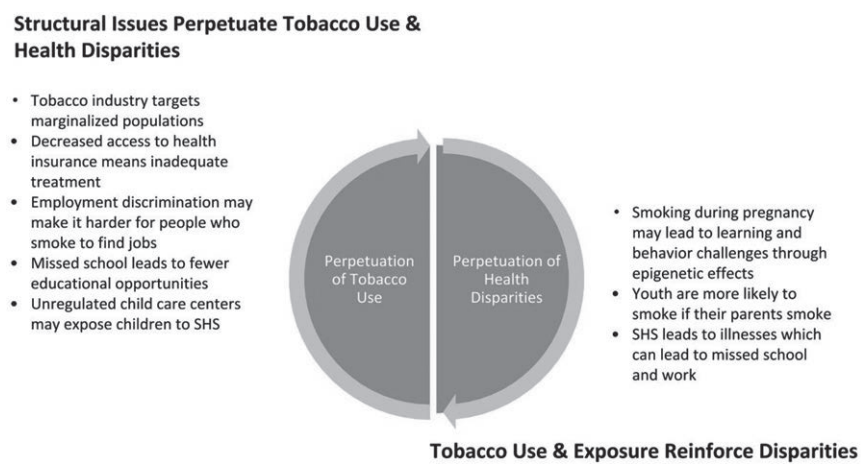


FIGURE 1
Tobacco use and exposure reinforce existing health disparities, and these health disparities perpetuate tobacco use.

Lesbian, gay, bisexual, transgender, and queer (LGBTQ) individuals are a focus of targeted campaigns, likely contributing to higher smoking rates compared with non-LGBTQ individuals. In 1992, a tobacco industry memo stated, "We see the gay community as an area of opportunity.… Philip Morris would be one of the first (if not the first) tobacco advertiser in this category and would thus 'own the market.'"[26] The tobacco industry subsequently began advertising in publications aimed at the LGBTQ community and financially supporting LGBTQ organizations.[27]

Black and African American youth and adults have been systematically targeted through advertisements, retailers, and promotion of menthol products. More tobacco advertisements are found in communities with a higher density of Black and African American residents. In these communities, Black and African American youth have been recruited to smoke through advertising and the distribution of free cigarette samples.[28] The proportion of Black and African American smokers who use menthol cigarettes increased from 5% in 1952 to 89% in 2011, likely because of aggressive racial targeting by the menthol cigarette industry. Between 1998 and 2002, *Ebony* magazine, a monthly publication with a large Black and African American readership, was nearly 10 times as likely to contain ads for menthol cigarettes as *People* magazine, which has a larger readership among white Americans.[29] This targeted advertising has contributed to nearly 90% of Black and African American smokers using menthol cigarettes, which are more addictive and more harmful than nonmenthol cigarettes.[7]

American Indian and Alaskan native people are also subject to predatory targeting by the tobacco industry. Tobacco companies exploit the federal exemptions that accompany

the unique sovereign status of tribal lands to increase their own economic profit, using tactics such as promotional coupons, price reductions, giveaways, and sponsorships.[30] Tobacco companies employ manipulative strategies to exploit sacred use of tobacco. For example, the Santa Fe Natural Tobacco Company, now owned by R.J. Reynolds, produced "an exclusive line of authentic reproductions of Native American pipes, snuff containers, tobacco pouches, and other natural tobacco implements."[31] These and other tactics are believed to contribute to the disproportionate burden of tobacco-related disease in Indigenous populations.[30]

Since the 1920s, women have been targeted through appealing tobacco advertising that gave them perceived psychosocial needs around weight loss, independence, stress relief, and the need to escape.[32] As smoking rates for increasingly educated women started to decrease, targeting of low-income women increased, with significant resources devoted to understanding the psychological profiles of potential customers.[32] R.J. Reynolds Tobacco Company attempted to distribute coupons for packs of cigarettes in envelopes with foods stamps. Coupons were for individual packs, not cartons, because "the lower-income groups tend to buy single packs."[32]

People living in rural areas are also at higher risk of smoking and tobacco-related disease. Rural adolescents start smoking earlier and are more likely to be daily smokers than adolescents living in nonrural areas. Young rural men have historically been targeted through tobacco advertisements featuring cowboys, hunters, and other "rugged images." Antitobacco media are less likely to reach youth living in rural areas.[10] This targeting contributes to higher rates of tobacco use and lower life expectancies in the 12 contiguous states collectively known as "Tobacco Nation"[9]: Alabama, Arkansas, Indiana, Kentucky, Louisiana, Michigan, Mississippi, Missouri, Ohio, Oklahoma, Tennessee, and West Virginia.

The industry also cultivated relationships with organizations working with people with mental illness and funded research to encourage the erroneous ideas that cessation is too stressful for people with mental illness and that people with mental illness need to self-medicate with nicotine to relieve negative moods.[8]

Tobacco companies use targeted marketing strategies because they are incredibly effective in recruiting smokers. As "big tobacco" and "big vaping" become increasingly entwined,[33] a resurgence of these advertising tactics aimed at attracting youth to e-cigarettes has been observed. Pediatricians need to be aware of this targeted advertising and its impact on vulnerable populations.[34]

Structural Barriers: Decreased Access to Insurance

Structural barriers maintain intergenerational smoking by reinforcing economic disparities and limiting access to tobacco-dependence treatment.

Access to health insurance is one example. In more than 40 states, people who smoke can be charged higher insurance rates than those who do not smoke[35]; in some states, these rates can be up to 25% higher than rates for nonsmokers.[36] People from marginalized groups are already much less likely to have health insurance; raising premiums for people who smoke makes health insurance even harder and more expensive to obtain. In a 2016 study, authors examined the impact of tobacco surcharges on insurance coverage and cessation among people who smoked and found that smokers were 7.3% less likely to have health insurance coverage than nonsmokers.[37] The authors also noted that "tobacco surcharges increased neither smoking cessation nor financial protection from high health care costs."[37] Without health insurance, tobacco users may have limited access to care for smoking-related illnesses as well as less access to tobacco-dependence treatment. The treatment they can access may be inadequate, for example, providing limited medication only for a limited period of time. Such regressive policies do little to treat nicotine addiction as a chronic illness; instead, they limit access to treatment for people who are addicted to nicotine.[36]

Life insurance is also more expensive for people who smoke,[38] which affects the ability of those who smoke, who have a higher mortality rate from numerous health problems, to provide financial security for their survivors, including minor children or grandchildren, in the event of their demise.

Structural Barriers: Employment Challenges

Discrimination in employment is another example of a structural barrier. Cross-sectional studies have consistently demonstrated an association between smoking and unemployment.[39] A 2006–2007 study of more than 52 000 construction workers found that those who smoked were more likely to be unemployed than those who did not smoke.[40] In one study of unemployed job seekers, people who smoke were found to be less likely to be reemployed after 1 year than those who did not smoke and were paid less when they were rehired.[39] The cost of hiring someone who smokes is estimated at nearly $6000 more than the cost of hiring a nonsmoker,[41] meaning that some employers simply refuse to hire people who smoke.[42] Those who are living in poverty, are unemployed, and have less formal education are more likely to use tobacco. Refusing to employ smokers

effectively restricts access to jobs and ensures that people who smoke remain at an economic disadvantage.[43]

Structural Barriers: Missing Work and School

Adding to the economic burden is hardship caused by missed work because of caregiver or child illness. Children are more likely to be absent from school if their caregiver smokes,[44] meaning caregivers may have to miss work to care for their sick child. The cost of missing work to care for a sick child can be high; caregivers lose an estimated $227 million per year caring for ill children,[44] which reinforces economic disparities. Repeated school absences can hinder a child's school performance[45] and, in the long-term, may influence career trajectory and earning potential.[44]

The cycle of health and economic disparities among people who use tobacco is self-perpetuating; adults who smoke who are unable to escape the cycle of addiction are more likely to have children who smoke,[46,47] giving rise to new generations addicted to nicotine and susceptible to these same economic hardships.

Structural Barriers: Exposure in Child Care Settings

For young children, out-of-home child care may represent a significant portion of their day and a source of exposure, particularly for parents who have low incomes, do not speak English, have lower educational levels, or are single parents. These families are more likely to use non–center-based care[48] and instead may rely on child care with less oversight, where children may be more likely to be exposed to SHS.

INTERGENERATIONAL FACTORS PERPETUATING DISPARITIES

Smoking Rates During Pregnancy Are Higher in Marginalized Groups

Smoking during pregnancy is a risk factor for perpetuating intergenerational health disparities. Data from the Pregnancy Risk Assessment Monitoring System reveal that although prevalence of maternal smoking during pregnancy declined significantly between 2000 and 2010,[49] differences in prevalence by race and/or ethnicity persist. In 2010, smoking during pregnancy was highest among American Indian women (26.0%), followed by non-Hispanic white women (14.3%), non-Hispanic Black women (8.9%), Hispanic women (3.4%), and Asian American and/or Pacific Islander women (2.1%).[49] Birth certificate data for 2014 reveal that, overall, approximately 8.4% of women smoked at any time during pregnancy. Higher smoking rates during pregnancy were observed in women with fewer than 12 years of education (14.1%), women with Medicaid coverage (14.0%), women between 20 and 24 years of age (13.0%), unmarried women (14.7%), and non-Hispanic American Indian women (18.0%).[50] Smoking during pregnancy is associated with maternal vulnerability: women who experienced intimate partner violence were more likely to smoke during pregnancy and less likely to stop smoking.[51]

Smoking During Pregnancy Perpetuates Disparities

A large body of literature describes links between smoking during pregnancy and short- and long-term health issues in offspring, including increased infant mortality, sudden unexpected infant death,[52] low birth weight, and respiratory problems. In addition to these detrimental outcomes of exposure to smoking in utero, epidemiological observational evidence links prenatal smoking to increased risks of obesity, behavioral problems, conduct disorder, attention-deficit/hyperactivity disorder (ADHD), and cognitive issues in children.[53–59] Recent research has revealed a dose-response relationship between maternal cotinine concentrations (indicating nicotine exposure) during pregnancy and presence of ADHD in children.[60] These associations remain even after controlling for confounding factors, such as maternal income and education and maternal and paternal ADHD diagnoses, and are linked to poor health and lower educational attainment. The research cited here has been conducted internationally (United States, Canada, and Europe), so it does not reflect a particular geographic confounding factor to explain the association between smoking during pregnancy and poor outcomes in children. Such pregnancy exposure can be said to perpetuate disparities because children with behavioral, conduct, and learning issues are likely to have a more difficult time throughout the life span. The potential mechanisms for adverse outcomes from prenatal smoking include direct effects of nicotine, carbon monoxide, and other tobacco toxicants on the developing fetal brain along with the potential for fetal adaptation to an adverse prenatal environment, potentially through epigenetic changes. Although epigenetic research is in the early stages,[61] smoking-related epigenetic modifications of gene transcription in specific cells may be mechanisms by which the effects of maternal smoking during pregnancy are transmitted to the next generation.[61,62] Further research will elucidate the epigenetic effects of prenatal smoking on alterations in neural circuitry during fetal development[62] and may help establish mechanisms of the relationships between prenatal smoking and poor behavioral and cognitive outcomes in children.

Women who stop smoking during pregnancy are at risk for relapse after birth, leading to SHS exposure in infants and children.[63] Relapse may also perpetuate the cycle of beginning the next pregnancy with fetal exposure to maternal smoking.

SHS Exposure and Childhood Disparities

Children's SHS exposure is a socioeconomic and educational disparity[4] that leads to differences in health outcomes. It can be difficult to separate effects of prenatal smoking and postnatal SHS exposure; several of these outcomes, including sleep problems (sleep-disordered breathing, sleep apnea, nighttime awakenings)[64–67] and sudden infant death syndrome,[68–70] are linked to both prenatal smoking and postnatal smoke exposure. Impaired sleep itself during childhood is linked to cognitive and behavior issues and poor quality of life.[71–75]

Children exposed to SHS are more likely to develop asthma, and their asthma is more severe than that in nonexposed children.[76–80] The prevalence and severity of bronchiolitis, acute otitis media, chronic otitis media, influenza, and preclinical cardiovascular changes[81–88] is linked to childhood SHS exposure. Smoke exposure in utero and during childhood sets children up for poorer physical and mental health throughout their lives, which leads to poor school performance and may affect future job success and earning potential.

Finally, parents who are addicted to tobacco may prioritize tobacco over food and other basic needs,[89–93] exacerbating negative health outcomes for children.

OFFICE-LEVEL INTERVENTIONS FOR PEDIATRICIANS

Pediatricians are well-positioned to help break the cycle of tobacco dependence at both the individual and structural levels. In this section, office-level interventions are described.

Screening for Tobacco Use and Exposure as SDHs

Tobacco use and exposure are SDHs that contribute to a more difficult future for already marginalized children, adolescents, and adults. Pediatricians have embraced screening and referral systems for other SDHs (eg, food insecurity, insurance access, mental health concerns, housing insecurity, unstable employment) that connect families to necessary resources.[94,95] SDHs are complex and often intertwined, increasing the challenge of addressing them, but tobacco use in parents and other caregivers is an SDH for which there currently are effective and actionable interventions.

Effective Interventions for Tobacco Cessation

Adults who smoke are able to achieve quit rates of more than 30% with a combination of medication and counseling from a primary care provider.[96] The pediatric visit provides a unique opportunity for pediatricians to offer tobacco-dependence treatment to parents and caregivers because most young parents see their children's pediatrician more frequently than they see their own health care providers. Pediatricians can identify children who are exposed to tobacco smoke and assist parents, caregivers, and other household members who want to stop smoking.

The AAP policy statement "Clinical Practice Policy to Protect Children from Tobacco, Nicotine, and Tobacco Smoke"[1] clearly delineates mechanisms for screening for tobacco use and exposure at each visit and providing support to people who smoke. This assistance may include connecting them to state quitlines (such as 1-800-QUIT-NOW) or cessation services and recommending

TABLE 2 AAP Policy Statements and Other Resources for Tobacco and E-cigarettes

Resources for Decreasing Tobacco Exposure at the Individual Practice Level	Evidence Base for Tobacco Control	E-cigarette and Vaping Resources	Advocacy and Policy Resources	Social Justice Frameworks
"Clinical Practice Policy to Protect Children From Tobacco, Nicotine, and Tobacco Smoke" (AAP policy statement, 2015)	"Protecting Children From Tobacco, Nicotine, and Tobacco Smoke" (AAP technical report, 2015)	"E-Cigarettes and Similar Devices" (AAP policy statement, 2019)	"Public Policy to Protect Children From Tobacco, Nicotine, and Tobacco Smoke" (AAP policy statement, 2015)	"Health Disparities in Tobacco Use and Exposure: A Structural Competency Approach" (AAP clinical report, 2021)
CEASE Resources (Massachusetts General Hospital Web site)	"Nicotine and Tobacco as Substances of Abuse in Children and Adolescents" (AAP technical report, 2017)	Vaping, JUUL and E-Cigarettes Presentation Toolkit (Julius B. Richmond Center of Excellence Web site)	Tobacco Prevention Policy Tool (Julius B. Richmond Center of Excellence Web site)	"The Impact of Racism on Child and Adolescent Health" (AAP policy statement, 2019)
Pediatric Environmental Health manual (AAP policy manual, 2018)			Tobacco Education Resources for Kids & Teens (HealthyChildren.org)	
"Substance Use Screening, Brief Intervention, and Referral to Treatment" (AAP clinical report, 2016)				

or prescribing nicotine replacement therapy (NRT). This policy addresses parameters for prescribing NRT to parents, including potential liability, disease assessment, risks versus benefits, and documentation.[1]

There are many ways to help caregivers cut down on or stop smoking[96]; accessible resources are available from the AAP (Table 2). One option for office practices is Clinical Effort Against Secondhand Smoke Exposure (CEASE), a program for clinicians designed to increase smoking cessation through brief motivational interviewing, a recommendation or prescription for NRTs, and referral to cessation helplines.[97,98] CEASE has been shown to increase tobacco-dependence treatment offered by pediatric clinics; recent research has revealed promising results that parents who received CEASE interventions at their child's clinic were more likely to quit smoking.[96,99]

Social networks also affect smoking cessation. Smoking cessation by a spouse, sibling, friend, or co-worker increases the chance that an individual will also stop smoking.[100] Therefore, it may be beneficial to ask about other people who use tobacco within a tobacco user's social network and to suggest cessation resources for those people as well. In addition,

TABLE 3 Suggested Structural Interventions to Reduce Tobacco-Related Disparities

Structural Intervention	Rationale	Comment
End predatory targeting by the tobacco industry	Tobacco companies target vulnerable and marginalized groups.	Regulating predatory marketing tactics used by tobacco companies will protect children and other vulnerable groups and reduce tobacco initiation.
Ensure basic health coverage for all	Adequate health care would include the following: (1) access to evidence-based therapies for smoking cessation, (2) early recognition and treatment of tobacco use–related diseases, and (3) coverage for mental health services.	Coverage also increases the likelihood that people with mental health problems who also smoke receive needed health services.
Make funds for tobacco-dependence treatment available for people without insurance	Adequate tobacco-dependence treatment should be accessible to all.	Tobacco taxes are a potential source of funding.
Advocate for employers to provide effective tobacco-dependence treatment to employees who smoke	Tobacco-dependence treatment in the workplace may help workers stop smoking, stay in the workforce, and gain a better economic footing.	Efforts may thus reduce the burden of unemployment on those already experiencing poverty.
Incorporate smoking cessation for caregivers into pediatric visits	Caregivers often visit pediatric clinicians more frequently than their own clinicians, creating important opportunities to discuss tobacco use and need for cessation.	Clinicians aware of structural issues may be more likely to understand counseling efforts as interventions to address these issues. They may be more likely to use a chronic disease model and motivational interviewing techniques.
Support reimbursement for clinicians treating caregivers who smoke; ensure consistent coverage for tobacco-dependence treatment	Pediatricians should be compensated for time spent treating caregivers' tobacco dependence.[102] Consistent payment by health insurers for health risk assessments and preventive care counseling, already defined by CPT coding, and consistent health coverage of FDA-approved medications for tobacco-dependence treatment of household contacts,[102] even when available over the counter, may improve cessation rates.	ICD-10 codes allow pediatricians to code for SHS exposure[a] but not for time to assist caregivers with smoking cessation.
Improve access to counseling and medications by investing in streamlined referrals from EHRs to smoking quitlines	Greater access may improve referral rates to counseling services; many quitlines provide free NRT to their users.	EHR systems also can be modified to allow opening a linked medical record for the child's caregiver. This can facilitate documentation of pediatrician support given to the caregiver.
Partner with schools to monitor absences; provide educational opportunities for children chronically absent because of illness	Children exposed to SHS are more likely to miss school, impeding academic achievement.	Strategies to help children stay on track educationally may help improve educational outcomes.
Urge all child care centers to follow guidance about tobacco exposure	For young children, out-of-home care may represent a significant portion of their day and a source of exposure—particularly for low-income parents who may rely on family day care with less oversight when it comes to these issues. Currently, even teachers in centers are often subject to the structural SDHs as they tend to be low wage workers as well.	This guidance is provided by the National Resource Center for Health and Safety in Child Care and Early Education in *Caring for Our Children*.[103]

CPT, *Current Procedural Terminology*; EHR, electronic health record; FDA, US Food and Drug Administration; ICD-10, *International Classification of Diseases, 10th Revision*.

[a] American Academy of Pediatrics. Tobacco/e-cigarettes use/exposure coding fact sheet for primary care pediatrics. Available at: https://downloads.aap.org/AAP/PDF/coding_factsheet_tobacco.pdf. Accessed November 17, 2020.

tobacco users may be able to help identify ways in which their social networks can support cessation.

EDUCATION AND TRAINING

Evidence-based smoking cessation counseling techniques can be integrated into curricula for medical students and residents so that trainees become familiar with behavioral and pharmacologic strategies to help people stop smoking.[1] Trainees should learn that tobacco dependence is a chronic disease similar to other chronic diseases that need consistent treatment by clinicians. Important components of treatment include cessation medications approved by the US Food and Drug Administration, including the nicotine patch, gum, and lozenge. E-cigarettes and similar devices should not be prescribed for tobacco-dependence treatment.[13] Counseling and recommending or prescribing NRT can be incorporated into their practice. Trainees who plan to prescribe NRT for parents should review the guidelines described above.[1] In addition, as part of their curriculum, trainees can be educated on big tobacco's history of deceptive, targeted marketing techniques and encouraged to discuss potential parallels with the current vaping epidemic. Framing this information as a structural issue will make it clearer to trainees that tobacco use and its consequences are not uniformly distributed in the population.

Including smoking cessation counseling as part of pediatric graduate medical education will help trainees recognize that the most effective way to treat children exposed to SHS (and to prevent the children from using tobacco themselves) is to treat their caregivers. Regular trainings in this area will increase workforce capacity to treat tobacco dependence in families, which will decrease structural barriers to smoking cessation and eventually help improve child outcomes. Trainees can be taught smoking cessation approaches by using a structural competency framework as part of the advocacy curriculum required in pediatric residency training.[101]

TOBACCO-RELATED ADVOCACY AND POLICY INTERVENTIONS

Pediatricians are trusted members of their communities and can play important roles in advocating for policies to protect children from tobacco use. Although a comprehensive review of advocacy strategies is beyond the scope of this document, we encourage readers to consult the resources available through the AAP (Table 2) for advocacy and policy actions related to tobacco use.

STRUCTURAL INTERVENTIONS TO REDUCE DISPARITIES

Larger systems that keep people in poverty need to change to address the disparities that perpetuate tobacco use. Changing these systems may be difficult because they have significant up-front costs and may threaten existing power structures. These structural changes are discussed above; Table 3 includes several key recommendations. Actions taken by pediatricians at local, state, and federal levels can support these and other initiatives aimed at addressing structural barriers that perpetuate intergenerational cycles of tobacco dependence and health disparities.

CONCLUSIONS

Tobacco dependence is a chronic, relapsing, addictive disease, and tobacco use causes 480 000 deaths in the United States every year. Structural barriers ensure that some marginalized groups initiate and use tobacco at disproportionately high rates. Members of these groups continue to experience health and economic disparities because of tobacco dependence, which, in turn, perpetuate tobacco dependence through generations. Pediatricians have opportunities to reframe their understanding of tobacco-dependence treatment to include both individual and structural interventions. Viewing tobacco exposure as an SDH can help pediatricians systematically identify and provide support to family members using tobacco. Framing tobacco dependence through a structural competency lens and supporting appropriate advocacy and policy actions can disrupt tobacco use patterns and increase opportunities for children and their caregivers to live healthy, tobacco-free lives.

LEAD AUTHORS

Jyothi Marbin, MD, FAAP
Sophie J. Balk, MD, FAAP
Valerie Gribben, MD, FAAP
Judith Groner, MD, FAAP

SECTION ON TOBACCO CONTROL EXECUTIVE COMMITTEE, 2018–2019

Susan C. Walley, MD, FAAP
Rachel Boykan, MD, FAAP
Judith Groner, MD, FAAP
Brian P. Jenssen, MD, FAAP
Jyothi Marbin, MD, FAAP
Bryan Mih, MD, FAAP
Nina L. Alfieri, MD, FAAP
Alice Little Caldwell, MD, FAAP

STAFF

Karen S. Smith
Colleen Spatz, MSBA

ABBREVIATIONS

AAP: American Academy of Pediatrics
ADHD: attention-deficit/hyperactivity disorder
CEASE: Clinical Effort Against Secondhand Smoke Exposure
e-cigarette: electronic cigarette
LGBTQ: lesbian, gay, bisexual, transgender, and queer
NRT: nicotine replacement therapy
SDH: social determinant of health
SHS: secondhand smoke
THS: thirdhand smoke

FUNDING: No external funding.

POTENTIAL CONFLICT OF INTEREST: The authors have indicated they have no potential conflicts of interest to disclose.

REFERENCES

1. Farber HJ, Walley SC, Groner JA, Nelson KE; Section on Tobacco Control. Clinical practice policy to protect children from tobacco, nicotine, and tobacco smoke. *Pediatrics*. 2015; 136(5):1008–1017
2. Centers for Disease Control and Prevention. 2014 US Surgeon General's report: the health consequences of smoking—50 years of progress. Available at: https://www.cdc.gov/tobacco/data_statistics/sgr/50th-anniversary/index.htm. Accessed July 14, 2020
3. Bernstein SL, Toll BA. Ask about smoking, not quitting: a chronic disease approach to assessing and treating tobacco use. *Addict Sci Clin Pract*. 2019;14(1):29
4. Tobacco Use and Dependence Guideline Panel. *Treating Tobacco Use and Dependence: 2008 Update*. Rockville, MD: US Department of Health and Human Services; 2008. Available at: https://www.ncbi.nlm.nih.gov/books/NBK63952/. Accessed August 30, 2020
5. Centers for Disease Control and Prevention. Current cigarette smoking among adults in the United States. Available at: https://www.cdc.gov/tobacco/data_statistics/fact_sheets/adult_data/cig_smoking/index.htm. Accessed July 14, 2020
6. US National Cancer Institute. *A Socioecological Approach to Addressing Tobacco-Related Health Disparities*. Bethesda, MD: US Department of Health and Human Services, National Institutes of Health; 2017
7. Centers for Disease Control and Prevention. African Americans and tobacco use. Available at: https://www.cdc.gov/tobacco/disparities/african-americans/index.htm. Accessed July 14, 2020
8. Centers for Disease Control and Prevention. Tobacco use and quitting among individuals with behavioral health conditions. Available at: https://www.cdc.gov/tobacco/disparities/mental-illness-substance-use/index.htm. Accessed July 14, 2020
9. Truth Initiative. Tobacco Nation: the deadly state of smoking disparity in the U.S. Available at: https://truthinitiative.org/research-resources/smoking-region/tobacco-nation-deadly-state-smoking-disparity-us. Accessed July 14, 2020
10. Centers for Disease Control and Prevention. Tobacco use by geographic region. Available at: https://www.cdc.gov/tobacco/disparities/geographic/index.htmw. Accessed xx xx, xxxx
11. Jacob P III, Benowitz NL, Destaillats H, et al. Thirdhand smoke: new evidence, challenges, and future directions. *Chem Res Toxicol*. 2017;30(1):270–294
12. US Food and Drug Administration. Statement from FDA Commissioner Scott Gottlieb, M.D., on new steps to address epidemic of youth e-cigarette use. 2018. Available at: https://www.fda.gov/news-events/press-announcements/statement-fda-commissioner-scott-gottlieb-md-new-steps-address-epidemic-youth-e-cigarette-use. Accessed July 14, 2020
13. Cullen KA, Ambrose BK, Gentzke AS, Apelberg BJ, Jamal A, King BA. Notes from the field: use of electronic cigarettes and any tobacco product among middle and high school students - United States, 2011–2018. *MMWR Morb Mortal Wkly Rep*. 2018; 67(45):1276-1277
14. Jenssen BP, Walley SC; Section on Tobacco Control. E-cigarettes and similar devices. *Pediatrics*. 2019;143(2): e20183652
15. van Eerd EAM, Bech Risør M, Spigt M, et al. Why do physicians lack engagement with smoking cessation treatment in their COPD patients? A multinational qualitative study. *NPJ Prim Care Respir Med*. 2017;27(1):41
16. Collins BN, Levin KP, Bryant-Stephens T. Pediatricians' practices and attitudes about environmental tobacco smoke and parental smoking. *J Pediatr*. 2007; 150(5):547–552
17. Metzl JM, Hansen H. Structural competency: theorizing a new medical engagement with stigma and inequality. *Soc Sci Med*. 2014;103:126–133
18. National Association of County and City Health Officials. Advancing Public Narrative for Health Equity & Social Justice. Washington, DC: National Association of County and City Health Officials; 2018. Available at: http://publichealth.lacounty.gov/CenterForHealthEquity/PDF/advancing%20public%20narrative%20for%20health%20equity%20and%20social%20justice_NACCHO.pdf. Accessed July 14, 2020
19. American Lung Association in California. State of tobacco control 2014. Available at: http://tobaccocontrol.usc.edu/files/SOTC_2014_CA_REPORT_and_GRADES_3_7.pdf. Accessed July 14, 2020
20. Astor RL, Urman R, Barrington-Trimis JL, et al. Tobacco retail licensing and youth product use. *Pediatrics*. 2019; 143(2):e20173536
21. Campaign for Tobacco-Free Kids. Tobacco company quotes on marketing to kids. Available at: https://www.tobaccofreekids.org/assets/factsheets/0114.pdf. Accessed xx xx, xxxx
22. Yuan M, Cross SJ, Loughlin SE, Leslie FM. Nicotine and the adolescent brain. *J Physiol*. 2015;593(16):3397–3412
23. National Center for Chronic Disease Prevention and Health Promotion (US) Office on Smoking and Health. *Preventing Tobacco Use Among Youth and Young Adults: A Report of the*

Surgeon General. Atlanta, GA: Centers for Disease Control and Prevention, National Center for Chronic Disease Prevention and Health Promotion, Office on Smoking and Health; 2012. Available at: https://www.ncbi.nlm.nih.gov/books/NBK99237/. Accessed November 17, 2020

24. Cummings KM, Morley CP, Horan JK, Steger C, Leavell NR. Marketing to America's youth: evidence from corporate documents. *Tob Control*. 2002;11(suppl 1):I5–I17
25. Bach L; Campaign for Tobacco-Free Kids. Tobacco company marketing to kids. Available at: https://www.tobaccofreekids.org/assets/factsheets/0008.pdf. Accessed July 14, 2020
26. Smith EA, Thomson K, Offen N, Malone RE. "If you know you exist, it's just marketing poison": meanings of tobacco industry targeting in the lesbian, gay, bisexual, and transgender community. *Am J Public Health*. 2008;98(6):996–1003
27. Offen N, Smith EA, Malone RE. Is tobacco a gay issue? Interviews with leaders of the lesbian, gay, bisexual and transgender community. *Cult Health Sex*. 2008;10(2):143–157
28. Hafez N, Ling PM. Finding the Kool Mixx: how Brown & Williamson used music marketing to sell cigarettes. *Tob Control*. 2006;15(5):359–366
29. Landrine H, Klonoff EA, Fernandez S, et al. Cigarette advertising in Black, Latino, and White magazines, 1998-2002: an exploratory investigation. *Ethn Dis*. 2005;15(1):63–67
30. Lempert LK, Glantz SA. Tobacco industry promotional strategies targeting American Indians/Alaska Natives and exploiting tribal sovereignty. *Nicotine Tob Res*. 2019;21(7):940–948
31. American Cancer Society; Americans for Nonsmokers' Rights; Cancer Action Network. Manipulating a sacred tradition: an investigation of commercial tobacco marketing & sales strategies on the Navajo Nation and other native tribes. Available at: http://action.acscan.org/site/DocServer/Industry_Influence-_Indian_Lands-_Indian_Gaming.pdf?docID=8902. Accessed August 29, 2020
32. Brown-Johnson CG, England LJ, Glantz SA, Ling PM. Tobacco industry marketing to low socioeconomic status women in the U.S.A. *Tob Control*. 2014;23(e2):e139–e146
33. LaVito A. Tobacco giant Altria takes 35% stake in Juul, valuing e-cigarette company at $38 billion. Available at: https://www.cnbc.com/2018/12/20/altria-takes-stake-in-juul-a-pivotal-moment-for-the-e-cigarette-maker.html. Accessed July 14, 2020
34. Marbin JN, Gribben V. Tobacco use as a health disparity: what can pediatric clinicians do? *Children (Basel)*. 2019;6(2):31
35. Monti D, Kuzemchak M, Politi M. *The Effects of Smoking on Health Insurance Decisions Under the Affordable Care Act*. St Louis, MO: Center for Health Economics and Policy, Institute for Public Health at Washington University; 2016. Available at: https://publichealth.wustl.edu/wp-content/uploads/2016/07/The-Effects-of-Smoking-on-Health-Insurance-Decisions-under-the-ACA.pdf. Accessed July 14, 2020
36. Kaplan CM, Graetz I, Waters TM. Most exchange plans charge lower tobacco surcharges than allowed, but many tobacco users lack affordable coverage. *Health Aff (Millwood)*. 2014;33(8):1466–1473
37. Friedman AS, Schpero WL, Busch SH. Evidence suggests that the ACA's tobacco surcharges reduced insurance take-up and did not increase smoking cessation. *Health Aff (Millwood)*. 2016;35(7):1176–1183
38. Loudenback T. Anyone trying to get life insurance should be ready to answer a loaded question: do you smoke pot? *Business Insider*. April 11, 2019. Available at: https://www.businessinsider.com/smokers-marijuana-life-insurance-rates. Accessed July 14, 2020
39. Prochaska JJ, Michalek AK, Brown-Johnson C, et al. Likelihood of unemployed smokers vs nonsmokers attaining reemployment in a one-year observational study. *JAMA Intern Med*. 2016;176(5):662–670
40. Okechukwu C, Bacic J, Cheng KW, Catalano R. Smoking among construction workers: the nonlinear influence of the economy, cigarette prices, and antismoking sentiment. *Soc Sci Med*. 2012;75(8):1379–1386
41. Berman M, Crane R, Seiber E, Munur M. Estimating the cost of a smoking employee. *Tob Control*. 2014;23(5):428–433
42. Patel RR, Schmidt H. Should employers be permitted not to hire smokers? A review of US legal provisions. *Int J Health Policy Manag*. 2017;6(12):701–706
43. Schmidt H, Voigt K, Emanuel EJ. The ethics of not hiring smokers. *N Engl J Med*. 2013;368(15):1369–1371
44. Levy DE, Winickoff JP, Rigotti NA. School absenteeism among children living with smokers. *Pediatrics*. 2011;128(4):650–656
45. Allison MA, Attisha E; Council on School Health. The link between school attendance and good health. *Pediatrics*. 2019;143(2):e20183648
46. Cornelius MD, Leech SL, Goldschmidt L, Day NL. Prenatal tobacco exposure: is it a risk factor for early tobacco experimentation? *Nicotine Tob Res*. 2000;2(1):45–52
47. Vuolo M, Staff J. Parent and child cigarette use: a longitudinal, multigenerational study. *Pediatrics*. 2013;132(3). Available at: www.pediatrics.org/cgi/content/full/132/3/e568
48. Chaudry A, Pedroza JM, Sandstrom H, et al. *Child Care Choices of Low-Income Working Families*. Washington, DC: Urban Institute; 2011. Available at: https://www.urban.org/sites/default/files/publication/27331/412343-Child-Care-Choices-of-Low-Income-Working-Families.PDF. Accessed July 14, 2020
49. Tong VT, Dietz PM, Farr SL, D'Angelo DV, England LJ. Estimates of smoking before and during pregnancy, and smoking cessation during pregnancy: comparing two population-based data sources. *Public Health Rep*. 2013;128(3):179–188
50. Curtin SC, Matthews TJ. Smoking prevalence and cessation before and during pregnancy: data from the birth certificate, 2014. *Natl Vital Stat Rep*. 2016;65(1):1–14
51. Cheng D, Salimi S, Terplan M, Chisolm MS. Intimate partner violence and

maternal cigarette smoking before and during pregnancy. *Obstet Gynecol*. 2015; 125(2):356–362

52. Anderson TM, Lavista Ferres JM, Ren SY, et al. Maternal smoking before and during pregnancy and the risk of sudden unexpected infant death. *Pediatrics*. 2019;143(4):e20183325
53. Sun K, Zhang Y, Tian Y, Jiang X. Environmental tobacco smoke exposure and risk of habitual snoring in children: a meta-analysis. *J Epidemiol Community Health*. 2018;72(11): 1064–1070
54. Aris IM, Rifas-Shiman SL, Li LJ, et al. Pre-, perinatal, and parental predictors of body mass index trajectory milestones. *J Pediatr*. 2018;201:69–77.e8
55. Kristjansson AL, Thomas S, Lilly CL, Thorisdottir IE, Allegrante JP, Sigfusdottir ID. Maternal smoking during pregnancy and academic achievement of offspring over time: a registry data-based cohort study. *Prev Med*. 2018;113:74–79
56. Kandel DB, Griesler PC, Schaffran C. Educational attainment and smoking among women: risk factors and consequences for offspring. *Drug Alcohol Depend*. 2009;104(suppl 1): S24–S33
57. Zhu JL, Olsen J, Liew Z, Li J, Niclasen J, Obel C. Parental smoking during pregnancy and ADHD in children: the Danish national birth cohort. *Pediatrics*. 2014;134(2). Available at: www.pediatrics.org/cgi/content/full/134/2/e382
58. Ruisch IH, Dietrich A, Glennon JC, Buitelaar JK, Hoekstra PJ. Maternal substance use during pregnancy and offspring conduct problems: a meta-analysis. *Neurosci Biobehav Rev*. 2018; 84:325–336
59. Oken E, Baccarelli AA, Gold DR, et al. Cohort profile: project viva. *Int J Epidemiol*. 2015;44(1):37–48
60. Sourander A, Sucksdorff M, Chudal R, et al. Prenatal cotinine levels and ADHD among offspring. *Pediatrics*. 2019; 143(3):e20183144
61. Lewis AJ, Austin E, Knapp R, Vaiano T, Galbally M. Perinatal maternal mental health, fetal programming and child development. *Healthcare (Basel)*. 2015; 3(4):1212–1227
62. Knopik VS, Maccani MA, Francazio S, McGeary JE. The epigenetics of maternal cigarette smoking during pregnancy and effects on child development. *Dev Psychopathol*. 2012; 24(4):1377–1390
63. Lelong N, Kaminski M, Saurel-Cubizolles MJ, Bouvier-Colle MH. Postpartum return to smoking among usual smokers who quit during pregnancy. *Eur J Public Health*. 2001;11(3):334–339
64. Jara SM, Benke JR, Lin SY, Ishman SL. The association between secondhand smoke and sleep-disordered breathing in children: a systematic review. *Laryngoscope*. 2015;125(1):241–247
65. Yolton K, Xu Y, Khoury J, et al. Associations between secondhand smoke exposure and sleep patterns in children. *Pediatrics*. 2010;125(2). Available at: www.pediatrics.org/cgi/content/full/125/2/e261
66. Weinstock TG, Rosen CL, Marcus CL, et al. Predictors of obstructive sleep apnea severity in adenotonsillectomy candidates. *Sleep*. 2014;37(2):261–269
67. Zhu Y, Au CT, Leung TF, Wing YK, Lam CWK, Li AM. Effects of passive smoking on snoring in preschool children. *J Pediatr*. 2013;163(4):1158–1162.e4
68. Sawnani H, Jackson T, Murphy T, Beckerman R, Simakajornboon N. The effect of maternal smoking on respiratory and arousal patterns in preterm infants during sleep. *Am J Respir Crit Care Med*. 2004;169(6): 733–738
69. Tirosh E, Libon D, Bader D. The effect of maternal smoking during pregnancy on sleep respiratory and arousal patterns in neonates. *J Perinatol*. 1996;16(6): 435–438
70. Sawnani H, Olsen E, Simakajornboon N. The effect of in utero cigarette smoke exposure on development of respiratory control: a review. *Pediatr Allergy Immunol Pulmonol*. 2010;23(3): 161–167
71. Jackman AR, Biggs SN, Walter LM, et al. Sleep-disordered breathing in preschool children is associated with behavioral, but not cognitive, impairments. *Sleep Med*. 2012;13(6): 621–631
72. Galland B, Spruyt K, Dawes P, McDowall PS, Elder D, Schaughency E. Sleep disordered breathing and academic performance: a meta-analysis. *Pediatrics*. 2015;136(4). Available at: www.pediatrics.org/cgi/content/full/136/4/e934
73. Beebe DW, Rausch J, Byars KC, Lanphear B, Yolton K. Persistent snoring in preschool children: predictors and behavioral and developmental correlates. *Pediatrics*. 2012;130(3): 382–389
74. Rosen CL, Palermo TM, Larkin EK, Redline S. Health-related quality of life and sleep-disordered breathing in children. *Sleep*. 2002;25(6):657–666
75. Gottlieb DJ, Chase C, Vezina RM, et al. Sleep-disordered breathing symptoms are associated with poorer cognitive function in 5-year-old children. *J Pediatr*. 2004;145(4):458–464
76. Farber HJ, Wattigney W, Berenson G. Trends in asthma prevalence: the Bogalusa Heart Study. *Ann Allergy Asthma Immunol*. 1997;78(3):265–269
77. Howrylak JA, Spanier AJ, Huang B, et al. Cotinine in children admitted for asthma and readmission. *Pediatrics*. 2014;133(2). Available at: www.pediatrics.org/cgi/content/full/133/2/e355
78. McCarville M, Sohn MW, Oh E, Weiss K, Gupta R. Environmental tobacco smoke and asthma exacerbations and severity: the difference between measured and reported exposure. *Arch Dis Child*. 2013; 98(7):510–514
79. Cohen RT, Raby BA, Van Steen K, et al.; Childhood Asthma Management Program Research Group. In utero smoke exposure and impaired response to inhaled corticosteroids in children with asthma. *J Allergy Clin Immunol*. 2010;126(3):491–497
80. Burke H, Leonardi-Bee J, Hashim A, et al. Prenatal and passive smoke exposure and incidence of asthma and wheeze: systematic review and meta-analysis. *Pediatrics*. 2012;129(4): 735–744
81. Semple MG, Taylor-Robinson DC, Lane S, Smyth RL. Household tobacco smoke and admission weight predict severe bronchiolitis in infants independent of deprivation: prospective cohort study. *PLoS One*. 2011;6(7):e22425

82. Figueras-Aloy J, Carbonell-Estrany X, Quero-Jiménez J, et al.; IRIS Study Group. FLIP-2 Study: risk factors linked to respiratory syncytial virus infection requiring hospitalization in premature infants born in Spain at a gestational age of 32 to 35 weeks. *Pediatr Infect Dis J*. 2008;27(9):788–793

83. Jones LL, Hashim A, McKeever T, Cook DG, Britton J, Leonardi-Bee J. Parental and household smoking and the increased risk of bronchitis, bronchiolitis and other lower respiratory infections in infancy: systematic review and meta-analysis. *Respir Res*. 2011;12(1):5

84. Hawkins SS, Berkman L. Increased tobacco exposure in older children and its effect on asthma and ear infections. *J Adolesc Health*. 2011;48(6):647–650

85. Jones LL, Hassanien A, Cook DG, Britton J, Leonardi-Bee J. Parental smoking and the risk of middle ear disease in children: a systematic review and meta-analysis. *Arch Pediatr Adolesc Med*. 2012;166(1):18–27

86. Weitzman M, Cook S, Auinger P, et al. Tobacco smoke exposure is associated with the metabolic syndrome in adolescents. *Circulation*. 2005;112(6): 862–869

87. Groner JA, Huang H, Joshi MS, Eastman N, Nicholson L, Bauer JA. Secondhand smoke exposure and preclinical markers of cardiovascular risk in toddlers. *J Pediatr*. 2017;189:155–161

88. Celermajer DS, Adams MR, Clarkson P, et al. Passive smoking and impaired endothelium-dependent arterial dilatation in healthy young adults. *N Engl J Med*. 1996;334(3):150–154

89. Belvin C, Britton J, Holmes J, Langley T. Parental smoking and child poverty in the UK: an analysis of national survey data. *BMC Public Health*. 2015;15:507

90. Busch SH, Jofre-Bonet M, Falba TA, Sindelar JL. Burning a hole in the budget: tobacco spending and its crowd-out of other goods. *Appl Health Econ Health Policy*. 2004;3(4):263–272

91. John RM. Crowding out effect of tobacco expenditure and its implications on household resource allocation in India. *Soc Sci Med*. 2008; 66(6):1356–1367

92. John RM, Sung HY, Max WB, Ross H. Counting 15 million more poor in India, thanks to tobacco. *Tob Control*. 2011; 20(5):349–352

93. Nonnemaker J, Sur M. Tobacco expenditures and child health and nutritional outcomes in rural Bangladesh. *Soc Sci Med*. 2007;65(12): 2517–2526

94. Garg A, Toy S, Tripodis Y, Silverstein M, Freeman E. Addressing social determinants of health at well child care visits: a cluster RCT. *Pediatrics*. 2015;135(2). Available at: www.pediatrics.org/cgi/content/full/135/2/e296

95. Cheng TL, Emmanuel MA, Levy DJ, Jenkins RR. Child health disparities: what can a clinician do? *Pediatrics*. 2015;136(5):961–968

96. Agency for Healthcare Research and Quality. *Treating Tobacco Use and Dependence: 2008 Update*. Rockville, MD: Agency for Healthcare Research and Quality; 2008. Available at: www.ahrq.gov/professionals/clinicians-providers/guidelines-recommendations/tobacco/index.html. Accessed October 2018

97. Rosen LJ, Noach MB, Winickoff JP, Hovell MF. Parental smoking cessation to protect young children: a systematic review and meta-analysis. *Pediatrics*. 2012;129(1):141–152

98. Winickoff JP, Hipple B, Drehmer J, et al. The Clinical Effort Against Secondhand Smoke Exposure (CEASE) intervention: a decade of lessons learned. *J Clin Outcomes Manag*. 2012;19(9):414–419

99. Nabi-Burza E, Drehmer JE, Hipple Walters B, et al. Treating parents for tobacco use in the pediatric setting: the Clinical Effort Against Secondhand Smoke Exposure cluster randomized clinical trial. *JAMA Pediatr*. 2019; 173(10):931–939

100. Christakis NA, Fowler JH. The collective dynamics of smoking in a large social network. *N Engl J Med*. 2008;358(21): 2249–2258

101. Accreditation Council for Graduate Medical Education. ACGME Program Requirements for Graduate Medical Education in Pediatrics. Chicago, IL: Accreditation Council for Graduate Medical Education; 2020. Available at: https://www.acgme.org/Portals/0/PFAssets/ProgramRequirements/320_Pediatrics_2020.pdf?ver=2020-06-29-162726-647. Accessed November 17, 2020

102. Committee On Child Health Financing. Scope of health care benefits for children from birth through age 26. *Pediatrics*. 2012;129(1):185–189

103. National Resource Center for Health and Safety in Child Care and Early Education. Policies prohibiting smoking, tobacco, alcohol, illegal drugs, and toxic substances. Available at: https://nrckids.org/CFOC/Database/9.2.3.15. Accessed July 14, 2020

104. Walker AK, Fox EL. Why marginalization, not vulnerability, can best identify people in need of special medical and nutrition care. *AMA J Ethics*. 2018; 20(10):E941–E947

Identification and Management of Eating Disorders in Children and Adolescents

• *Clinical Report*

CLINICAL REPORT Guidance for the Clinician in Rendering Pediatric Care

American Academy of Pediatrics
DEDICATED TO THE HEALTH OF ALL CHILDREN®

Identification and Management of Eating Disorders in Children and Adolescents

Laurie L. Hornberger, MD, MPH, FAAP,[a] Margo A. Lane, MD, FRCPC, FAAP,[b] THE COMMITTEE ON ADOLESCENCE

Eating disorders are serious, potentially life-threatening illnesses afflicting individuals through the life span, with a particular impact on both the physical and psychological development of children and adolescents. Because care for children and adolescents with eating disorders can be complex and resources for the treatment of eating disorders are often limited, pediatricians may be called on to not only provide medical supervision for their patients with diagnosed eating disorders but also coordinate care and advocate for appropriate services. This clinical report includes a review of common eating disorders diagnosed in children and adolescents, outlines the medical evaluation of patients suspected of having an eating disorder, presents an overview of treatment strategies, and highlights opportunities for advocacy.

INTRODUCTION

Definitions

Although the earliest medical account of an adolescent patient with an eating disorder was more than 300 years ago,[1] a thorough understanding of the pathophysiology and psychobiology of eating disorders remains elusive today. The *Diagnostic and Statistical Manual of Mental Disorders, Fifth Edition* (*DSM-5*) includes the latest effort to describe and categorize eating disorders,[2] placing greater emphasis on behavioral rather than physical and cognitive criteria, thereby clarifying these conditions in those children who do not express body or weight distortion. *DSM-5* diagnostic criteria for several of the eating disorders commonly seen in children and adolescents are presented in Table 1.

Notable changes in *DSM-5* since the previous edition include the elimination of amenorrhea and specific weight percentiles in the diagnosis of anorexia nervosa (AN) and a reduction in the frequency of binge eating and compensatory behaviors required for the diagnosis of bulimia nervosa (BN). The diagnosis "eating disorder not otherwise specified" has been

abstract

[a]Division of Adolescent Medicine, Children's Mercy Kansas City and School of Medicine, University of Missouri–Kansas City, Kansas City, Missouri; and [b]Department of Pediatrics and Child Health, Max Rady College of Medicine, Rady Faculty of Health Sciences, University of Manitoba, Winnipeg, Manitoba

Drs Hornberger and Lane were equally responsible for conceptualizing, writing, and revising the manuscript and considering input from all reviewers and the board of directors; and all authors approve the final manuscript as submitted.

The guidance in this report does not indicate an exclusive course of treatment or serve as a standard of medical care. Variations, taking into account individual circumstances, may be appropriate.

All clinical reports from the American Academy of Pediatrics automatically expire 5 years after publication unless reaffirmed, revised, or retired at or before that time.

DOI: https://doi.org/10.1542/peds.2020-040279

Address correspondence to Laurie L. Hornberger, MD. Email: lhornberger@cmh.edu

To cite: Hornberger LL, Lane MA, AAP THE COMMITTEE ON ADOLESCENCE. Identification and Management of Eating Disorders in Children and Adolescents. *Pediatrics*. 2021; 147(1):e2020040279

TABLE 1 Diagnostic Features of Eating Disorders Commonly Seen in Children and Adolescents

DSM-5 Eating Disorder Diagnosis	Diagnostic Features
Anorexia nervosa (AN)	
	A. Restricted caloric intake relative to energy requirements, leading to significantly low body weight for age, sex, projected growth, and physical health
	B. Intense fear of gaining weight or behaviors that consistently interfere with weight gain, despite being at a significantly low weight
	C. Altered perception of one's body weight or shape, excessive influence of body weight or shape on self-value, or persistent lack of acknowledgment of the seriousness of one's low body weight
	Subtypes: restricting type (weight loss is achieved primarily through dieting, fasting, and/or excessive exercise. In the previous 3 mo, there have been no repeated episodes of binge eating or purging); binge-eating/purging type (in the previous 3 mo, there have been repeated episodes of binge eating or purging; ie, self-induced vomiting or misuse of laxatives, diuretics, or enemas)
Bulimia nervosa (BN)	
	Repeated episodes of binge eating. Binge eating is characterized by both of the following: within a distinct period of time (eg, 2 h), eating an amount of food that is clearly larger than what most individuals would eat during a similar period of time under similar circumstances and a sense that one cannot limit or control their overeating during the episode
	Repeated use of inappropriate compensatory behaviors for the prevention of weight gain, such as self-induced vomiting; misuse of laxatives, diuretics, or other medications; fasting; or excessive exercise
	On average, the binge eating and compensatory behaviors both occur at least once a week for 3 mo
	Self-value is overly influenced by body shape and weight
	The binge eating and compensatory behaviors do not occur exclusively during episodes of AN
Binge-eating disorder (BED)	
	Recurrent episodes of binge eating. An episode of binge eating is characterized by both of the following: within a distinct period of time (eg, 2 h), eating an amount of food that is clearly larger than what most individuals would eat during a similar period of time under similar circumstances and sense that one cannot limit or control their overeating during the episode
	The binge-eating episodes include 3 or more of the following: eating much more quickly than normal, eating until uncomfortably full, eating large amounts of food when not feeling hungry, eating alone because of embarrassment at how much one is eating, and feeling guilty, disgusted, or depressed afterward
	Marked anguish is experienced regarding binge eating
	On average, the binge eating occurs at least once a week for 3 mo
	The binge eating is not associated with the use of inappropriate compensatory behavior as in BN and does not occur only in the context of BN or AN
Avoidant/restrictive food intake disorder (ARFID)	
	A disrupted eating pattern (eg, seeming lack of interest in eating or food; avoidance based on the sensory qualities of food; concern about unpleasant consequences of eating) as evidenced by persistent failure to meet appropriate nutritional and/or energy needs associated with 1 (or more) of the following: significant weight loss or, in children, failure to achieve expected growth and/or weight gain, marked nutritional deficiency, reliance on enteral feeding or oral nutritional supplements, significant interference with psychosocial functioning
	The disturbance cannot be better explained by lack of available food or by an associated culturally sanctioned practice
	The eating disturbance cannot be attributed to a coexisting medical condition nor better explained by another mental disorder. If the eating disturbance occurs in the context of another condition or disorder, the severity of the eating disturbance exceeds that routinely associated with the condition or disorder
Other specified feeding or eating disorders, examples	
	Atypical AN: all of the criteria for AN are met yet the individual's weight is within or above the normal range despite significant weight loss
	BN (of low frequency and/or limited duration): All of the criteria for BN are met, but, on average, the binge eating and compensatory behaviors occur less than once a week and/or for <3 mo
	BED (of low frequency and/or limited duration): All of the criteria for BED are met, but, on average, the binge eating occurs less than once a week and/or for <3 mo
	Purging disorder: recurrent purging behavior (eg, self-induced vomiting; misuse of laxatives, diuretics, or other medications) in the absence of binge eating with the intent to influence weight or body shape

Adapted from the *DSM-5*, American Psychiatric Association, 2013.[2]

eliminated, and several diagnoses have been added, including binge-eating disorder (BED) and avoidant/restrictive food intake disorder (ARFID).[3–5] The diagnosis of ARFID encompasses feeding behaviors previously categorized in the fourth edition (*DSM-IV*) as "feeding disorder of infancy and early childhood" and

expands these into adolescence and adulthood. Individuals with ARFID intentionally limit intake for reasons other than for concern for body weight, such as the sensory properties of food, a lack of interest in eating, or a fear of adverse consequences with eating (eg, choking or vomiting). As a result, they may experience weight loss or failure to achieve expected weight gain, malnutrition, dependence on nutritional supplementation, and/or interference with psychosocial functioning.[6–9] The category "other specified feeding and/or eating disorder" is now applied to patients whose symptoms do not meet the full criteria for an eating disorder despite causing significant distress or impairment. Among these disorders is atypical AN in which diminished self-worth, nutritional restriction, and weight loss mirrors that seen with AN, although body weight at presentation is in the normal or above-normal range. Efforts are ongoing to further categorize abnormal eating behaviors and refine diagnoses.[10]

Epidemiology

Prevalence data for eating disorders vary according to study populations and the criteria used to define an eating disorder.[11] A systematic review of prevalence studies published between 1994 and 2013 found widely varied estimates in the lifetime prevalence of eating disorders, with a range from 1.0% to 22.7% for female individuals and 0.3% to 0.6% for male indnividuals.[12] A 2011 cross-sectional survey of more than 10 000 nationally representative US adolescents 13 to 18 years of age estimated prevalence rates of AN, BN, and BED at 0.3%, 0.9%, and 1.6%, respectively. Behaviors suggestive of AN and BED but not meeting diagnostic thresholds were identified in another 0.8% and 2.5%, respectively. The mean age of onset for each of these disorders was 12.5 years.[13] Several studies have suggested higher BED prevalence rates of 2% to 4%, with a more equal distribution between girls and boys, making it perhaps the most common eating disorder among adolescents.[14] In contrast, the diagnoses seen in treatment may belie the relative prevalence of these disorders. In a review of 6 US adolescent eating disorder treatment programs, the distribution of diagnoses was 32% AN, 30% atypical AN, 9% BN, 19% ARFID, 6% purging disorder, and 4% others. [15] This may reflect the underrecognition and/or undertreatment of disorders such as BED.

Although previously mischaracterized as diseases of non-Hispanic white, affluent adolescent girls, eating disorder behaviors are increasingly recognized across all racial and ethnic groups[16–20] and in lower socioeconomic classes,[21] preadolescent children,[22] males, and children and adolescents perceived as having an average or increased body size.

Preteens with eating disorders are more likely than older adolescents to have premorbid psychopathology (depression, obsessive-compulsive disorder, or other anxiety disorders) and less likely to have binge and purge behaviors. There is a more equal distribution of illness by sex among younger patients and, frequently, more rapid weight loss, leading to earlier presentation to health care providers.[23]

Although diagnosis in males may increase with the more inclusive *DSM-5* criteria,[24,25] it is often delayed because of the misperception of health care providers that eating disorders are female disorders.[26] In addition, disordered eating attitudes may differ in male individuals,[27] focusing on leanness, weight control, and muscularity. Purging, use of muscle-building supplements, substance abuse, and comorbid depression are common in males.[28–30]

Eating disorders can occur in individuals with various body habitus, and their presence in those of larger body habitus is increasingly apparent.[31–34] Weight stigma (the undervaluation or negative stereotyping of individuals because they have overweight or obesity) seems to play a role. Adolescents with larger body habitus are exposed to weight stigma through the media, their families, peers, and teachers, and health care professionals, resulting in depression, anxiety, poor body image, social isolation, unhealthy eating behaviors, and worsening obesity.[35] When presenting with significant weight loss but a BMI still classified in the "healthy," overweight, or obese ranges, patients with eating disorders such as atypical AN may be overlooked by health care providers[36,37] but may experience the same severe medical complications as those who are severely underweight.[38–40]

Increased rates of disordered eating may be found in sexual minority youth.[41–43] Analysis of Youth Risk Behavior Survey data reveals lesbian, gay, and bisexual high school students have significantly higher rates of unhealthy and disordered weight-control behaviors than their heterosexual peers.[44,45] Transgender youth may be at particular risk.[46,47] In a survey of nearly 300 000 college students, transgender students had the highest rates of self-reported eating disorder diagnoses and compensatory behaviors (ie, use of diet pills or laxatives or vomiting) compared with all cisgender groups. Nearly 16% of transgender respondents reported having been diagnosed with an eating disorder, as compared with 1.85% of cisgender heterosexual women.[48]

Adolescents with chronic health conditions requiring dietary control

TABLE 2 Example Questions to Ask Adolescents With a Possible Eating Disorder

History/Information	Example Questions
Weight history	
	What was your highest weight? How tall were you? How old were you?
	What was your lowest weight? How tall were you? How old were you?
Body image	
	What do you think your weight should be? What feels too high? What feels too low?
	Are there body areas that cause you stress? Which areas?
	Do you do any body checking (ie, weighing, body pinching or checking, mirror checking)?
	How much of your day is spent thinking about food or your body?
Diet history	
	24-h diet history
	Do you count calories, fat, carbohydrates? How much do you allow? What foods do you avoid?
	Do you ever feel guilty about eating? How do you deal with that guilt (ie, exercising, purging, eating less)?
	Do you feel out of control when eating?
Exercise history	
	Do you exercise? What activities? How often? How intense is your workout?
	How stressed do you feel when you are unable to exercise?
Binge eating and purging	
	Do you ever binge? On what foods? How much? How often? Any triggers?
	Do you vomit? How often? How soon after eating?
	Do you use laxatives, diuretics, diet pills, caffeine? What types? How many? How often?
Family history	
	Does anyone in your family have a history of dieting or an eating disorder? Anyone on special diets (eg, vegetarian, gluten-free)? Anyone with obesity?
	Does anyone in your family have a history of depression, anxiety, bipolar disorder, obsessive-compulsive disorder, substance abuse, or other psychiatric illness?
	Does anyone in your family take psychiatric medication?
Review of systems	
	Dizziness, syncope, weakness or fatigue?
	Pallor, easy bruising or bleeding, cold intolerance?
	Hair loss, lanugo, dry skin?
	Constipation, diarrhea, early fullness, bloating, abdominal pain, heartburn?
	Palpitations, chest pain?
	Muscle cramps, joint pains?
	Excessive thirst and voiding?
	For girls: Age at menarche? Frequency of menses? LMP? Weight at time of LMP?
Psychosocial history (HEADSS)	
Home	
	Who lives in the home?
	How well do the family members get along with each other?
	Is the family experiencing any stressors?
Education	
	Where do you attend school? What grade? Regular classroom?
	Is school challenging for you? What grades do you receive? Has there been a change in your grades?
Activities	
	What activities are you involved in outside of the classroom?
	Do you have friends you can trust? Have you experienced any bullying?
	What Web sites do you most often visit when you go online? How much time is spent each day online?
Drug use	
	Have you ever used tobacco, e-cigarettes, alcohol, or drugs? Which ones? How much? How often?
	Have you ever used anabolic steroids or stimulants? Caffeine consumption? Other substances?
Depression/suicide	
	How is your mood? Increased irritability? Feelings of depression or hopelessness? Any anxiety or obsessive-compulsive thoughts or behaviors?
	Any history of cutting or self-injury?
	Have you ever wished you were dead? How often do you have these thoughts? When was the last time? Any thoughts of suicide? What methods have you imagined? Any attempts?
	History of physical, sexual or emotional abuse?
	Any previous mental health care?

TABLE 2 Continued

History/Information	Example Questions
Sexual history	
	Do you feel that the gender you feel inside matches your body on the outside?
	Are you romantically or sexually attracted to guys, girls, or both? Not sure?
	Have you had any sexual contact with another person? If yes, was it with guys, girls or both? Use of condoms? Use of contraceptives? History of pregnancy or sexually transmitted infection?
	Has anyone touched you sexually when you didn't want to be touched?

Adapted from Rome and Strandjord.[89] LMP, last menstrual period.

(eg, diabetes, cystic fibrosis, inflammatory bowel disease, and celiac disease) may also be at increased risk of disordered eating.[49–51] Among teenagers with type 1 diabetes mellitus, at least one-third may engage in binge eating, self-induced vomiting, insulin omission for weight loss, and excessive exercise,[52,53] resulting in poorer glycemic control.[54]

Many adolescents engage in dietary practices that may overlap with or disguise eating disorders. The lay term "orthorexia" describes the behavior of individuals who become increasingly restrictive in their food consumption, not based on concerns for quantity of food but the quality of food (eg, specific nutritional content or organically produced). The desire to improve one's health through optimal nutrition and food quality is the initial focus of the patient, and weight loss and/or malnutrition may ensue as various foods are eliminated from the diet. Individuals with orthorexia may spend excessive amounts of time in meal planning and experience extreme guilt or frustration when their food-related practices are interrupted.[55,56] Psychologically, this behavior appears to be related to AN and obsessive-compulsive disorder[57] and is considered by some to be a subset within the restrictive eating disorders. Vegetarianism is a lifestyle choice adopted by many adolescents and young adults that may sometimes signal underlying eating pathology.[58,59] In a comparison of adolescent and young adult females with and without a history of eating disorders, those with eating disorders were more likely to report ever having been vegetarian. Many of these young women acknowledged that their decision to become vegetarian was primarily motivated by their desire for weight loss, and most reported that they had done so at least a year after first developing eating disorder symptoms.[60]

In an attempt to improve performance or achieve a desired physique, adolescent athletes may engage in unhealthy weight-control behaviors.[61] The term "female athlete triad" has historically referred to (1) low energy availability that may or may not be related to disordered eating; (2) menstrual dysfunction; and (3) low bone mineral density (BMD) in physically active females.[62–65] Inadequate caloric intake in comparison to energy expenditure is the catalyst for endocrine changes and leads to decreased bone density and menstrual irregularities. Body weight may be stable. This energy imbalance may result from a lack of knowledge regarding nutritional needs in the athlete or from intentional intake restriction associated with disordered eating.

Hormonal disruption and low BMD can occur in undernourished male athletes as well.[66] Increased recognition of the role of energy deficiency in disrupting overall physiologic function in both male and female individuals led a 2014 International Olympic Committee consensus group to recommend replacing the term female athlete triad to the more inclusive term, "relative energy deficiency in sport."[67,68] Athletes participating in sports involving endurance, weight requirements, or idealized body shapes may be at particular risk of relative energy deficiency in sport. Signs and symptoms of relative energy deficiency, such as amenorrhea, bradycardia, or stress fractures, may alert pediatricians to this condition.

SCREENING FOR EATING DISORDERS

Pediatricians are in a unique position to detect eating disorders early and interrupt their progression. Annual health supervision visits and preparticipation sports examinations offer opportunities to screen for eating disorders. *Bright Futures: Guidelines for Health Supervision of Infants, Children, and Adolescents*, fourth edition, offers sample screening questions about eating patterns and body image.[69] Reported dieting, body image dissatisfaction, experiences of weight-based stigma, or changes in eating or exercise patterns invite further exploration. Positive responses on a standard review of symptoms may need further probing. For example, oligomenorrhea or amenorrhea (either primary or secondary) may indicate energy deficiency.[70] Serial weight and height measurements plotted on growth charts are invaluable. Weight loss or the failure to make expected weight gain may be more obvious when documented on a graph. Similarly, weight fluctuations or rapid weight gain may cue a health care provider to question binge eating or BN symptoms. Recognizing that

TABLE 3 Notable Physical Examination Features in Children and Adolescents With Eating Disorders

Features related to inadequate energy intake or malnutrition:
Deviation from previous growth trajectory when plotted on height, weight, and BMI graphs
Abnormal vital signs:
Low resting HR or BP
Orthostatic increase in HR (>20 beats per min) or decrease in BP (>10 mm Hg)
Hypothermia
Flat or anxious affect
Pallor, dry sallow skin; carotenemia (particularly palms and soles)
Cachexia: facial wasting, decreased subcutaneous fat, decreased muscle mass
Dull, thin scalp hair or lanugo
Cardiac murmur (one-third with mitral valve prolapse), cool extremities; acrocyanosis; poor perfusion
Stool mass left lower quadrant
Delayed or interrupted pubertal development
Small breasts; vaginal dryness
Small testes
Features related to purging:
Abnormal vital signs:
Orthostatic increase in HR (>20 beats per min) or decrease in BP (>10 mm Hg)
Angular stomatitis; palatal scratches; dental enamel erosions
Russell's sign (abrasion or callous on knuckles from self-induced emesis)
Salivary gland enlargement (parotid and submandibular)
Epigastric tenderness
Bruising or abrasions over the spine (related to excessive exercise or sit ups)
Features related to excess energy intake:
Deviation from previous growth trajectory when plotted on height, weight, and BMI curves
Obesity
Elevated BP or hypertension
Acanthosis nigricans, acne, hirsutism
Hepatomegaly
Premature puberty
Musculoskeletal pain

Adapted from Rosen; American Academy of Pediatrics.[208]

many patients who present to eating disorder treatment programs have or previously had elevated weight according to criteria from the Centers for Disease Control and Prevention,[71] it is worthwhile to carefully inquire about eating and exercise patterns when weight loss is noted in any child or adolescent. Screening for unhealthy and extreme weight-control measures before praising desirable weight loss can avoid inadvertently reinforcing these practices.

ASSESSMENT OF CHILDREN AND ADOLESCENTS WITH SUSPECTED EATING DISORDERS

A comprehensive assessment of a child or adolescent suspected of having an eating disorder includes a thorough medical, nutritional, and psychiatric history, followed by a detailed physical examination. A useful web resource for assessment is published in multiple languages by the Academy for Eating Disorders.[72] Relevant interview questions are listed in Table 2. A collateral history from a parent may reveal abnormal eating-related behaviors that were denied or minimized by the child or adolescent.

A full psychosocial assessment, including a home, education, activities, drugs/diet, sexuality, suicidality/depression (HEADSS) assessment is vital. This evaluation includes screening for physical or sexual abuse by using the principles of trauma-informed care and responding according to American Academy of Pediatrics guidance on suspected physical or sexual abuse or sexual assault[73–75] as well as state laws. Vital to the HEADSS assessment is an evaluation for symptoms of other potential psychiatric diagnoses, including suicidal thinking, which may have been unrecognized previously.

A comprehensive physical examination, including close attention to growth parameters and vital signs, allows the pediatrician to assess for signs of medical compromise and for signs and symptoms of eating disorder behaviors; findings may be subtle and, thus, overlooked without careful notice. For accuracy, weights are best obtained after the patient has voided and in an examination gown without shoes. Weight, height, and BMI can be evaluated by using appropriate growth charts. Low body temperature, resting blood pressure (BP), or resting heart rate (HR) for age may suggest energy restriction. Because a HR of 50 beats per minute or less is unusual even in college-aged athletes,[76] the finding of a low HR may be a sign of restrictive eating. Orthostatic vital signs (HR and BP, obtained after 5 minutes of supine rest and repeated after 3 minutes of standing)[77,78] revealing a systolic BP drop greater than 20 mm Hg, a diastolic BP drop greater than 10 mm Hg, or tachycardia may suggest volume depletion from restricted fluid intake or purging or a compromised cardiovascular system.

Pertinent physical findings in children and adolescents with eating disorders are summarized in Table 3. A differential diagnosis for the signs and symptoms of an eating disorder is found in Table 4, and selected medical complications of eating disorders are provided in Table 5.

LABORATORY EVALUATION

Initial laboratory evaluation is performed to screen for medical complications of eating disorders or to rule out alternate diagnoses (Tables 4 and 5). Typical initial laboratory testing includes

TABLE 4 Selected Differential Diagnosis for Eating Disorders According to Presentation

Clinical Presentations	Differential Diagnosis
Weight loss	
Gastrointestinal	Inflammatory bowel disease; celiac disease
Endocrine	Hyperthyroidism; diabetes mellitus; adrenal insufficiency
Infectious	Chronic infections, such as tuberculosis or HIV; intestinal parasite
Psychiatric	Depression; psychosis; anxiety or obsessive-compulsive disorder; substance use
Other	Neoplasm; superior mesenteric artery syndrome
Vomiting	Gastroesophageal reflux disease
Gastrointestinal disease	Gastroesophageal reflux disease
	Eosinophilic esophagitis
	Pancreatitis
	Cyclic vomiting
Neurologic	Increased intercranial pressure
	Migraine
Other	Food allergy
Binge eating or unexplained weight gain	
Endocrine	Hypothyroidism; hypercortisolism
Psychiatric	Depression
Iatrogenic	Medication side effect
Genetic	Prader Willi syndrome; Kleine-Levin syndrome

Adapted from Rome and Strandjord[89] and Rosen; American Academy of Pediatrics.[208]

a complete blood cell count; serum electrolytes, calcium, magnesium, phosphorus, and glucose; liver transaminases; urinalysis; and thyroid-stimulating hormone concentration.[72] Screening for specific vitamin and mineral deficiencies (eg, vitamin B_{12}, vitamin D, iron, and zinc) may be indicated on the basis of the nutritional history of the patient. Laboratory investigations are often normal in patients with eating disorders; normal results do not exclude the presence of serious illness with an eating disorder or the need for hospitalization for medical stabilization. An electrocardiogram is important for those with significant weight loss, abnormal cardiovascular signs (such as orthostasis or bradycardia), or an electrolyte abnormality. A urine pregnancy test and serum gonadotropin and prolactin levels may be indicated for girls with amenorrhea; a serum estradiol concentration may serve as a baseline for reassessment during

TABLE 5 Selected Medical Complications Resulting From Eating Disorders

Eating Disorder Behaviors	Medical Complications
Related to dietary restriction or weight loss	
Fluids and electrolytes	Dehydration; electrolyte abnormalities: hypokalemia, hyponatremia
Psychiatric	Depressed mood or mood dysregulation; obsessive-compulsive symptoms; anxiety
Neurologic	Cerebral cortical atrophy; cognitive deficits; seizures
Cardiac	Decreased cardiac muscle mass, right axis deviation, low cardiac voltage; cardiac dysrhythmias, cardiac conduction delays; mitral valve prolapse; pericardial effusion; congestive heart failure; edema
Gastrointestinal	Delayed gastric emptying, slowed gastrointestinal motility, constipation; superior mesenteric artery syndrome; pancreatitis; elevated transaminases; hypercholesterolemia
Endocrinologic	Growth retardation; hypogonadotropic hypogonadism: amenorrhea, testicular atrophy, decreased libido; sick euthyroid syndrome; hypoglycemia/hyperglycemia, impaired glucose tolerance; hypercholesterolemia; decreased BMD
Hematologic	Leukopenia, anemia, thrombocytopenia, elevated ferritin; depressed erythrocyte sedimentation rate
Related to vomiting	
Fluid and electrolytes	Electrolyte disturbance: hypokalemia, hypochloremia, metabolic alkalosis
Dental	Dental erosions
Gastrointestinal	Gastroesophageal reflux, esophagitis; Mallory-Weiss tears; esophageal or gastric rupture
Related to laxative use	
Fluids and electrolytes	Hyperchloremic metabolic acidosis; hypocalcemia
Gastrointestinal	Laxative dependence
Related to binge eating	Obesity with accompanying complications
Related to refeeding	Night sweats; polyuria, nocturia; refeeding syndrome: electrolyte abnormalities, edema, seizures, congestive heart failure (rare)
Seen among all eating disorder behaviors	Suicide

Adapted from Rosen; American Academy of Pediatrics.[208]

recovery.[79] Similarly, serum gonadotropin and testosterone levels can be useful to assess and monitor for central hypogonadism in boys with restrictive eating. Bone densitometry, by using dual radiograph absorptiometry analyzed with age-appropriate software, may be considered for those with amenorrhea for more than 6 to 12 months.[80,81] If there is uncertainty about the diagnosis, other studies including inflammatory markers, serological testing for celiac disease, serum cortisol concentrations, testing stool for parasites, or radiographic imaging of the brain or gastrointestinal tract may be considered. In the occasional patient, both an eating disorder and an organic illness, such as celiac disease, may be discovered.[82]

MEDICAL COMPLICATIONS IN PATIENTS WITH EATING DISORDERS

Eating disorders can affect every organ system[83,84] with potentially serious medical complications that develop as a consequence of malnutrition, weight changes, or purging. Details of complications are described in reviews[85–89] and are summarized in Table 5. Most medical complications resolve with weight normalization and/or resolution of purging. Complications of BED can include those of obesity; these are summarized in other reports and not reiterated here.[84,90]

Psychological and Neurologic Effects

Psychological symptoms can be primary to the eating disorder, a feature of a comorbid psychiatric disorder, or secondary to starvation. Initial symptoms of depression and anxiety may abate with refeeding.[91] Rumination about body weight and size is a core feature of AN, whereas rumination about food decreases as starvation reverses.[92] Difficulty in emotion regulation occurs across the spectrum of eating disorders but is more severe in those who binge eat or purge.[93] Cognitive function studies in a large population-based sample of adolescents revealed eating disorder participants had deficits in executive functioning, including global processing and cognitive flexibility but performed better than control participants on measures of visual attention and vigilance.[94]

Structural brain imaging studies to date have yielded inconsistent results, likely explained, at least in part, by methodologic differences and the need to control for many variables, including nutritional state, hydration, medication use, and comorbid illness.[95] A longitudinal study revealed that global cortical thinning in acutely ill adolescents and young adults with AN normalized with weight restoration over a period of approximately 3 months.[96]

Dermatologic Effects

Common skin changes in underweight patients include lanugo, hair thinning, dry scaly skin, and yellow discoloration related to carotenemia. Brittle nails and angular cheilitis may also be observed. Acrocyanosis can be observed in underweight patients and may be a protective mechanism against heat loss. Abrasions and calluses over the knuckles can occur from cutting the skin on incisors while self-inducing emesis.[97]

Dental and/or Oral Effects

Patients with eating disorders experience higher rates of dental erosion and caries. This occurs more frequently in those who self-induce emesis but can also be observed in those who do not.[98] Normal dental findings do not preclude the possibility that purging is occurring.[99] Hypertrophy of the parotid and other salivary glands, accompanied by elevations in serum amylase concentrations with normal lipase concentrations, may be a clue to vomiting.[99] Xerostomia, from either salivary gland dysfunction or psychiatric medication side effect, can reduce the oral pH, which can lead to increased growth of cariogenic oral bacteria.[98,100]

Cardiovascular Effects

Reports of cardiac complications in eating disorders are focused predominantly on restrictive eating disorders. Common cardiovascular signs include low HR, orthostasis, and poor peripheral perfusion. Orthostatic intolerance symptoms (eg, lightheadedness) and vital sign findings may resemble those of postural orthostatic tachycardia syndrome[101,102] and may contribute to a delay in referral to appropriate care if eating disorder behaviors are not disclosed or appreciated.

Cardiac structural changes include decreased left ventricular (LV) mass, LV end diastolic and LV end systolic volumes, functional mitral valve prolapse, pericardial effusion, and myocardial fibrosis (noted in adults).[103–105] Electrocardiographic abnormalities, including sinus bradycardia, and lower amplitude LV forces are more common in AN than in nonrestrictive eating disorders.[106] One study reported a nearly 10% prevalence of prolonged (>440 milliseconds) QTc interval in hospitalized adolescents and young adults with a restrictive eating disorder.[107] Repolarization abnormalities, a potential precipitant to lethal arrhythmia,[108] may prompt clinicians to also consider other factors, such as medication use or electrolyte abnormalities, that may affect cardiac conduction.[107,109]

Gastrointestinal Tract Effects

Gastrointestinal complaints are common and sometimes precede the diagnosis of the eating disorder. Delayed gastric emptying and slow intestinal transit time often contribute to reported sensations of nausea, bloating, and postprandial fullness[110] and may be a presenting feature of restrictive eating.

Constipation is a frequent experience for patients and multifactorial in etiology.[111] Esophageal mucosal damage from self-induced vomiting, including scratches, and bleeding secondary to Mallory-Weiss tears can occur.[99] Superior mesenteric artery syndrome may develop in the setting of severe weight loss.[111] Hepatic transaminase concentrations and coagulation times can be elevated as a consequence of malnutrition and, typically, normalize with appropriate nutrition.[110]

Renal and Electrolyte Effects

Fluid and electrolyte abnormalities may occur as a result of purging or cachexia.[99,112] Dehydration can be present in any patient with an eating disorder. Disordered osmotic regulation can present in many patterns (central and renal diabetes insipidus, syndrome of inappropriate antidiuretic hormone).[112] Patients who vomit may have a hypokalemic, hypochloremic metabolic alkalosis resulting from loss of gastric hydrochloric acid, chronic dehydration, and the subsequent increase in aldosterone that promotes sodium reabsorption in exchange for potassium and acid at the distal tubule level.[113] Patients who abuse laxatives may experience a variety of electrolyte and acid-base derangements.[113] Dilutional hyponatremia can be observed in patients who intentionally water load to induce satiety or to misrepresent their weight at clinic visits. Abrupt cessation of laxative use may be associated with peripheral edema and, therefore, motivate further laxative[114] or diuretic misuse.

Endocrine Effects

Restrictive eating disorders commonly cause endocrine dysfunction.[80,115] Euthyroid sick syndrome (low triiodothyronine, elevated reverse triiodothyronine, or normal or low thyroxine and thyroid-stimulating hormone) is the most common thyroid abnormality.[116] Functioning as an adaptive mechanism to starvation, supplemental thyroid hormone is not indicated when this pattern is noted.[116] Hypercortisolemia may be seen in AN.[81,116] Hypothalamic-pituitary-gonadal axis suppression may be attributable to weight loss, physical overactivity, or stress. Female individuals with AN may have amenorrhea, and male individuals can have small testicular volumes[117] and low testosterone concentrations.[118]

Growth retardation, short stature, and pubertal delay may all be observed in prepubertal and peripubertal children and adolescents with eating disorders.[115] AN is associated with low levels of insulin-like growth factor-1 and growth hormone resistance.[119] Catch-up growth has been inconsistently reported in the literature; younger patients may have greater and more permanent effects on growth.[120,121] Adolescent boys may be at an even greater risk for height deficits than girls; because boys typically enter puberty later than girls and experience their peak growth at a later sexual maturity stage, they are less likely to have completed their growth if an eating disorder develops in the middle teenage years.[119]

Low BMD is a frequent complication of eating disorders in both male and female patients[117] and is a risk in both AN and BN.[122] Low BMD is worrisome not only because of the increased risk of fractures in the short-term[123] but, also, because of the potential to irreversibly compromise skeletal health in adulthood.[124]

TREATMENT PRINCIPLES ACROSS THE EATING DISORDER SPECTRUM

The ultimate goals of care in eating disorders are that children and adolescents are nourished back to their full healthy weight and growth trajectory, that their eating patterns and behaviors are normalized, and that they establish a healthy relationship with food and their body weight, shape, and size as well as a healthy sense of self. Independent of a specific *DSM* diagnosis, treatment is focused on nutritional repletion and psychological therapy. Psychotropic medication can be a useful adjunct in select circumstances.

The Pediatrician's Role in Care

After diagnosing an eating disorder, the pediatrician arranges appropriate care. Patients who are medically unstable may require urgent referral to a hospital (Table 6). Patients with mild nutritional, medical, and psychological dysfunction may be managed in the pediatrician's office in collaboration with outpatient nutrition and mental health professionals with specific expertise in eating disorders. Because an early response to treatment may be associated with better outcomes,[125,126] timely referral to a specialized multidisciplinary team is preferred, when available. If resources do not exist locally, pediatricians may need to partner with health experts who are farther away for care. For patients who do not improve promptly with outpatient care, more intensive programming (eg, day-treatment programs or residential settings) may be indicated.

Often, an early task of the pediatrician is to identify a treatment goal weight. This goal weight may be determined in collaboration with a registered dietitian. Pediatricians who are planning to refer the patient to a specialized treatment team may opt to defer the task to the team. Acknowledging that body weights naturally fluctuate, the treatment goal weight is often expressed as a goal range. Individualized treatment goal weights are formulated on the basis of age, height, premorbid growth trajectory, pubertal stage, and menstrual history.[87,127] In a study of adolescent girls with AN, of those who resumed menses during

TABLE 6 Indications Supporting Hospitalization in an Adolescent With an Eating Disorder

One or More of the Following Justify Hospitalization
1. ≤75% median BMI for age and sex (percent median BMI calculated as patient BMI/50th percentile BMI for age and sex in reference population × 100)
2. Dehydration
3. Electrolyte disturbance (hypokalemia, hyponatremia, hypophosphatemia)
4. ECG abnormalities (eg, prolonged QTc or severe bradycardia)
5. Physiologic instability:
a. Severe bradycardia (HR <50 beats per min daytime; <45 beats per min at night);
b. Hypotension (90/45 mm Hg);
c. Hypothermia (body temperature <96°F, 35.6°C);
d. Orthostatic increase in pulse (>20 beats per min) or decrease in BP (>20 mm Hg systolic or >10 mm Hg diastolic)
6. Arrested growth and development
7. Failure of outpatient treatment
8. Acute food refusal
9. Uncontrollable binge eating and purging
10. Acute medical complications of malnutrition (eg, syncope, seizures, cardiac failure, pancreatitis and so forth)
11. Comorbid psychiatric or medical condition that prohibits or limits appropriate outpatient treatment (eg, severe depression, suicidal ideation, obsessive-compulsive disorder, type 1 diabetes mellitus)

Reprinted with permission from the Society for Adolescent Health and Medicine.[85] ECG, electrocardiogram.

treatment, this occurred, on average, at 95% of the treatment goal weight.[128] Health care providers may be pressured by patients, their patients' parents, or other health care providers to target a treatment goal weight that is lower than the previous growth trajectory or other clinical indicators would suggest is appropriate. If a treatment goal weight is inappropriately low, there is an inherent risk of offering only partial weight restoration and insufficient treatment.[129] The treatment goal weight is reassessed at regular intervals (eg, every 3–6 months) to account for changes in physical growth and development (in particular, age, height, and sexual maturity).[87,127]

An important role for the pediatrician is to offer guidance regarding eating and to manage the physical aspects of the illnesses. For all classifications of eating disorders, reestablishing regular eating patterns is a fundamental early step. Meals and snacks are reintroduced or improved in a stepwise manner, with 3 meals and frequent snacks per day. Giving the message that "food is the medicine that is required for recovery" and promoting adherence to taking that medicine at scheduled intervals often helps patients and families get on track.[130] A multivitamin with minerals can help ensure that deficits in micronutrients are addressed. To optimize bone health, calcium and vitamin D supplements can be dosed to target recommended daily amounts (elemental calcium: 1000 mg for patients 4–8 years of age, or 1300 mg for patients 9–18 years of age; vitamin D: 600 IU for patients 4–18 years of age).[87,131] Patients can be reassured that the bloating discomfort caused by slow gastric emptying improves with regular eating. When constipation is troubling, nutritional strategies, including weight restoration, are the treatments of choice.[111] When these interventions are inadequate to alleviate constipation, osmotic (eg, polyethylene glycol 3350) or bulk-forming laxatives are preferred over stimulant laxatives. The use of nonstimulant laxatives decreases the risks of electrolyte derangement and avoids the potential hazard of "cathartic colon syndrome" that may be associated with abuse of stimulant cathartics (senna, cascara, bisacodyl, phenolphthalein, anthraquinones).[99,114]

To optimize dental outcomes, patients can be encouraged to disclose their illness to their dentist. Current dental hygiene recommendations for patients who vomit include the use of topical fluoride, applied in the dental office or home, or use of a prescription fluoride (5000 ppm) toothpaste. Because brushing teeth immediately after vomiting may accelerate enamel erosion, patients can be advised to instead rinse with water, followed by using a sodium fluoride rinse whenever possible.[132]

AN

Collaborative Outpatient Care

Most patients with AN are treated in outpatient settings.[85,133] Pediatricians play an important role in the medical management and coordination of the treatment of these patients. The pediatrician plays a primary role in assessing for and managing acute and long-term medical complications, monitoring treatment progress, and coordinating care with nutritional and mental health colleagues.[85,130,134] Although some primary care pediatricians feel comfortable coordinating care, others choose to refer patients to providers with expertise in pediatric eating disorders. Ideally, all members of the treatment team are sensitive to the unique

developmental needs of children and adolescents.[133]

Educating young people and their parents about the physiologic and psychological effects of food restriction is an early component of care. Parents are empowered to feed their children regularly (typically 3 meals and 2–3 snacks per day) and adjust portion size and energy richness based on weight progress. Many parents are amazed to discover the amount of energy (3500 kcal or more) that may be required to restore weight for their children. Detailed tracking of caloric intake is not necessary. Serving foods with high caloric density and ensuring that beverages are energy rich (eg, choosing fruit juice or milk instead of water) are effective strategies to maximize energy intake without requiring large increases in volume. Parents can relieve adolescents of having to decide on appropriate serving sizes by plating meals for them. Accommodating special diets, such as vegetarian or vegan, can make meeting nutritional goals especially challenging. Reintroducing foods that have been avoided or that induce fear of weight gain are essential steps on the path to recovery.

Family-Based Treatment and Parent-Focused Therapy

Over the past 2 decades, a specialized eating disorder–focused, family-based intervention, commonly referred to as family-based treatment (FBT), has emerged as the leading first-line treatment approach for pediatric eating disorders.[135] Effectiveness is well established for AN.[133,136] Rather than dwelling on possible causes of the eating disorder, FBT is focused on recovery from the disease. FBT consists of 3 phases and contends that parents are not to blame for their child's illness, eating disorders are not caused by dysfunctional families, and parents play an essential role in recovery.[136] During appointments, the entire family unit meets with the therapist. In phase 1, weight restoration is the primary goal. Parents, supported by the therapist, take responsibility to ensure that their child eats sufficiently and limit pathologic weight-control behaviors. Parents are encouraged to take responsibility for meal planning and preparation. Pediatricians can be helpful by reminding parents of the importance of fighting the disease effectively in the early stages, with the goals of reaching a truly healthy weight, resuming pubertal development, reversing medical complications, and restoring normal cognitions. Early weight gain (4–5 pounds by session 4, typically correlating with 4 weeks of treatment) is predictive of better outcomes in adolescents.[126,137,138] By phase 2, substantial weight recovery has occurred, and the adolescent gradually resumes responsibility for his or her own eating. By phase 3, weight has been restored, and the therapy shifts to address general issues of adolescent psychosocial development.[136] This therapy is detailed in manuals for providers[137] and families.[139] FBT with experienced providers is not available in all communities. Nevertheless, community providers may integrate the essential principles of FBT in their work with patients and families.[130]

Parent-focused therapy is an adaptation of FBT wherein the therapist supports the parents to renourish the patient and limit weight-control behaviors but, after the initial appointment, meets only with the parents.[140] The patient has brief visits with a nurse or physician for the assessment of weight and acute mental health issues but is not directly involved with a therapist.

The role pediatricians serve in the care of an adolescent in FBT differs from the customary role of a physician with patients.[134] In the FBT setting, the pediatrician does not weigh the patient because that task is performed by the therapist. The pediatrician directs the care only when there are immediate medical safety concerns. If the pediatrician identifies an urgent medical issue that requires intervention or hospitalization, he or she is obligated to provide recommendations to the patient, the parents, and the primary therapist. For the medically stable patient, the pediatrician acts as a consultant to the parents and primary therapist. When a parent asks a question related to treatment, instead of directly advising the parents what to do, the pediatrician, ideally, redirects that treatment decision back to the parent: "You know your child the best. What do you think will best help in your child's recovery?" In this way, the physician empowers parents to make their own decisions, enhancing their confidence to care for their ill child.

Day-Treatment Programs

Day-treatment programs (day hospitalization and partial hospitalization) provide an intermediate level of care for patients with eating disorders who are medically stable and do not require 24-hour supervision but need more than outpatient care.[133,141] These programs may prevent the need for higher levels of care or may be a "step-down" from inpatient or residential to outpatient care. Day treatment typically involves 8 to 10 hours per day of care (including meals, therapy, groups, and other activities) by a multidisciplinary staff 5 days per week. Reported evaluations of child and adolescent day-treatment programs are few and observational in design.[142–145] Despite the absence of systematic data supporting their usefulness, these programs are generally believed to have an important role in the continuum of care.

Residential Treatment

Residential treatment may be necessary for a minority of medically stable patients with eating disorders. Indications for residential treatment include a poor motivation for recovery, need for structure and supervision to prevent unhealthy behaviors (eg, food restriction, compulsive exercise), lack of a supportive family environment, absence of outpatient treatment in the patient's locale,[146] or outpatient interventions having been unsuccessful.[133] Residential treatment typically includes 24 hour per day supervision, medical oversight, group-based psychoeducational therapy, nutritional counseling, individual therapy, and family therapy. The length of stay can be weeks to months, depending on the severity of illness and financial resources. Outcome studies reported by residential programs, generally, reveal improved symptomatology at discharge,[147] but the results at long-term follow-up are mixed.[148,149] However, few outcome studies are focused on adolescents, compare the efficacy of residential to outpatient treatment, or make comparisons across programs or treatment modalities.

Although some adolescents require this higher level of care, health care providers and families are encouraged to exercise caution when selecting a residential treatment program. The number of residential programs has more than tripled in the last decade, with many operated by for-profit companies. Marketing practices by some are questionable.[150] Outcome studies demonstrating program efficacy may be misleading because of a lack of rigorous design or peer review.[151] Until recently, there was no certification process to ensure program quality and safety. In 2016, The Joint Commission implemented new accreditation standards for behavioral health care organizations that provide outpatient or residential eating disorder treatment.[152] It remains to be seen how many programs will pursue this accreditation.

The National Eating Disorders Association Web site offers useful suggestions for evaluating treatment programs (www.nationaleatingdisorders.org).

Hospital-Based Stabilization

Suggested indications for the hospitalization of children and adolescents with eating disorders published by the Society for Adolescent Health and Medicine are listed in Table 6.

The most common goal for hospital-based stabilization is nutritional restoration. Variation occurs with regard to how quickly hospitalized patients with AN are refed.[153,154] It is important to balance 2 competing goals: achieve weight gain swiftly and avoid refeeding syndrome.[155] Refeeding syndrome refers to the metabolic and clinical changes that occasionally occur when a malnourished patient is aggressively nutritionally rehabilitated; the hallmarks are hypophosphatemia and multiorgan dysfunction.[155–157] A systematic review of hospitalized adolescents with AN reported an average incidence of refeeding hypophosphatemia (without necessarily organ dysfunction) of 14%.[158] Over the past decade, a long followed maxim, "start low and go slow," has been challenged.[87,155] Several centers have described starting calories at 1400 kcal or more per day,[154] including recent reports demonstrating safe treatment of mildly and moderately malnourished adolescents by using initial caloric prescriptions of 2200 to 2600 kcal per day, while achieving a weight gain of approximately 3 to 4.5 pounds per week.[159,160] Because the risk of refeeding hypophosphatemia may correlate with the degree of starvation, pediatricians may opt to take a more cautious approach in severely malnourished (<70% median BMI) children until further studies are reported.[87,154]

Nasogastric tube (NGT) feeding may be necessary for some hospitalized adolescents, but opinions vary regarding when they should be initiated.[161] Most North American programs reserve NGT feeds for when patients are not able to complete meals; however, internationally, some centers report the routine use of NGT feeding, either exclusively at first or in combination with meals.[162,163] Potential benefits of NGT feeding include faster weight gain and medical stabilization, with a possibility for a reduced hospital length of stay.[162,163] Although viewed by some health care providers as invasive or punitive, others view NGT feeding as empathic, by reducing both physical and psychological pain in the early treatment stages.[161] There is insufficient evidence to recommend one approach over another.[154] Independent of whether NGT feeds are used routinely, physicians involved in the treatment of hospitalized medically unstable patients may be called on to provide nutrition via an NGT when nutritional needs are not being met. The use of total parenteral nutrition carries higher risks of medical complications, is costly, and is not recommended unless other forms of refeeding are not possible.[154]

High-quality studies in which researchers examine the impact of inpatient care are limited, and the best end point for hospital treatment of children and adolescents is unclear. A US multicenter research collaborative showed that, in a national cohort of low-weight 9- to 21-year-olds with restrictive eating disorders, those who were hospitalized had a greater odds of being at 90% of the median BMI at 1-year follow-up.[164] However,

a randomized controlled trial (RCT) of treatment of adolescent AN in the United Kingdom revealed no benefits of inpatient over outpatient care[165]; this study was limited by poor adherence to the allocated treatment. An RCT in Germany in 2014 revealed that inpatient adolescents discharged earlier to outpatient treatment fared as well as those discharged later.[141] Similarly, an RCT conducted in Australia in 2015 revealed that adolescents who were discharged to FBT as soon as they were medically stable fared at least as well as adolescents who remained inpatients until achieving 90% of their treatment goal weight.[166] The recently reported average length of stay in the United States for patients admitted for medical stabilization by using higher caloric prescriptions was 3 to 12 days.[159,167,168]

Pharmacotherapy for AN

A variety of medications have been studied for the treatment of AN, primarily in adults, but none have been approved for this indication by the US Food and Drug Administration (FDA).[169] Despite their demonstrated ineffectiveness,[170] more than one-half of adolescents with restrictive eating disorders are prescribed psychotropic medications, most likely in attempts to treat comorbid conditions, such as depression and anxiety.[171] Selective serotonin-reuptake inhibitors (SSRIs) have been tried but are not effective in acutely ill, malnourished patients and have not been shown to prevent disease relapse in those who are weight restored.[172–174] A number of atypical antipsychotic medications have also been studied, including quetiapine, risperidone, and olanzapine. Results have generally revealed little benefit in weight gain or improvement in eating-disorder thinking.[169,175–178] Initial studies of augmentation of SSRIs with atypical antipsychotics in adult patients have been promising.[179]

The current recommendations to optimize bone health are full weight restoration with physiologic resumption of menses and supplementation with calcium and vitamin D.[79,81,87,115] Bisphosphonate treatment is not recommended.[79,87,115] Estrogen supplementation in the form of combined estrogen-progesterone oral contraceptive pills is not effective in enhancing BMD in adolescents with AN.[81] Small trials with transdermal estrogen[180] or with low-dose combined oral contraceptive pills plus dehydroepiandrosterone[181] have shown a positive effect on BMD compared with controls, but further studies are needed before these are considered standard care. Although cyclic vaginal bleeding may be induced with the use of exogenous hormones, this may reinforce a patient's denial of the medical consequences of her disease and masks the spontaneous return of menses.

BN and BED

Collaborative Outpatient Care

Most patients with BN and BED are managed in outpatient settings with the collaboration of a medical and mental health care providers as well as a dietitian, as needed.

Psychological treatment studies are more limited in BN compared with AN and are especially lacking in BED.[133] Cognitive behavioral therapy (CBT) has a modest evidence-base for BN and BED.[133,182] CBT explicitly recognizes the interrelationships among an individual's thoughts, feelings, and actions, and its principles can be used by all disciplines. Reestablishing regular eating patterns is a central goal, and educating patients about the perpetuating nature of the restriction-binge-purge cycle is an early focus. Patients with BN and BED can minimize the urge to binge that is typically experienced late in the day, if they eat regularly throughout the day. Decreasing the binge amount and frequency may decrease guilt and shame and the ensuing negative self-assessment. During CBT, patients are taught to question their distorted thoughts and remodel their eating behaviors.[182]

FBT

Although there is a manual to guide FBT for patients with BN,[183] it is based on more limited evidence than FBT for AN.[182] An RCT comparing FBT with CBT revealed patients in the FBT group were more likely to abstain from binge eating and purging at the end of the 18-week treatment (39% vs 20%) with no statistical difference (49% vs 32%) at 1-year follow-up.[184] There are no published studies in which researchers examine FBT for BED.

Pharmacotherapy for BN

As with other pharmacotherapy research, studies of treatment of BN have primarily been in adult subjects. Several pharmacologic agents, including SSRIs, have been demonstrated to be effective for the treatment of adult BN, although only fluoxetine has FDA approval. Although not approved for pediatric BN, fluoxetine is FDA approved for child and adolescent depression and obsessive-compulsive disorder, so it is a reasonable option if pharmacologic treatment of BN is considered.[169] The antiepileptic topiramate has been shown to significantly decrease binge eating in adults who do not respond to or are not able to tolerate SSRIs. However, cases of topiramate triggering eating disorder symptoms in adolescents have been reported.[185] Other drugs, including naltrexone and ondansetron, are being used with some success in adult BN, although data are lacking to recommend their use more broadly.[169]

Pharmacotherapy for BED

Research on the treatment of binge eating lags behind that for other eating disorders and has been focused on adult subjects. SSRIs have rarely differed from placebo in their effect on BED and show no better outcome than behavioral therapy alone. Although the use of topiramate has been shown to reduce binge eating and help with weight loss, the rates of adverse effects are relatively high.[186] Lisdexamfetamine, a central nervous system stimulant approved for treatment of attention-deficit/hyperactivity disorder, was approved by the FDA in 2015 for the treatment of moderate to severe BED in adults. Although it has been demonstrated to reduce the frequency of binge-eating episodes, lisdexamfetamine is not indicated for weight loss. As with the use of other central nervous system stimulants, there is a potential for abuse and dependence as well as serious cardiovascular reactions.[187]

ARFID

ARFID is a relatively new diagnosis, and, consequently, there is limited literature describing treatment.[188,189] Because patients with ARFID vary in terms of underlying psychological motivations for restrictive eating, individualized behavioral treatment strategies are needed.[182,190] Despite varying characteristics of the disorder, the dual goals of refeeding and normalization of eating align with the goals of treating other eating disorders. A study of pediatric and young adult patients admitted with ARFID at a single academic medical center reported that ARFID patients were more likely to require enteral nutrition and stayed in the hospital longer than patients with AN.[9]

No medication is specifically indicated for use in ARFID; pharmacotherapy is directed at treating underlying comorbid illness (eg, anxiety) as necessary.

FINANCIAL CONSIDERATIONS

The treatment of eating disorders is multidisciplinary, often long-term, and may require expensive, high-level care, such as inpatient stabilization or residential or partial hospitalization programs. The costs associated with treatment can create substantial financial burdens for families.[191] Having medical insurance, public or private, is no guarantee that these costs will be covered.[192] Insurance carriers are able to define their own criteria for eating disorder treatment, leading to wide variations in coverage from state to state. Some states do not identify eating disorders as life-threatening conditions, thereby limiting treatment coverage. State-sponsored public insurance plans may not cover out-of-state treatment programs, even when no comparable treatment programs exist within that state. Outpatient mental health providers who are willing to accept the lower payments from public insurance may have no expertise in treating eating disorders. Those who do and will see publicly insured patients or those in managed care plans typically limit the number of these patients in their panels. Private insurance may increase access to treatment but dictate lower levels and shorter periods of care than is indicated by a patient's clinical status and health care provider recommendation. Families of patients with eating disorders typically will need assistance navigating the financial aspects of treatment. The National Eating Disorders Association offers general information online for families regarding financial coverage for treatment (www.nationaleatingdisorders.org).

PROGNOSIS

The prognoses reported for adolescents with eating disorders vary widely, depending on research methodology, definitions of recovery, and duration of follow-up. Generally, adolescents have greater success in recovery from eating disorders than their adult counterparts,[193] with overall recovery rates of approximately 70%.[194]

In a review of 11 adolescent eating disorder treatment programs, 54% of patients treated for restrictive disorders had restored to at least 90% of their median body weight (MBW) for age and height at 1-year follow-up. This is essential for catch-up growth and resumption of menses in girls. Two significant predictors of weight recovery were a higher percentage of MBW at initial presentation and shorter duration of symptoms, highlighting the importance of early identification of these disorders. Outcomes did not vary meaningfully across programs, suggesting that all treatment models were helpful.[195]

In a more-recent study, researchers examined the weight restoration of patients from 14 adolescent treatment programs with a diagnosis of a restrictive eating disorder by *DSM-5* criteria. At 1-year follow-up, those with ARFID were the least likely (43%) to have regained ≥90% MBW and were also more likely to be younger, have had a longer duration of symptoms, and have left treatment prematurely. Eighty-two percent of those with atypical AN and 64% of those with AN had regained ≥90% MBW. Having received a higher level of care (eg, partial hospitalization and/or residential care) did not increase the likelihood of weight recovery. Again, there were no significant differences in outcomes between programs, despite various treatment modalities.[196]

Information on the long-term prognosis of adolescents with AN

is limited. In a study of adolescents who completed a 12-month outpatient AN treatment study (either FBT or adolescent-focused therapy), approximately one-third of patients were in full remission 1 year after completion, with better rates in the FBT group (49%) than in the adolescent-focused therapy group (23%).[197] Follow-up in a convenience sample of the original study 2 to 4 years after treatment revealed less than 10% of patients relapsed, with no difference between the 2 groups.[198] An RCT comparing parent-focused therapy with FBT demonstrated equivalent outcomes between the groups at 12-month follow-up (37% vs 29%).[140]

Information about recovery from BN, BED, and purging disorder in adolescents is less available but suggests higher rates of relapse and the development of comorbidities. Outcome studies on BN in adults reveal variable recovery rates, ranging from approximately 50% to 70% at 4- to 6-year follow-up, with relapse rates of 30% and about 25% having chronic disease.[194] A longitudinal study of adolescent girls with BED and purging disorders into early adulthood revealed that one-quarter of these girls started to use drugs other than marijuana, more than one-third began to binge drink frequently, and 27% demonstrated high levels of depressive symptoms.[199] Not surprisingly, misuse of drugs and alcohol among patients with eating disorders is associated with a poorer outcome or death.[193]

Mortality rates among individuals with eating disorders are substantially elevated in comparison with those of the general population, with death typically occurring in adulthood. Premature death is 4 to 5 times higher for patients with AN and 2 to 3 times as high for those with BN.[200–203] Suicide rates are increased among patients with eating disorders[204] and, in one study, accounted for 30% deaths.[203] In a national survey of adolescents, 35% of those meeting criteria for BN, 15% of those meeting criteria for BED, and 8% of those meeting criteria for AN reported having made a suicide attempt.[205] The risk of suicide among patients with eating disorders appears to be declining and has been attributed to an increased recognition of eating disorders and effective treatment.[206]

PEDIATRICIAN'S ROLE IN PREVENTION AND ADVOCACY

Efforts to prevent eating disorders may occur in clinical practice and community settings. By using sensitive, nonstigmatizing language and demonstrating supportive attitudes toward children and adolescents of all body shapes and sizes, pediatricians create a welcoming clinical setting for discussions about weight and weight-related behaviors. The American Academy of Pediatrics clinical report "Preventing Obesity and Eating Disorders in Adolescents" highlights steps that pediatricians can take to prevent both conditions.[207] These steps include focusing on healthy habits with patients and families rather than weight and dieting, encouraging more frequent family meals, discouraging "weight talk" and "weight teasing" in the home, closely monitoring weight loss in patients advised to lose weight, and promoting a healthy body image in all children and adolescents.[207] Pediatricians may also advise teachers, coaches, and athletic trainers about healthy approaches to nutrition and exercise, raise awareness of the detrimental effects of weight stigmatization, and alert them to the warning signs of eating disorders.

Pediatricians can join others in advocating for improved access to quality eating disorder treatment services. The limited availability of developmentally appropriate mental health services, lack of mental health parity, and service "carve-outs" all have been barriers to patients and families who seek necessary treatment and seem to be disproportionately problematic for patients with eating disorders. Despite evidence of its effectiveness, FBT is not available in many communities. Through advocacy, pediatricians can help support health care reform efforts that will enable children and adolescents with eating disorders to access necessary care.

GUIDANCE FOR PEDIATRICIANS

1. Pediatricians should be knowledgeable about the variety of risk factors and early signs and symptoms of eating disorders in both male and female children and adolescents. Pediatricians should screen patients for disordered eating and unhealthy weight-control behaviors at annual health supervision visits. Pediatricians should evaluate weight, height, and BMI by using age- and sex-appropriate charts, assess menstrual status in girls, and recognize the changes in vital signs that may signal the presence of an eating disorder.
2. When an eating disorder is suspected, pediatricians, in conjunction with appropriate consultants, should initiate a comprehensive evaluation of the patient that includes both medical and psychological assessments as well as suicide risk appraisal. Once diagnosed, patients should be monitored for medical and nutritional

complications by their pediatrician or referred to other qualified practitioners for medical oversight.

3. To facilitate multidisciplinary care, pediatricians should refer their patients with eating disorders to treatment resources in their region when available. Ideally, these treatment program providers should have expertise in the unique developmental needs of this age group.
4. Pediatricians are encouraged to advocate for legislation and policy changes that ensure appropriate services for patients with eating disorders, including medical care, nutritional intervention, mental health treatment, and care coordination, in settings that are appropriate for the developmental level of the patient and severity of the illness.

LEAD AUTHORS

Laurie L. Hornberger, MD, MPH
Margo A. Lane, MD, FRCPC

COMMITTEE ON ADOLESCENCE, 2018–2019

Cora C. Breuner, MD, MPH, Chairperson
Elizabeth M. Alderman, MD, FSAHM
Laura K. Grubb, MD, MPH
Makia Powers, MD, MPH
Krishna Kumari Upadhya, MD
Stephenie B. Wallace, MD

LIAISONS

Laurie L. Hornberger, MD, MPH – *Section on Adolescent Health*
Margo A. Lane, MD FRCPC – *Canadian Pediatric Society*
Meredith Loveless, MD – *American College of Obstetricians and Gynecologists*
Seema Menon, MD – *North American Society of Pediatric and Adolescent Gynecology*
Lauren Zapata, PhD, MSPH – *Centers for Disease Control and Prevention*
Liwei Hua, MD, PhD – *American Academy of Child and Adolescent Psychiatry*

STAFF

Karen Smith
James Baumberger, MPP

ABBREVIATIONS

AN: anorexia nervosa
ARFID: avoidant/restrictive food intake disorder
BED: binge-eating disorder
BMD: bone mineral density
BN: bulimia nervosa
BP: blood pressure
CBT: cognitive behavioral therapy
DSM-5: *Diagnostic and Statistical Manual of Mental Disorders Fifth Edition*
FBT: family-based treatment
FDA: Food and Drug Administration
HEADSS: home, activities, drugs/diet, sexuality, suicidality/depression
HR: heart rate
LV: left ventricular
MBW: median body weight
NGT: nasogastric tube
RCT: randomized controlled trial
SSRI: selective serotonin-reuptake inhibitor

PEDIATRICS (ISSN Numbers: Print, 0031-4005; Online, 1098-4275).

FINANCIAL DISCLOSURE: The authors have indicated they have no financial relationships relevant to this article to disclose.

FUNDING: No external funding.

POTENTIAL CONFLICT OF INTEREST: The authors have indicated they have no potential conflicts of interest to disclose.

REFERENCES

1. Weiselberg EC, Gonzalez M, Fisher M. Eating disorders in the twenty-first century. *Minerva Ginecol*. 2011;63(6):531–545
2. American Psychiatric Association. *Diagnostic and Statistical Manual of Mental Disorders*, 5th ed. Washington, DC: American Psychiatric Association Publishing; 2013
3. Ornstein RM, Rosen DS, Mammel KA, et al. Distribution of eating disorders in children and adolescents using the proposed DSM-5 criteria for feeding and eating disorders. *J Adolesc Health*. 2013;53(2):303–305
4. Call C, Walsh BT, Attia E. From DSM-IV to DSM-5: changes to eating disorder diagnoses. *Curr Opin Psychiatry*. 2013;26(6):532–536
5. Ornstein RM, Katzman DK. Child and adolescent feeding and eating disorders and the DSM-5: a brave new world. *Adolesc Med State Art Rev*. 2014;25(2):360–376
6. Norris ML, Spettigue WJ, Katzman DK. Update on eating disorders: current perspectives on avoidant/restrictive food intake disorder in children and youth. *Neuropsychiatr Dis Treat*. 2016;12:213–218
7. Fisher MM, Rosen DS, Ornstein RM, et al. Characteristics of avoidant/restrictive food intake disorder in children and adolescents: a "new disorder" in DSM-5. *J Adolesc Health*. 2014;55(1):49–52
8. Nicely TA, Lane-Loney S, Masciulli E, Hollenbeak CS, Ornstein RM. Prevalence and characteristics of avoidant/restrictive food intake disorder in a cohort of young patients in day treatment for eating disorders. *J Eat Disord*. 2014;2(1):21
9. Strandjord SE, Sieke EH, Richmond M, Rome ES. Avoidant/restrictive food intake disorder: illness and hospital

course in patients hospitalized for nutritional insufficiency. *J Adolesc Health*. 2015;57(6):673–678

10. Murray SB, Anderson LK. Deconstructing "atypical" eating disorders: an overview of emerging eating disorder phenotypes. *Curr Psychiatry Rep*. 2015;17(11):86
11. Smink FRE, van Hoeken D, Hoek HW. Epidemiology of eating disorders: incidence, prevalence and mortality rates. *Curr Psychiatry Rep*. 2012;14(4): 406–414
12. Lindvall Dahlgren C, Wisting L. Transitioning from DSM-IV to DSM-5: a systematic review of eating disorder prevalence assessment. *Int J Eat Disord*. 2016;49(11):975–997
13. Swanson SA, Crow SJ, Le Grange D, Swendsen J, Merikangas KR. Prevalence and correlates of eating disorders in adolescents. Results from the national comorbidity survey replication adolescent supplement. *Arch Gen Psychiatry*. 2011;68(7):714–723
14. Marzilli E, Cerniglia L, Cimino S. A narrative review of binge eating disorder in adolescence: prevalence, impact, and psychological treatment strategies. *Adolesc Health Med Ther*. 2018;9:17–30
15. Fisher M, Gonzalez M, Malizio J. Eating disorders in adolescents: how does the DSM-5 change the diagnosis? *Int J Adolesc Med Health*. 2015;27(4):437–441
16. Wang ML, Walls CE, Peterson KE, et al. Dietary and physical activity factors related to eating disorder symptoms among middle school youth. *J Sch Health*. 2013;83(1):14–20
17. Gee L, Peebles R, Golden NH, Storfer-Isser A, Heinberg LJ, Horwitz SM. Language spoken at home and parental birthplace moderate the association of race/ethnicity and distorted weight perception. *Clin Pediatr (Phila)*. 2012; 51(12):1155–1163
18. Marques L, Alegria M, Becker AE, et al. Comparative prevalence, correlates of impairment, and service utilization for eating disorders across US ethnic groups: implications for reducing ethnic disparities in health care access for eating disorders. *Int J Eat Disord*. 2011;44(5):412–420
19. Striegel-Moore RH, Rosselli F, Holtzman N, Dierker L, Becker AE, Swaney G. Behavioral symptoms of eating disorders in Native Americans: results from the ADD Health Survey Wave III. *Int J Eat Disord*. 2011;44(6):561–566
20. Rodrigues M. Do Hispanic girls develop eating disorders? A critical review of the literature. *Hisp Health Care Int*. 2017;15(4):189–196
21. Mitchison D, Hay P, Slewa-Younan S, Mond J. The changing demographic profile of eating disorder behaviors in the community. *BMC Public Health*. 2014;14:943
22. Pinhas L, Morris A, Crosby RD, Katzman DK. Incidence and age-specific presentation of restrictive eating disorders in children: a Canadian Paediatric Surveillance Program study. *Arch Pediatr Adolesc Med*. 2011;165(10): 895–899
23. Peebles R, Wilson JL, Lock JD. How do children with eating disorders differ from adolescents with eating disorders at initial evaluation? *J Adolesc Health*. 2006;39(6):800–805
24. Raevuori A, Keski-Rahkonen A, Hoek HW. A review of eating disorders in males. *Curr Opin Psychiatry*. 2014;27(6): 426–430
25. Vo M, Lau J, Rubinstein M. Eating disorders in adolescent and young adult males: presenting characteristics. *J Adolesc Health*. 2016;59(4):397–400
26. Räisänen U, Hunt K. The role of gendered constructions of eating disorders in delayed help-seeking in men: a qualitative interview study. *BMJ Open*. 2014;4(4):e004342
27. Darcy AM. Eating disorders in adolescent males: an critical examination of five common assumptions. *Adolesc Psychiatry (Hilversum)*. 2011;1(4):307–312
28. Calzo JP, Horton NJ, Sonneville KR, et al. Male eating disorder symptom patterns and health correlates from 13 to 26 years of age. *J Am Acad Child Adolesc Psychiatry*. 2016;55(8):693–700.e2
29. Piacentino D, Kotzalidis GD, Del Casale A, et al. Anabolic-androgenic steroid use and psychopathology in athletes. A systematic review. *Curr Neuropharmacol*. 2015;13(1):101–121
30. Valente S, Di Girolamo G, Forlani M, et al. Sex-specific issues in eating disorders: a clinical and psychopathological investigation. *Eat Weight Disord*. 2017;22(4):707–715
31. Haines J, Neumark-Sztainer D. Prevention of obesity and eating disorders: a consideration of shared risk factors. *Health Educ Res*. 2006; 21(6):770–782
32. Corsica JA, Hood MM. Eating disorders in an obesogenic environment. *J Am Diet Assoc*. 2011;111(7):996–1000
33. Rancourt D, McCullough MB. Overlap in eating disorders and obesity in adolescence. *Curr Diab Rep*. 2015; 15(10):78
34. Flament MF, Henderson K, Buchholz A, et al. Weight status and DSM-5 diagnoses of eating disorders in adolescents from the community. *J Am Acad Child Adolesc Psychiatry*. 2015; 54(5):403–411.e2
35. Pont SJ, Puhl R, Cook SR, Slusser W; Section on Obesity; Obesity Society. Stigma experienced by children and adolescents with obesity. *Pediatrics*. 2017;140(6):e20173034
36. Sim LA, Lebow J, Billings M. Eating disorders in adolescents with a history of obesity. *Pediatrics*. 2013;132(4). Available at: www.pediatrics.org/cgi/content/full/132/4/e1026
37. Kennedy GA, Forman SF, Woods ER, et al. History of overweight/obesity as predictor of care received at 1-year follow-up in adolescents with anorexia nervosa or atypical anorexia nervosa. *J Adolesc Health*. 2017;60(6):674–679
38. Peebles R, Hardy KK, Wilson JL, Lock JD. Are diagnostic criteria for eating disorders markers of medical severity? *Pediatrics*. 2010;125(5). Available at: www.pediatrics.org/cgi/content/full/125/5/e1193
39. Sawyer SM, Whitelaw M, Le Grange D, Yeo M, Hughes EK. Physical and psychological morbidity in adolescents with atypical anorexia nervosa. *Pediatrics*. 2016;137(4):e20154080
40. Swenne I. Influence of premorbid BMI on clinical characteristics at presentation of adolescent girls with eating disorders. *BMC Psychiatry*. 2016; 16:81

41. Nagata JM, Garber AK, Tabler JL, Murray SB, Bibbins-Domingo K. Prevalence and correlates of disordered eating behaviors among young adults with overweight or obesity. *J Gen Intern Med*. 2018;33(8): 1337–1343

42. Watson RJ, Adjei J, Saewyc E, Homma Y, Goodenow C. Trends and disparities in disordered eating among heterosexual and sexual minority adolescents. *Int J Eat Disord*. 2017;50(1):22–31

43. Watson RJ, VanKim NA, Rose HA, Porta CM, Gahagan J, Eisenberg ME. Unhealthy weight control behaviors among youth: sex of sexual partner is linked to important differences. *Eat Disord*. 2018;26(5):448–463

44. Austin SB, Nelson LA, Birkett MA, Calzo JP, Everett B. Eating disorder symptoms and obesity at the intersections of gender, ethnicity, and sexual orientation in US high school students. *Am J Public Health*. 2013;103(2):e16–e22

45. Hadland SE, Austin SB, Goodenow CS, Calzo JP. Weight misperception and unhealthy weight control behaviors among sexual minorities in the general adolescent population. *J Adolesc Health*. 2014;54(3):296–303

46. Connolly MD, Zervos MJ, Barone CJ II, Johnson CC, Joseph CL. The mental health of transgender youth: advances in understanding. *J Adolesc Health*. 2016;59(5):489–495

47. McClain Z, Peebles R. Body image and eating disorders among lesbian, gay, bisexual, and transgender youth. *Pediatr Clin North Am*. 2016;63(6): 1079–1090

48. Diemer EW, Grant JD, Munn-Chernoff MA, Patterson DA, Duncan AE. Gender identity, sexual orientation, and eating-related pathology in a national sample of college students. *J Adolesc Health*. 2015;57(2):144–149

49. Quick VM, Byrd-Bredbenner C, Neumark-Sztainer D. Chronic illness and disordered eating: a discussion of the literature. *Adv Nutr*. 2013;4(3):277–286

50. Toni G, Berioli MG, Cerquiglini L, et al. Eating disorders and disordered eating symptoms in adolescents with type 1 diabetes. *Nutrients*. 2017;9(8):906

51. Ilzarbe L, Fàbrega M, Quintero R, et al. Inflammatory bowel disease and eating disorders: a systematized review of comorbidity. *J Psychosom Res*. 2017; 102:47–53

52. d'Emden H, Holden L, McDermott B, et al. Disturbed eating behaviours and thoughts in Australian adolescents with type 1 diabetes. *J Paediatr Child Health*. 2013;49(4):E317–E323

53. Colton PA, Olmsted MP, Daneman D, et al. Eating disorders in girls and women with type 1 diabetes: a longitudinal study of prevalence, onset, remission, and recurrence. *Diabetes Care*. 2015;38(7):1212–1217

54. Young V, Eiser C, Johnson B, et al. Eating problems in adolescents with Type 1 diabetes: a systematic review with meta-analysis. *Diabet Med*. 2013;30(2): 189–198

55. Koven NS, Abry AW. The clinical basis of orthorexia nervosa: emerging perspectives. *Neuropsychiatr Dis Treat*. 2015;11:385–394

56. Dunn TM, Bratman S. On orthorexia nervosa: a review of the literature and proposed diagnostic criteria. *Eat Behav*. 2016;21:11–17

57. Costa CB, Hardan-Khalil K, Gibbs K. Orthorexia nervosa: a review of the literature. *Issues Ment Health Nurs*. 2017;38(12):980–988

58. Robinson-O'Brien R, Perry CL, Wall MM, Story M, Neumark-Sztainer D. Adolescent and young adult vegetarianism: better dietary intake and weight outcomes but increased risk of disordered eating behaviors. *J Am Diet Assoc*. 2009;109(4):648–655

59. Zuromski KL, Witte TK, Smith AR, et al. Increased prevalence of vegetarianism among women with eating pathology. *Eat Behav*. 2015;19:24–27

60. Bardone-Cone AM, Fitzsimmons-Craft EE, Harney MB, et al. The inter-relationships between vegetarianism and eating disorders among females. *J Acad Nutr Diet*. 2012;112(8):1247–1252

61. Carl RL, Johnson MD, Martin TJ; Council on Sports Medicine and Fitness. Promotion of healthy weight-control practices in young athletes. *Pediatrics*. 2017;140(3):e20171871

62. Hergenroeder AC, De Souza MJ, Anding RH. The female athlete triad: energy deficiency, physiologic consequences, and treatment. *Adolesc Med State Art Rev*. 2015;26(1):116–142

63. De Souza MJ, Nattiv A, Joy E, et al.; Expert Panel. 2014 female athlete triad coalition consensus statement on treatment and return to play of the female athlete triad: 1st International Conference held in San Francisco, California, May 2012 and 2nd International Conference held in Indianapolis, Indiana, May 2013. *Br J Sports Med*. 2014;48(4):289

64. Weiss Kelly AK, Hecht S; Council on Sports Medicine and Fitness. The female athlete triad. *Pediatrics*. 2016; 138(2):e20160922

65. Committee on Adolescent Health Care. Committee opinion No.702: female athlete triad. *Obstet Gynecol*. 2017; 129(6):e160–e167

66. Tenforde AS, Barrack MT, Nattiv A, Fredericson M. Parallels with the female athlete triad in male athletes. *Sports Med*. 2016;46(2):171–182

67. Mountjoy M, Sundgot-Borgen J, Burke L, et al. The IOC consensus statement: beyond the female athlete triad–relative energy deficiency in sport (RED-S). *Br J Sports Med*. 2014; 48(7):491–497

68. Mountjoy M, Sundgot-Borgen J, Burke L, et al. International Olympic Committee (IOC) consensus statement on relative energy deficiency in sport (RED-S): 2018 update. *Int J Sport Nutr Exerc Metab*. 2018;28(4):316–331

69. Hagan JF, Shaw JS, Duncan PM, eds.. *Bright Futures: Guidelines for Health Supervision of Infants, Children, and Adolescents*, 4th ed. Elk Grove Village, IL: American Academy of Pediatrics; 2017

70. American College of Obstetricians and Gynecologists. Committee opinion No. 651 summary: menstruation in girls and adolescents: using the menstrual cycle as a vital sign. *Obstet Gynecol*. 2015;126(6):1328

71. Lebow J, Sim LA, Kransdorf LN. Prevalence of a history of overweight and obesity in adolescents with restrictive eating disorders. *J Adolesc Health*. 2015;56(1):19–24

72. Academy for Eating Disorders Medical Care Standards Committee. *Eating Disorders: A Guide to Medical Care*. 3rd ed. Reston, VA: Academy for Eating

Disorders; 2016. Available at: https://www.aedweb.org/learn/publications/medical-care-standards. Accessed September 16, 2019

73. Jenny C, Crawford-Jakubiak JE; Committee on Child Abuse and Neglect; American Academy of Pediatrics. The evaluation of children in the primary care setting when sexual abuse is suspected. *Pediatrics*. 2013;132(2). Available at: www.pediatrics.org/cgi/content/full/132/2/e558
74. Christian CW; Committee on Child Abuse and Neglect, American Academy of Pediatrics. The evaluation of suspected child physical abuse. [published correction appears in *Pediatrics*. 2015; 136(3):583]. *Pediatrics*. 2015;135(5). Available at: www.pediatrics.org/cgi/content/full/135/5/e1337
75. Crawford-Jakubiak JE, Alderman EM, Leventhal JM; Committee on Child Abuse and Neglect; Committee on Adolescence. Care of the adolescent after an acute sexual assault. [published correction appears in *Pediatrics*. 2017;139(6):e20170958]. *Pediatrics*. 2017;139(3):e20164243
76. Bessem B, de Bruijn MC, Nieuwland W. Gender differences in the electrocardiogram screening of athletes. *J Sci Med Sport*. 2017;20(2): 213–217
77. Freeman R, Wieling W, Axelrod FB, et al. Consensus statement on the definition of orthostatic hypotension, neurally mediated syncope and the postural tachycardia syndrome. *Clin Auton Res*. 2011;21(2):69–72
78. Kaufman H. Mechanisms, causes, and evaluation of orthostatic hypotension. Available at: https://www.uptodate.com/contents/mechanisms-causes-and-evaluation-of-orthostatic-hypotension/print. Accessed September 16, 2019
79. Committee on Adolescent Health Care. ACOG committee opinion No. 740: gynecologic care for adolescents and young women with eating disorders. *Obstet Gynecol*. 2018;131(6):e205–e213
80. Misra M, Klibanski A. Anorexia nervosa and its associated endocrinopathy in young people. *Horm Res Paediatr*. 2016; 85(3):147–157
81. Misra M, Golden NH, Katzman DK. State of the art systematic review of bone disease in anorexia nervosa. *Int J Eat Disord*. 2016;49(3):276–292
82. Mårild K, Størdal K, Bulik CM, et al. Celiac disease and anorexia nervosa: a nationwide study. *Pediatrics*. 2017; 139(5):e20164367
83. Palla B, Litt IF. Medical complications of eating disorders in adolescents. *Pediatrics*. 1988;81(5):613–623
84. Barlow SE; Expert Committee. Expert committee recommendations regarding the prevention, assessment, and treatment of child and adolescent overweight and obesity. *Pediatrics*. 2007;120(suppl 4):S164–S192
85. Golden NH, Katzman DK, Sawyer SM, et al.; Society for Adolescent Health and Medicine. Position Paper of the Society for Adolescent Health and Medicine: medical management of restrictive eating disorders in adolescents and young adults. *J Adolesc Health*. 2015; 56(1):121–125
86. Herpertz-Dahlmann B. Adolescent eating disorders: update on definitions, symptomatology, epidemiology, and comorbidity. *Child Adolesc Psychiatr Clin N Am*. 2015;24(1):177–196
87. Golden NH, Katzman DK, Sawyer SM, et al. Update on the medical management of eating disorders in adolescents. *J Adolesc Health*. 2015; 56(4):370–375
88. Campbell K, Peebles R. Eating disorders in children and adolescents: state of the art review. *Pediatrics*. 2014;134(3): 582–592
89. Rome ES, Strandjord SE. Eating disorders. *Pediatr Rev*. 2016;37(8): 323–336
90. Kelly AS, Barlow SE, Rao G, et al.; American Heart Association Atherosclerosis, Hypertension, and Obesity in the Young Committee of the Council on Cardiovascular Disease in the Young, Council on Nutrition, Physical Activity and Metabolism, and Council on Clinical Cardiology. Severe obesity in children and adolescents: identification, associated health risks, and treatment approaches: a scientific statement from the American Heart Association. *Circulation*. 2013;128(15): 1689–1712
91. Gauthier C, Hassler C, Mattar L, et al.; EVHAN Group. Symptoms of depression and anxiety in anorexia nervosa: links with plasma tryptophan and serotonin metabolism. *Psychoneuroendocrinology*. 2014;39: 170–178
92. Fürtjes S, Seidel M, King JA, Biemann R, Roessner V, Ehrlich S. Rumination in anorexia nervosa: cognitive-affective and neuroendocrinological aspects. *Behav Res Ther*. 2018;111:92–98
93. Weinbach N, Sher H, Bohon C. Differences in emotion regulation difficulties across types of eating disorders during adolescence. *J Abnorm Child Psychol*. 2018;46(6): 1351–1358
94. Allen KL, Byrne SM, Hii H, van Eekelen A, Mattes E, Foster JK. Neurocognitive functioning in adolescents with eating disorders: a population-based study. *Cogn Neuropsychiatry*. 2013;18(5): 355–375
95. Frank GKW. Advances from neuroimaging studies in eating disorders. *CNS Spectr*. 2015;20(4): 391–400
96. Bernardoni F, King JA, Geisler D, et al. Weight restoration therapy rapidly reverses cortical thinning in anorexia nervosa: a longitudinal study. *Neuroimage*. 2016;130:214–222
97. Strumia R. Eating disorders and the skin. *Clin Dermatol*. 2013;31(1):80–85
98. Kisely S, Baghaie H, Lalloo R, Johnson NW. Association between poor oral health and eating disorders: systematic review and meta-analysis. *Br J Psychiatry*. 2015;207(4):299–305
99. Sachs K, Mehler PS. Medical complications of bulimia nervosa and their treatments. *Eat Weight Disord*. 2016;21(1):13–18
100. Johnson LB, Boyd LD, Rainchuso L, Rothman A, Mayer B. Eating disorder professionals' perceptions of oral health knowledge. *Int J Dent Hyg*. 2017; 15(3):164–171
101. Stewart JM, Boris JR, Chelimsky G, et al.; Pediatric Writing Group of the American Autonomic Society. Pediatric disorders of orthostatic intolerance. *Pediatrics*. 2018;141(1):e20171673
102. Gibson D, Drabkin A, Krantz MJ, et al. Critical gaps in the medical knowledge

base of eating disorders. *Eat Weight Disord*. 2018;23(4):419–430

103. Spaulding-Barclay MA, Stern J, Mehler PS. Cardiac changes in anorexia nervosa. *Cardiol Young*. 2016;26(4):623–628
104. Lelli L, Rotella F, Castellini G, et al. Echocardiographic findings in patients with eating disorders: a case-control study. *Nutr Metab Cardiovasc Dis*. 2015;25(7):694–696
105. Oflaz S, Yucel B, Oz F, et al. Assessment of myocardial damage by cardiac MRI in patients with anorexia nervosa. *Int J Eat Disord*. 2013;46(8):862–866
106. Panagiotopoulos C, McCrindle BW, Hick K, Katzman DK. Electrocardiographic findings in adolescents with eating disorders. *Pediatrics*. 2000;105(5):1100–1105
107. Guerrier K, Mitan L, Wang Y, Czosek RJ. Risk for prolonged QT interval and associated outcomes in children with early restrictive eating patterns. *Cardiol Young*. 2016;26(4):644–649
108. Giovinazzo S, Sukkar SG, Rosa GM, et al. Anorexia nervosa and heart disease: a systematic review. *Eat Weight Disord*. 2019;24(2):199–207
109. Sachs KV, Harnke B, Mehler PS, Krantz MJ. Cardiovascular complications of anorexia nervosa: a systematic review. *Int J Eat Disord*. 2016;49(3):238–248
110. Norris ML, Harrison ME, Isserlin L, Robinson A, Feder S, Sampson M. Gastrointestinal complications associated with anorexia nervosa: a systematic review. *Int J Eat Disord*. 2016;49(3):216–237
111. Bern EM, Woods ER, Rodriguez L. Gastrointestinal manifestations of eating disorders. *J Pediatr Gastroenterol Nutr*. 2016;63(5):e77–e85
112. Stheneur C, Bergeron S, Lapeyraque A-L. Renal complications in anorexia nervosa. *Eat Weight Disord*. 2014;19(4):455–460
113. Mehler PS, Walsh K. Electrolyte and acid-base abnormalities associated with purging behaviors. *Int J Eat Disord*. 2016;49(3):311–318
114. Roerig JL, Steffen KJ, Mitchell JE, Zunker C. Laxative abuse: epidemiology, diagnosis and management. *Drugs*. 2010;70(12):1487–1503
115. Donaldson AA, Gordon CM. Skeletal complications of eating disorders. *Metabolism*. 2015;64(9):943–951
116. Warren MP. Endocrine manifestations of eating disorders. *J Clin Endocrinol Metab*. 2011;96(2):333–343
117. Misra M, Katzman DK, Cord J, et al. Bone metabolism in adolescent boys with anorexia nervosa. *J Clin Endocrinol Metab*. 2008;93(8):3029–3036
118. Sabel AL, Rosen E, Mehler PS. Severe anorexia nervosa in males: clinical presentations and medical treatment. *Eat Disord*. 2014;22(3):209–220
119. Misra M. Long-term skeletal effects of eating disorders with onset in adolescence. *Ann N Y Acad Sci*. 2008;1135:212–218
120. Katzman DK. Medical complications in adolescents with anorexia nervosa: a review of the literature. *Int J Eat Disord*. 2005;37(suppl):S52–S59, NaN–S89
121. Swenne I. Weight requirements for catch-up growth in girls with eating disorders and onset of weight loss before menarche. *Int J Eat Disord*. 2005;38(4):340–345
122. Robinson L, Aldridge V, Clark EM, Misra M, Micali N. A systematic review and meta-analysis of the association between eating disorders and bone density. *Osteoporos Int*. 2016;27(6):1953–1966
123. Faje AT, Fazeli PK, Miller KK, et al. Fracture risk and areal bone mineral density in adolescent females with anorexia nervosa. *Int J Eat Disord*. 2014;47(5):458–466
124. Solmi M, Veronese N, Correll CU, et al. Bone mineral density, osteoporosis, and fractures among people with eating disorders: a systematic review and meta-analysis. *Acta Psychiatr Scand*. 2016;133(5):341–351
125. Le Grange D, Accurso EC, Lock J, Agras S, Bryson SW. Early weight gain predicts outcome in two treatments for adolescent anorexia nervosa. *Int J Eat Disord*. 2014;47(2):124–129
126. Madden S, Miskovic-Wheatley J, Wallis A, Kohn M, Hay P, Touyz S. Early weight gain in family-based treatment predicts greater weight gain and remission at the end of treatment and remission at 12-month follow-up in adolescent anorexia nervosa. *Int J Eat Disord*. 2015;48(7):919–922
127. Norris ML, Hiebert JD, Katzman DK. Determining treatment goal weights for children and adolescents with anorexia nervosa. *Paediatr Child Health*. 2018;23(8):551–552
128. Faust JP, Goldschmidt AB, Anderson KE, et al. Resumption of menses in anorexia nervosa during a course of family-based treatment. *J Eat Disord*. 2013;1:12
129. Lebow J, Sim LA, Accurso EC. Is there clinical consensus in defining weight restoration for adolescents with anorexia nervosa? *Eat Disord*. 2018;26(3):270–277
130. Findlay S, Pinzon J, Taddeo D, Katzman DK; Canadian Paediatric Society, Adolescent Health Committee. Family-based treatment of children and adolescents with anorexia nervosa: guidelines for the community physician. *Paediatr Child Health*. 2010;15(1):31–40
131. Golden NH, Abrams SA; Committee on Nutrition. Optimizing bone health in children and adolescents. *Pediatrics*. 2014;134(4). Available at: www.pediatrics.org/cgi/content/full/134/4/e1229
132. Steinberg BJ. Medical and dental implications of eating disorders. *J Dent Hyg*. 2014;88(3):156–159
133. Madden S, Miskovic-Weatley J; American Academy of Child and Adolescent Psychiatry, Committee on Quality Issues. Practice parameter for the assessment and treatment of children and adolescents with eating disorders. *Psychol Med*. 2015;45(2):415–427
134. Katzman DK, Peebles R, Sawyer SM, Lock J, Le Grange D. The role of the pediatrician in family-based treatment for adolescent eating disorders: opportunities and challenges. *J Adolesc Health*. 2013;53(4):433–440
135. Rienecke RD. Family-based treatment of eating disorders in adolescents: current insights. *Adolesc Health Med Ther*. 2017;8:69–79
136. Forsberg S, Lock J. Family-based treatment of child and adolescent eating disorders. *Child Adolesc Psychiatr Clin N Am*. 2015;24(3):617–629

137. Lock J, Le Grange D. *Treatment Manual for Anorexia Nervosa: A Family-Based Approach*, 2nd ed. New York, NY: Guilford Press; 2012

138. Doyle PM, Le Grange D, Loeb K, Doyle AC, Crosby RD. Early response to family-based treatment for adolescent anorexia nervosa. *Int J Eat Disord.* 2010; 43(7):659–662

139. Lock J, Le Grange D. *Help Your Teenager Beat an Eating Disorder*, 2nd ed. New York, NY: Guilford Press; 2015

140. Le Grange D, Hughes EK, Court A, Yeo M, Crosby RD, Sawyer SM. Randomized clinical trial of parent-focused treatment and family-based treatment for adolescent anorexia nervosa. *J Am Acad Child Adolesc Psychiatry.* 2016; 55(8):683–692

141. Herpertz-Dahlmann B, Schwarte R, Krei M, et al. Day-patient treatment after short inpatient care versus continued inpatient treatment in adolescents with anorexia nervosa (ANDI): a multicentre, randomised, open-label, non-inferiority trial. *Lancet.* 2014;383(9924):1222–1229

142. Dancyger I, Fornari V, Schneider M, et al. Adolescents and eating disorders: an examination of a day treatment program. *Eat Weight Disord.* 2003;8(3): 242–248

143. Goldstein M, Peters L, Baillie A, McVeagh P, Minshall G, Fitzjames D. The effectiveness of a day program for the treatment of adolescent anorexia nervosa. *Int J Eat Disord.* 2011;44(1): 29–38

144. Ornstein RM, Lane-Loney SE, Hollenbeak CS. Clinical outcomes of a novel, family-centered partial hospitalization program for young patients with eating disorders. *Eat Weight Disord.* 2012; 17(3):e170–e177

145. Henderson K, Buchholz A, Obeid N, et al. A family-based eating disorder day treatment program for youth: examining the clinical and statistical significance of short-term treatment outcomes. *Eat Disord.* 2014;22(1):1–18

146. American Psychiatric Association. Treatment of Patients with Eating Disorders, Third Edition. In: *Am J Psychiatry*, vol. 163. 2006:4–54

147. Twohig MP, Bluett EJ, Cullum JL, et al. Effectiveness and clinical response rates of a residential eating disorders facility. *Eat Disord.* 2016;24(3):224–239

148. Friedman K, Ramirez AL, Murray SB, et al. A narrative review of outcome studies for residential and partial hospital-based treatment of eating disorders. *Eur Eat Disord Rev.* 2016; 24(4):263–276

149. Weltzin T, Kay B, Cornella-Carlson T, et al. Long-term effects of a multidisciplinary residential treatment model on improvements of symptoms and weight in adolescents with eating disorders. *J Groups Addict Recovery.* 2014;9(1):71–85

150. Attia E, Blackwood KL, Guarda AS, Marcus MD, Rothman DJ. Marketing residential treatment programs for eating disorders: a call for transparency. *Psychiatr Serv.* 2016; 67(6):664–666

151. Frisch MJ, Herzog DB, Franko DL. Residential treatment for eating disorders. *Int J Eat Disord.* 2006;39(5): 434–442

152. The Joint Commission. New requirements for residential and outpatient eating disorders programs. 2016. Available at: https://www.jointcommission.org/standards/r3-report/r3-report-issue-7-eating-disorders-standards-for-behavioral-health-care/. Accessed September 16, 2019

153. Schwartz BI, Mansbach JM, Marion JG, Katzman DK, Forman SF. Variations in admission practices for adolescents with anorexia nervosa: a North American sample. *J Adolesc Health.* 2008;43(5):425–431

154. Garber AK, Sawyer SM, Golden NH, et al. A systematic review of approaches to refeeding in patients with anorexia nervosa. *Int J Eat Disord.* 2016;49(3): 293–310

155. Society for Adolescent Health and Medicine. Refeeding hypophosphatemia in hospitalized adolescents with anorexia nervosa: a position statement of the Society for Adolescent Health and Medicine. *J Adolesc Health.* 2014;55(3): 455–457

156. Pulcini CD, Zettle S, Srinath A. Refeeding syndrome. *Pediatr Rev.* 2016;37(12): 516–523

157. O'Connor G, Goldin J. The refeeding syndrome and glucose load. *Int J Eat Disord.* 2011;44(2):182–185

158. O'Connor G, Nicholls D. Refeeding hypophosphatemia in adolescents with anorexia nervosa: a systematic review. *Nutr Clin Pract.* 2013;28(3):358–364

159. Strandjord SE, Sieke EH, Richmond M, Khadilkar A, Rome ES. Medical stabilization of adolescents with nutritional insufficiency: a clinical care path. *Eat Weight Disord.* 2016;21(3): 403–410

160. Parker EK, Faruquie SS, Anderson G, et al. Higher caloric refeeding is safe in hospitalised adolescent patients with restrictive eating disorders. *J Nutr Metab.* 2016;2016:5168978

161. Hart S, Franklin RC, Russell J, Abraham S. A review of feeding methods used in the treatment of anorexia nervosa. *J Eat Disord.* 2013;1:36

162. Agostino H, Erdstein J, Di Meglio G. Shifting paradigms: continuous nasogastric feeding with high caloric intakes in anorexia nervosa. *J Adolesc Health.* 2013;53(5):590–594

163. Madden S, Miskovic-Wheatley J, Clarke S, Touyz S, Hay P, Kohn MR. Outcomes of a rapid refeeding protocol in adolescent anorexia nervosa. *J Eat Disord.* 2015;3:8

164. Kapphahn CJ, Graham DA, Woods ER, et al. Effect of hospitalization on percent median body mass index at one year, in underweight youth with restrictive eating disorders. *J Adolesc Health.* 2017;61(3):310–316

165. Gowers SG, Clark AF, Roberts C, et al. A randomised controlled multicentre trial of treatments for adolescent anorexia nervosa including assessment of cost-effectiveness and patient acceptability - the TOuCAN trial. *Health Technol Assess.* 2010;14(15):1–98

166. Madden S, Miskovic-Wheatley J, Wallis A, et al. A randomized controlled trial of in-patient treatment for anorexia nervosa in medically unstable adolescents. *Psychol Med.* 2015;45(2): 415–427

167. Peebles R, Lesser A, Park CC, et al. Outcomes of an inpatient medical nutritional rehabilitation protocol in children and adolescents with eating disorders. *J Eat Disord.* 2017;5:7

168. Garber AK, Mauldin K, Michihata N, Buckelew SM, Shafer M-A, Moscicki A-B. Higher calorie diets increase rate of weight gain and shorten hospital stay in hospitalized adolescents with anorexia nervosa. *J Adolesc Health*. 2013;53(5):579–584

169. Powers PS, Cloak NL. Psychopharmacologic treatment of obesity and eating disorders in children and adolescents. *Child Adolesc Psychiatr Clin N Am*. 2012;21(4):831–859

170. van den Heuvel LL, Jordaan GP. The psychopharmacological management of eating disorders in children and adolescents. *J Child Adolesc Ment Health*. 2014;26(2):125–137

171. Monge MC, Forman SF, McKenzie NM, et al. Use of psychopharmacologic medications in adolescents with restrictive eating disorders: analysis of data from the National Eating Disorder Quality Improvement Collaborative. *J Adolesc Health*. 2015;57(1):66–72

172. Kaye W, Nagata T, Weltzin TE, et al. Double-blind placebo-controlled administration of fluoxetine in restricting- and restricting-purging-type anorexia nervosa. *Biol Psychiatry*. 2001; 49(7):644–652

173. Walsh BT, Kaplan AS, Attia E, et al. Fluoxetine after weight restoration in anorexia nervosa: a randomized controlled trial. [published correction appears in *JAMA*. 2006 Aug 23;296(8): 934]. *JAMA*. 2006;295(22):2605–2612

174. Sebaaly JC, Cox S, Hughes CM, Kennedy MLH, Garris SS. Use of fluoxetine in anorexia nervosa before and after weight restoration. *Ann Pharmacother*. 2013;47(9):1201–1205

175. Hagman J, Gralla J, Sigel E, et al. A double-blind, placebo-controlled study of risperidone for the treatment of adolescents and young adults with anorexia nervosa: a pilot study. *J Am Acad Child Adolesc Psychiatry*. 2011; 50(9):915–924

176. Kafantaris V, Leigh E, Hertz S, et al. A placebo-controlled pilot study of adjunctive olanzapine for adolescents with anorexia nervosa. *J Child Adolesc Psychopharmacol*. 2011;21(3):207–212

177. Norris ML, Spettigue W, Buchholz A, et al. Olanzapine use for the adjunctive treatment of adolescents with anorexia nervosa. *J Child Adolesc Psychopharmacol*. 2011;21(3):213–220

178. Kishi T, Kafantaris V, Sunday S, Sheridan EM, Correll CU. Are antipsychotics effective for the treatment of anorexia nervosa? Results from a systematic review and meta-analysis. *J Clin Psychiatry*. 2012;73(6):e757–e766

179. Marzola E, Desedime N, Giovannone C, Amianto F, Fassino S, Abbate-Daga G. Atypical antipsychotics as augmentation therapy in anorexia nervosa. *PLoS One*. 2015;10(4):e0125569

180. Misra M, Katzman D, Miller KK, et al. Physiologic estrogen replacement increases bone density in adolescent girls with anorexia nervosa. *J Bone Miner Res*. 2011;26(10):2430–2438

181. Divasta AD, Feldman HA, Giancaterino C, Rosen CJ, Leboff MS, Gordon CM. The effect of gonadal and adrenal steroid therapy on skeletal health in adolescents and young women with anorexia nervosa. *Metabolism*. 2012; 61(7):1010–1020

182. Lock J. An update on evidence-based psychosocial treatments for eating disorders in children and adolescents. *J Clin Child Adolesc Psychol*. 2015;44(5): 707–721

183. Lock J, Le Grange D. *Treating Bulimia in Adolescents: A Family-Based Approach*. New York, NY: Guilford Press; 2007

184. Le Grange D, Lock J, Agras WS, Bryson SW, Jo B. Randomized clinical trial of family-based treatment and cognitive–behavioral therapy for adolescent bulimia nervosa. *J Am Acad Child Adolesc Psychiatry*. 2015;54(11): 886–894.e2

185. Lebow J, Chuy JA, Cedermark K, Cook K, Sim LA. The development or exacerbation of eating disorder symptoms after topiramate initiation. *Pediatrics*. 2015; 135(5). Available at: www.pediatrics.org/cgi/content/full/135/5/e1312

186. Reas DL, Grilo CM. Pharmacological treatment of binge eating disorder: update review and synthesis. *Expert Opin Pharmacother*. 2015;16(10):1463–1478

187. Heo Y-A, Duggan ST. Lisdexamfetamine: a review in binge eating disorder. *CNS Drugs*. 2017;31(11):1015–1022

188. Zimmerman J, Fisher M. Avoidant/restrictive food intake disorder (ARFID). *Curr Probl Pediatr Adolesc Health Care*. 2017;47(4):95–103

189. Mammel KA, Ornstein RM. Avoidant/restrictive food intake disorder: a new eating disorder diagnosis in the diagnostic and statistical manual 5. *Curr Opin Pediatr*. 2017;29(4):407–413

190. Mairs R, Nicholls D. Assessment and treatment of eating disorders in children and adolescents. *Arch Dis Child*. 2016;101(12):1168–1175

191. Toulany A, Wong M, Katzman DK, et al. Cost analysis of inpatient treatment of anorexia nervosa in adolescents: hospital and caregiver perspectives. *CMAJ Open*. 2015;3(2):E192–E197

192. Marcell AV, Breuner CC, Hammer L, Hudak ML; Committee on Adolescence; Committee on Child Health Financing. Targeted reforms in health care financing to improve the care of adolescents and young adults. *Pediatrics*. 2018;142(6):e20182998

193. Ackard DM, Richter S, Egan A, Cronemeyer C. Poor outcome and death among youth, young adults, and midlife adults with eating disorders: an investigation of risk factors by age at assessment. *Int J Eat Disord*. 2014; 47(7):825–835

194. Steinhausen H-C. Outcome of eating disorders. *Child Adolesc Psychiatr Clin N Am*. 2009;18(1):225–242

195. Forman SF, Grodin LF, Graham DA, et al.; National Eating Disorder QI Collaborative. An eleven site national quality improvement evaluation of adolescent medicine-based eating disorder programs: predictors of weight outcomes at one year and risk adjustment analyses. *J Adolesc Health*. 2011;49(6):594–600

196. Forman SF, McKenzie N, Hehn R, et al. Predictors of outcome at 1 year in adolescents with DSM-5 restrictive eating disorders: report of the national eating disorders quality improvement collaborative. *J Adolesc Health*. 2014; 55(6):750–756

197. Lock J, Le Grange D, Agras WS, Moye A, Bryson SW, Jo B. Randomized clinical trial comparing family-based treatment with adolescent-focused individual therapy for adolescents with anorexia nervosa. *Arch Gen Psychiatry*. 2010; 67(10):1025–1032

198. Le Grange D, Lock J, Accurso EC, et al. Relapse from remission at two- to four-year follow-up in two treatments for adolescent anorexia nervosa. *J Am Acad Child Adolesc Psychiatry*. 2014; 53(11):1162–1167

199. Field AE, Sonneville KR, Micali N, et al. Prospective association of common eating disorders and adverse outcomes. *Pediatrics*. 2012;130(2). Available at: www.pediatrics.org/cgi/content/full/130/2/e289

200. Franko DL, Keshaviah A, Eddy KT, et al. A longitudinal investigation of mortality in anorexia nervosa and bulimia nervosa. *Am J Psychiatry*. 2013;170(8): 917–925

201. Arcelus J, Mitchell AJ, Wales J, Nielsen S. Mortality rates in patients with anorexia nervosa and other eating disorders. A meta-analysis of 36 studies. *Arch Gen Psychiatry*. 2011; 68(7):724–731

202. Keshaviah A, Edkins K, Hastings ER, et al. Re-examining premature mortality in anorexia nervosa: a meta-analysis redux. *Compr Psychiatry*. 2014;55(8): 1773–1784

203. Suokas JT, Suvisaari JM, Gissler M, et al. Mortality in eating disorders: a follow-up study of adult eating disorder patients treated in tertiary care, 1995-2010. *Psychiatry Res*. 2013; 210(3):1101–1106

204. Smith AR, Zuromski KL, Dodd DR. Eating disorders and suicidality: what we know, what we don't know, and suggestions for future research. *Curr Opin Psychol*. 2018;22: 63–67

205. Crow SJ, Swanson SA, le Grange D, Feig EH, Merikangas KR. Suicidal behavior in adolescents and adults with bulimia nervosa. *Compr Psychiatry*. 2014;55(7): 1534–1539

206. Preti A, Rocchi MBL, Sisti D, Camboni MV, Miotto P. A comprehensive meta-analysis of the risk of suicide in eating disorders. *Acta Psychiatr Scand*. 2011; 124(1):6–17

207. Golden NH, Schneider M, Wood C; Committee on Nutrition; Committee on Adolescence; Section on Obesity. Preventing obesity and eating disorders in adolescents. *Pediatrics*. 2016;138(3):e20161649

208. Rosen DS; American Academy of Pediatrics Committee on Adolescence. Identification and management of eating disorders in children and adolescents. *Pediatrics*. 2010;126(6):1240–1253

Immunizing Against Hate: Overcoming Asian American and Pacific Islander Racism

Immunizing Against Hate: Overcoming Asian American and Pacific Islander Racism

Lee Savio Beers, MD, FAAP,[a] Moira Szilagyi, MD, PhD, FAAP,[b] Warren M. Seigel, MD, MBA, FAAP,[c] Wendy S. Davis, MD, FAAP,[d] Yasuko Fukuda, MD, FAAP,[e] Madeline Joseph, MD, FAAP,[f] Joseph L. Wright, MD, MPH, FAAP,[g] Sara H. Goza, MD, FAAP,[h] AMERICAN ACADEMY OF PEDIATRICS BOARD OF DIRECTORS EXECUTIVE COMMITTEE, BOARD COMMITTEE ON EQUITY

It has been more than a year since Immediate Past President of the American Academy of Pediatrics (AAP), Sally Goza, MD, FAAP, warned against the threat severe acute respiratory syndrome-coronavirus 2 (SARS-CoV-2) posed to children and families, including the harm coronavirus disease 2019 (COVID-19)–fueled racism and xenophobia could cause the Asian American community. Sadly, as the COVID-19 pandemic spread, racism and violent attacks on Asian Americans spread along with it.

COVID-19–FUELED RACISM AND ATTACKS ON ASIAN AMERICANS

Since March 2020, increases in racist rhetoric have coincided with increases in racist abuse, bullying, and attacks. According to Human Rights Watch,[1] an organization that investigates abuses happening throughout the world, reports of discrimination and violence against Asians and people of Asian descent have surged both in the United States and worldwide. A new study of police department statistics[2] from 16 of America's largest cities reveals that hate crimes against Asian Americans rose nearly 150% in 2020, despite overall hate crimes dropping by 7%.

Stop AAPI Hate,[3] a national coalition that tracks incidents of violence and harassment against Asian Americans and Pacific Islanders in the United States, reported nearly 3800 instances of discrimination against Asians between March 19, 2020, and February 28, 2021. Although these reports may represent only a fraction of the hate incidents that occur, it is an indication of how vulnerable Asian Americans have become to racial attacks and discrimination.

Widespread media coverage of violence committed against elderly Asian Americans in cities across the country is stirring up fear and a sense of increased vulnerability. These horrific, unprovoked attacks are not only heartbreaking to witness, they erode the sense of personal safety and well-being of the entire Asian American community. In addition, these hate crimes against the elderly are particularly devastating in light of the Asian American cultures influenced by values that promote positive views of aging and teach younger people to respect, obey, and care for their elders. Our Asian American patients tell us that they are afraid to walk or ride the bus to school, go to

[a]Children's National Medical Center, Washington, District of Columbia; [b]University of California, Los Angeles, Los Angeles, California; [c]State University of New York Downstate Medical Center, Brooklyn, New York; [d]University of Vermont, Burlington, Vermont; [e]Pacific Pediatrics, San Francisco, California; [f]University of Florida Health Science Center, Jacksonville, Florida; [g]University of Maryland Schools of Medicine and Public Health, College Park, Maryland; and [h]First Georgia Physicians Group, Peachtree City, Georgia

DOI: https://doi.org/10.1542/peds.2021-051836

Address correspondence to Lee Savio Beers, MD, FAAP. E-mail: president@aap.org

PEDIATRICS (ISSN Numbers: Print, 0031-4005; Online, 1098-4275).

FINANCIAL DISCLOSURE: The authors have indicated they have no financial relationships relevant to this article to disclose.

FUNDING: No external funding.

POTENTIAL CONFLICT OF INTEREST: The authors have indicated they have no potential conflicts of interest to disclose.

To cite: Beers L S, Szilagyi M, Seigel W M, et al; AAP Board of Directors Executive Committee, Board Committees on Equity. Immunizing Against Hate: Overcoming Asian American and Pacific Islander Racism. *Pediatrics*. 2021;148(1):e2021051836

church, or play outside, because they, too, have been targets of taunts and harassment. But even staying inside the home does not protect them. Many children say they have experienced cyberbullying or feel shunned and anxious because of hateful, racist language online. Their parents tell us that although they themselves have previously experienced anti-Asian racism in the United States, never before have they felt so unsafe. It is no longer a sense of "not belonging," it is a sense of being on high alert. The alarming statistics and the trauma behind them illustrate that America is again waging a battle against two pandemics: COVID-19 and racism.

HISTORY OF ANTI-ASIAN RACISM AND DISCRIMINATION IN THE UNITED STATES

Unfortunately, the racialization of a disease and the tendency to offer up scapegoats in times of crisis are not new phenomena. People of Chinese descent were implicated in the 2003 severe acute respiratory syndrome (SARS) pandemic. Such stigmatization invoked widespread fear and distrust and had damaging social and economic consequences for many Asian Americans.

In a 2020 commentary in *Pediatrics,* Cheng and Conca-Cheng[4] wrote about the long legacy of anti-Asian racism in the United States. They pointed to the Chinese Exclusion Act of 1882, which prevented Chinese laborers from immigrating to the United States, the Immigration Act of 1924, which extended these restrictions to other Asian immigrant groups, and President Franklin Roosevelt ordering forced relocation and internment of 120 000 individuals of Japanese ancestry during World War II. In times of crisis and fear, the instinct throughout history has been to find someone to blame. Often, this is targeted at communities that have been historically marginalized and people who are least able to defend themselves.

RACISM AS A SOCIAL DETERMINANT OF HEALTH

The 2019 AAP policy statement[5] titled "The Impact of Racism on Child and Adolescent Health" declared racism "a social determinant of health that has a profound impact on the health status of children, adolescents, emerging adults, and their families." The policy states, "The social environment in which children are raised shapes child and adolescent development, and pediatricians are poised to prevent and respond to environmental circumstances that undermine child health." This is one of those times when we must step up to the plate.

In a 2020 article in the *American Journal of Public Health*, "Potential Impact of COVID-19-Related Racial Discrimination on the Health of Asian Americans,"[6] Chen et al warned that COVID-19–related racial discrimination will exert harmful effects on Asian American health. They pointed to historical precedent of the association between racial discrimination and worsened psychological and physical health outcomes. Examples included the findings that Japanese Americans confined to internment camps during World War II experienced roughly double the rates of suicide and cardiovascular disease compared with their noninterned counterparts later in life and that Arab and Muslim Americans had greater psychological distress and short- and long-term health problems after the increase in Islamophobia, anti-Muslim rhetoric, and hate crimes that stemmed from the 9/11 terrorist attacks. In addition, the basic science and epigenetic elucidation of intergenerational transmission of historically experienced racism is evolving and supports these clinical observations.[7,8]

PROTECTING AND PROMOTING MENTAL HEALTH

In a 2020 article in *Pediatrics*, Cheah et al[9] examined the rates of COVID-19–related racism and racial discrimination experienced by Chinese American parents and youth and the associations with their mental health. The authors found that nearly half of parents and youth reported being directly targeted by COVID-19 racial discrimination online and that higher levels of perceived racism and racial discrimination were associated with poorer mental health.

For the past decade, rates of suicide, depression, and anxiety have been increasing for all children and adolescents. Many factors unique to the pandemic are adding to the toll on children's emotional and behavioral health: isolation from friends, family, and other community supports; emotional challenges, such as grief, fear, and disappointment; parental stress; and economic hardship. Asian American youth are further affected by having to wrestle with Sinophobic discrimination, slurs, and attacks, as well as the frightening reality that people from Black, Asian, and minority ethnic backgrounds are at greater risk of becoming severely ill and more likely to die of COVID-19 if infected.[10] Although we do not yet have complete data on the pandemic's impact on children's mental health, evidence is emerging that suggests both the prevalence and severity of mental health issues have worsened over the past year.

RENEWING THE CALL TO ACTION AGAINST RACISM

We urge all pediatricians to refamiliarize themselves with the AAP policy statement "The Impact of Racism on Child and Adolescent Health,"[5] to examine our own biases, be prepared to discuss and counsel Asian American families on the effects of exposure to racism, and make appropriate mental health referrals as needed.

And we echo and reemphasize the urgency of Dr Goza's call not only to vaccinate children against COVID-19 but also to strengthen our children's immunity to the virus of hate. The AAP's commitment[11] to dismantling racism has been, and will continue to be, at the forefront of our highest priorities.

ABBREVIATIONS

AAP: American Academy of Pediatrics
COVID-19: coronavirus disease 2019
SARS-CoV-2: severe acute respiratory syndrome-coronavirus 2

REFERENCES

1. Human Rights Watch. Covid-19 fueling anti-Asian racism and xenophobia worldwide: national action plans needed to counter intolerance. 2020. Available at: https://www.hrw.org/news/2020/05/12/covid-19-fueling-anti-asian-racism-and-xenophobia-worldwide. Accessed April 8, 2021
2. Center for the Study of Hate and Extremism, California State University San Bernardino. Fact sheet: anti-Asian prejudice March 2020 – Center for the Study of Hate & Extremism. Available at: https://www.csusb.edu/sites/default/files/FACT%20SHEET-%20Anti-Asian%20Hate%202020%203.2.21.pdf. Accessed April 8, 2021
3. Stop AAPI Hate. Stop AAPI Hate 2020-2021 national report. Available at: http://stopaapihate.org/wp-content/uploads/2021/04/Stop-AAPI-Hate-National-Report-210316.pdf. Accessed April 8, 2021
4. Cheng TL, Conca-Cheng AM. The pandemics of racism and COVID-19: danger and opportunity. *Pediatrics*. 2020;146(5):e2020024836
5. Trent M, Dooley DG, Dougé J; Section on Adolescent Health; Council on Community Pediatrics; Committee on Adolescence. The impact of racism on child and adolescent health. *Pediatrics*. 2019;144(2):e20191765
6. Chen JA, Zhang E, Liu CH. Potential impact of COVID-19–related racial discrimination on the health of Asian Americans. *Am J Public Health*. 2020;110(11):1624–1627
7. Dias BG, Ressler KJ. Parental olfactory experience influences behavior and neural structure in subsequent generations. *Nat Neurosci*. 2014;17(1):89–96
8. Hong JY, Lim J, Carvalho F, et al. Long-term programming of CD8 T cell immunity by perinatal exposure to glucocorticoids. *Cell*. 2020;180(5):847–861.e15
9. Cheah CSL, Wang C, Ren H, Zong X, Cho HS, Xue X. COVID-19 racism and mental health in Chinese American families. *Pediatrics*. 2020;146(5):e2020021816
10. Kingsland J. COVID-19: Why are Asian and Black patients at greater risk? *Medical News Today*. February 2, 2021. Available at: https://www.medicalnewstoday.com/articles/covid-19-why-are-asian-and-black-patients-at-greater-risk. Accessed April 8, 2021
11. American Academy of Pediatrics. AAP equity agenda. 2021. Available at: https://services.aap.org/en/about-the-aap/aap-equity-agenda/. Accessed April 22, 2021

Integrating Web Services/Applications to Improve Pediatric Functionalities in Electronic Health Records

- *Policy Statement*

POLICY STATEMENT Organizational Principles to Guide and Define the Child Health Care System and/or Improve the Health of all Children

American Academy of Pediatrics
DEDICATED TO THE HEALTH OF ALL CHILDREN™

Integrating Web Services/Applications to Improve Pediatric Functionalities in Electronic Health Records

Stuart T. Weinberg, MD, FAAP, FAMIA,[a] Craig Monsen, MD, MS,[b] Christoph U. Lehmann, MD, FAAP, FACMI, FIAHSI,[c] Michael G. Leu, MD, MS, MHS, FAAP, FAMIA,[d] COUNCIL ON CLINICAL INFORMATION TECHNOLOGY

The past decade has seen a substantial increase in the use of electronic health records (EHRs) by health care providers caring for children. However, gaps in pediatric-specific functionalities continue to exist in some EHR systems, including population-specific growth curves, immunization clinical decision support, weight-based medication dosing with rounding, calculation of pediatric hypertension percentiles, age-specific developmental assessment, newborn bilirubin nomograms, anticipatory guidance reminders, and other functionalities described elsewhere. Implementing pediatric functionalities into EHRs is critical to the provision of safe pediatric care. As an alternative to direct implementation in EHRs, EHR vendor agnostic Web applications, Web services, and application programming interfaces offer an opportunity to provide pediatric functionalities and eliminate the need for each vendor to develop these functionalities. Successful implementation of Web services and related technologies requires responsible attention from both EHR vendors and developers of Web services, Web applications, and application programming interfaces to the use of data terminology standards, adherence to privacy and security requirements, rigorous testing, change management processes, and robust system support and maintenance. Education of health care providers about opportunities to improve pediatric functionalities in EHRs by using these services can facilitate discussions in EHR user groups in which vendors can be lobbied to implement them. This policy statement emphasizes the need to address pediatric-specific functionalities in EHRs by providing insight and recommendations into the development, maintenance, integration, and support of these novel solutions.

abstract

[a]Departments of Biomedical Informatics and Pediatrics, Vanderbilt University Medical Center, Nashville, Tennessee; [b]Center for Informatics, Atrius Health, Auburndale, Massachusetts; [c]Departments of Pediatrics, Bioinformatics, and Population and Data Sciences and Clinical Informatics Center, University of Texas Southwestern Medical Center, Dallas, Texas; and [d]Departments of Pediatrics and Biomedical Informatics and Medical Education, University of Washington and Seattle Children's Hospital, Seattle, Washington

DOI: https://doi.org/10.1542/peds.2021-052047

Address correspondence to Stuart T. Weinberg, MD. Email: stwmd@stwmd.net

To cite: Weinberg S T, Monsen C, Lehmann C U, et al. Integrating Web Services/Applications to Improve Pediatric Functionalities in Electronic Health Records. *Pediatrics*. 2021;148(1):e2021052047

BACKGROUND

Between 2008 and 2015, adoption of a basic electronic health record (EHR) by children's hospitals increased from 10% to 55%. The percentage of acute care hospitals using a certified EHR by 2015 was 96%.[1] The percentage of office-based physicians in the United States using a certified EHR system was estimated to be 77.9% in 2015[2] and 94% in 2016.[3]

Many EHR systems lack pediatric functionalities, including plotting growth charts, computing anthropometric percentiles, tracking adherence to well-child visits and immunization schedules, and supporting weight-based dosing.[4,5] These core pediatric functionalities have been described for both the outpatient[6] and inpatient[7] settings. More recently, as part of the 21st Century Cures Act, additional core pediatric functionalities were recommended by the Health IT for the Care Continuum Task Force in conjunction with the Office of the National Coordinator for Health Information Technology as pediatric EHR certification criteria.[8] As an alternative to implementing these core features directly as core functionalities in EHR systems, Web services and Web applications offer opportunities to integrate and thereby increase the use of pediatric functionalities across multiple EHR systems by using standard technologies and terminologies for those EHR systems that provide access to Web services and applications.

STATEMENT OF THE PROBLEM

Emerging evidence supports continuous development and modification of guidelines and clinical policies. Examples include:

1. In October 2016, the Centers for Disease Control and Prevention released a new recommendation to the human papillomavirus vaccine schedule. The novel recommendation required only 2 doses spaced at least 6 months apart if the first dose was administered before age 15 years.[9]
2. In August of 2017, the American Academy of Pediatrics (AAP) published a clinical practice guideline that included "significant changes" in the screening and management of high blood pressure in children and adolescents, new normative pediatric blood pressure tables, and an action statement to include flags for abnormal blood pressure values both when the values are being entered and when they are being viewed.[10]
3. In February of 2017, the AAP published the fourth edition of *Bright Futures: Guidelines for Health Supervision of Infants, Children, and Adolescents,* containing a periodicity schedule of screenings and recommendations for 31 age-specific visits, from the newborn visit through visits for 21-year-olds.

These are but a few examples of pediatric-specific clinical guideline changes that provide significant challenges to EHR vendors who want to keep their clinical content up to date. In the current product development model, every vendor has to invest development resources to implement these new functionalities, guidelines, and clinical decision support. Often, vendors instead deploy content development tools with which each customer maintains embedded clinical content at a significant cost. Web services and Web applications offer solutions that can be shared among multiple EHRs and health care settings.

Examples of Current Web Services and Web Applications

A Web service is software that resides on a server that can be accessed by multiple applications and computers and provides functionality that does not involve user interaction, such as credit card authorization or medical calculations. A Web application can be accessed through a browser and has a user interface. There are pediatric examples that could serve as models for the integration of Web services and Web applications into existing EHRs.[11–18] It is important to apply the key considerations listed below when using these Web services and applications, especially those related to accuracy, testing, and transparency. Because Web services are smaller, more specialized software modules compared with EHRs, they have the advantage that they are easier to develop, test, and augment in a more rapid development cycle and do not have to rely on vendors to prioritize functions for development.

Key Considerations in the Development, Integration, and Use of Web Services

As these resources continue to be developed and implemented, several key issues need to be considered by developers, vendors integrating these tools, organizations, and end-users:

1. Dependability, access time, and speed: The use of a Web service or Web application introduces an external dependency, which needs to be reliable. Vendors must ensure that EHRs fail gracefully when the Web service or Web application is unavailable and allow users to complete their tasks.
2. Privacy, security, and confidentiality: Developers of these tools and the EHR vendors that integrate them need to be compliant with all relevant Health Insurance Portability and Accountability Act regulations. Business associate agreements between developers and vendors may need to be

developed. Because health care providers assume responsibility, as per Health Insurance Portability and Accountability Act security rules, to "ensure the confidentiality, integrity, and availability of all e-PHI they create, receive, maintain, or transmit,"[19] it is important that vendors provide security information documenting this compliance. Audit logs of data sent to and received from the Web service should be maintained in the EHR.

3. Accuracy, testing, versioning, and change management: Developers need to rigorously test the performance and accuracy of their tools. The developer, in collaboration with the EHR vendor, should test the system in a production environment using exhaustive testing scenarios to ensure that (a) the Web service is available and functions properly and its performance is acceptable to users; (b) the Web service fails gracefully, informing the user and allowing tasks to be completed later (eg, if the Web service is not available, the health care provider can still use the EHR); and (c) the version of the Web service and data used to generate calculations and/or recommendations are recorded with each use. The latter will allow retrospective validation of past calculations and/or recommendations once an upgrade of the Web service becomes available. As new versions are developed, a versioning history should be in place so that end-users are aware of changes, and EHR vendors should have a clear process to communicate those changes. Before going live, health care provider end-users must have an opportunity to test the system using realistic patient data.
4. Standards in technology and terminology: There are well-established technical and terminology standards related to data structure, data transport, and medical vocabularies (such as SNOMED CT, LOINC, and RxNorm) that should be adopted by Web services and Web applications.
5. Usability and transparency: Particularly with tools that deliver clinical decision support, Web application and/or service developers should provide, and EHR vendors should display, "show your work" functionality that allows end-users to understand underlying algorithms and how and why alerts and recommendations are generated.
6. Business models: Several business models exist for the use of Web services and Web applications by EHR vendors, including a subscription model, a per-use model, or a hybrid of the two. Vendors should be transparent if these costs are being transferred to end-users.

RECOMMENDATIONS

The AAP recommends the following basic principles for the ideal integration of Web services, Web applications, and application programming interfaces into EHR systems:

1. Health care providers and other users of EHRs should know how to access their EHR vendor user groups, through which requests for additional pediatric functionalities can be addressed. Within these user groups, they should research whether Web services or Web applications exist that can be used without the vendor redeveloping the same functionality (eg, in application marketplaces).
2. EHR vendors should support the ability to integrate Web services and Web applications within their systems, consistent with current standards for data terminologies, transport protocols, and privacy and/or security compliance. Vendors should be encouraged to make their interfaces uniform so that services can be available to different EHRs simultaneously.
3. Qualified health system or EHR vendor staff should consider integrating a Web service or Web application if:
   a. pediatric functionality provided by an available Web service or Web application is not present in the EHR or
   b. the functionality provided by the Web service or Web application enhances existing EHR functionality; and
   c. uptime, privacy, and security are within acceptable parameters.
4. EHR vendors that integrate Web services and Web applications should actively communicate and be transparent with users about any changes in the content or delivery of these tools. For example, vendors should inform users when an integrated Web service or application has been updated and allow end-users the opportunity to steward Web services by providing feedback to mitigate any issues with accuracy.
5. Web service developers should demonstrate sustainability and support continued development and maintenance as clinical guidelines and technical standards change.
6. Web service developers should employ current standards for data terminologies, transport protocols, and privacy and/or security compliance in a uniform manner so that Web services do not need to be customized for various platforms.
7. Web service developers should engage pediatric subject matter experts in the creation and testing of Web services with pediatric clinical content. In addition, physician groups should make it easier to identify informaticians

who are willing to work with these developers and EHR vendors.

CONCLUSIONS

Web services, Web applications, and application programming interfaces offer opportunities to extend and improve pediatric functionalities of existing EHRs. An increasing number of EHR vendors are making access to these tools possible. Pediatricians' awareness of these tools can facilitate discussions with EHR vendor user groups to implement these solutions where useful and feasible.

ABBREVIATIONS

AAP: Academy of Pediatrics
EHR: electronic health record

FINANCIAL DISCLOSURE: The authors have indicated they have no financial relationships relevant to this article to disclose.

FUNDING: No external funding.

POTENTIAL CONFLICT OF INTEREST: Dr Lehmann has a board-of-directors relationship with the International Medical Informatics Association an editor-in-chief relationship with *Applied Clinical Informatics*; and Drs Weinberg, Monsen, and Leu have indicated they have no potential conflicts of interest to disclose.

REFERENCES

1. Henry J, Pylypchuk Y, Searcy T, Patel V. Adoption of electronic health record systems among U.S. non-federal acute care hospitals: 2008-2015. Available at: https://dashboard.healthit.gov/evaluations/data-briefs/non-federal-acute-care-hospital-ehr-adoption-2008-2015.php. Accessed June 21, 2018
2. Jamoom E, Yang N. National Electronic Health Records Survey: 2015 state and national electronic health record adoption summary tables. Available at: https://www.cdc.gov/nchs/data/ahcd/nehrs/2015_nehrs_web_table.pdf. Accessed June 21, 2018
3. Temple MW, Sisk B, Krams LA, Schneider JH, Kirkendall ES, Lehmann CU. Trends in use of electronic health records in pediatric office settings. *J Pediatr*. 2019;206:164–171.e2
4. Wald JS, Haque SN, Rizk S, et al. Enhancing health IT functionality for children: the 2015 Children's EHR Format. *Pediatrics*. 2018;141(4):e20163894
5. Lehmann CU, O'Connor KG, Shorte VA, Johnson TD. Use of electronic health record systems by office-based pediatricians. *Pediatrics*. 2015;135(1). Available at: www.pediatrics.org/cgi/content/full/135/1/e7
6. Dufendach KR, Eichenberger JA, McPheeters ML, et al. *Core Functionality in Pediatric Electronic Health Records*. Rockville, MD: Agency for Healthcare Research and Quality; 2015. Available at: www.ncbi.nlm.nih.gov/books/NBK293626/. Accessed May 27, 2019
7. Lehmann CU; Council on Clinical Information Technology. Pediatric aspects of inpatient health information technology systems. *Pediatrics*. 2015;135(3). Available at: www.pediatrics.org/cgi/content/full/135/3/e756
8. Health IT for the Care Continuum Task Force. Pediatric Health IT worksheets. Available at: https://www.healthit.gov/sites/default/files/page/2019-03/PediatricHealthITWorksheets.pdf. Accessed January 30, 2020
9. Centers for Disease Control and Prevention. CDC recommends only two HPV shots for younger adolescents. 2016. Available at: https://www.cdc.gov/media/releases/2016/p1020-HPV-shots.html. Accessed June 21, 2018
10. Flynn JT, Kaelber DC, Baker-Smith CM, et al; Subcommittee on Screening and Management of High Blood Pressure in Children. Clinical practice guideline for screening and management of high blood pressure in children and adolescents. *Pediatrics*. 2017;140(3):e20171904

11. Physician's Computer Company Pediatric EHR Solutions. A robust pediatric-focused EHR improves the immunization process. Available at: https://blog.pcc.com/a-robust-pediatric-focused-ehr-improves-the-immunization-process. Accessed May 27, 2019

12. Suralek M. Immunization calculation engine (ICE): an open source clinical decision support system for integration with health information systems. Available at: https://www.hln.com/assets/pdf/ICE-OSEHRA-Summit-2017.pdf. Accessed June 21, 2018

13. Longhurst C, Turner S, Burgos AE. Development of a Web-based decision support tool to increase use of neonatal hyperbilirubinemia guidelines. *Jt Comm J Qual Patient Saf.* 2009;35(5):256–262

14. BiliTool EMR. Bilitool.net Web site. Available at: http://emr.bilitool.net/. Accessed June 21, 2018

15. Boston Children's Hospital. Growth chart. Available at: https://apps.smarthealthit.org/app/growth-chart. Accessed May 27, 2019

16. Mandel JC, Kreda DA, Mandl KD, Kohane IS, Ramoni RB. SMART on FHIR: a standards-based, interoperable apps platform for electronic health records. *J Am Med Inform Assoc.* 2016;23(5):899–908

17. Healthcare Innovation. Mix of applications at showcase to demonstrate FHIR's potential. Available at: https://www.hcinnovationgroup.com/interoperability-hie/blog/13027160/mix-of-applications-at-showcase-to-demonstrate-fhirs-potential. Accessed May 27, 2019

18. MedlinePlus Connect. Linking patient portals and EHRs to consumer health information. 2018. Available at: https://medlineplus.gov/connect/overview.html. Accessed June 21, 2018

19. Department of Health & Human Services. Summary of the HIPAA security rule. Available at: https://www.hhs.gov/hipaa/for-professionals/security/laws-regulations/index.html. Accessed December 9, 2018

Leukodystrophies in Children: Diagnosis, Care, and Treatment

- *Clinical Report*

CLINICAL REPORT Guidance for the Clinician in Rendering Pediatric Care

American Academy of Pediatrics
DEDICATED TO THE HEALTH OF ALL CHILDREN™

Leukodystrophies in Children: Diagnosis, Care, and Treatment

Joshua L. Bonkowsky, MD, PhD, FAAP,[a] Stephanie Keller, MD, FAAP,[b] AAP Section on Neurology, Council on Genetics

Leukodystrophies are a group of genetically determined disorders that affect development or maintenance of central nervous system myelin. Leukodystrophies have an incidence of at least 1 in 4700 live births and significant morbidity and elevated risk of early death. This report includes a discussion of the types of leukodystrophies; their prevalence, clinical presentation, symptoms, and diagnosis; and current and future treatments. Leukodystrophies can present at any age from infancy to adulthood, with variability in disease progression and clinical presentation, ranging from developmental delay to seizures to spasticity. Diagnosis is based on a combination of history, examination, and radiologic and laboratory findings, including genetic testing. Although there are few cures, there are significant opportunities for care and improvements in patient well-being. Rapid advances in imaging and diagnosis, the emergence of and requirement for timely treatments, and the addition of leukodystrophy screening to newborn screening, make an understanding of the leukodystrophies necessary for pediatricians and other care providers for children.

INTRODUCTION

Inherited leukodystrophies are a group of genetically diverse diseases with more than 30% mortality by 8 years of age. Leukodystrophies, which are attributable to abnormalities of the brain myelin (white matter), are individually rare but collectively common, with a published incidence of 1 in 4700 live births.[1–4] Leukodystrophies can present at any age from preterm infants and neonates to late adulthood[5,6] and have been reported across all ethnicities and regions of the world.[7–13] Clinical recognition of leukodystrophies accelerated with the widespread clinical adoption of MRI in the 1980s and 1990s,[14,15] and recent improvements in genetic diagnosis techniques have led to specific diagnosis in more than half of all patients with leukodystrophy.[2,16,17]

abstract

[a]*Division of Pediatric Neurology, Department of Pediatrics, School of Medicine, University of Utah and Brain and Spine Center, Primary Children's Hospital, Salt Lake City, Utah; and* [b]*Department of Pediatrics, Division of Pediatric Neurology, Emory University and Children's Healthcare of Atlanta, Atlanta, Georgia*

DOI: https://doi.org/10.1542/peds.2021-053126

Address correspondence to Joshua L. Bonkowsky, MD, PhD. E-mail: joshua.bonkowsky@hsc.utah.edu

PEDIATRICS (ISSN Numbers: Print, 0031-4005; Online, 1098-4275).

FINANCIAL DISCLOSURE: Other than the potential conflicts of interest listed below, the authors have indicated they have no financial relationships relevant to this article to disclose.

FUNDING: Supported by the Bray Chair in Child Neurology Research and the Brain and Spine Center of Primary Children's Hospital.

To cite: Bonkowsky JL, Keller S; AAP Section on Neurology, Council on Genetics. Leukodystrophies in Children: Diagnosis, Care, and Treatment. *Pediatrics.* 2021;148(3):e2021053126

Today, definitive cures exist only for a few leukodystrophies. However, there is tremendous excitement for patients, providers, and families because of a multitude of clinical trials and genetic therapies that are being pursued and rapidly becoming available.[18] In addition, a crucial point is that all leukodystrophies are treatable. Improved general care and quality of life for patients and their families is recognized as a central goal of treatment. An analogous dramatic example is that of cystic fibrosis, for which average life expectancy has increased from 30 days to 30 years even in the absence of a genetic cure.[18,19] These gains in longevity were largely derived from incremental improvements in the approach to routine care (eg, aggressive physiotherapy, antibiotics), and applying standard preventive health maintenance has the potential to improve overall health.[20]

Because of the potential for treatment when recognized early, the US Health and Human Services Advisory Committee on Heritable Disorders in Newborns and Children (ACHDNC) Recommended Uniform Screening Panel (RUSP) now recommends universal newborn screening (NBS) for X-linked adrenoleukodystrophy (X-ALD).[21] New York, Connecticut, Pennsylvania, Minnesota, and California now include some leukodystrophies in their NBS panels, and more than 15 states added testing for X-ALD in their panels in 2019 and 2020.[22] Additional states are in the evaluation process for consideration to add X-ALD and/or Krabbe disease to their NBS panels.

The general pediatrician plays an important role for children with leukodystrophies. The pediatrician may need to assist with prompt and appropriate referral for NBS results, provide a medical home for patients and families as they navigate between different subspecialists for treatments, provide long-term follow-up after therapies such as hematopoietic stem cell transplant (HSCT), and counsel families who have an affected child or an affected relative. These roles for the pediatrician are new and transforming rapidly and often have not been addressed in residency training.

This clinical report from the AAP on leukodystrophies will help guide policy management for NBS, approaches to diagnosis, timing and choice of treatment, and supportive therapies. Leukodystrophies, formerly considered a rare neurologic disorder that would not be seen by a general pediatrician, are relatively common as a group of disorders. Therefore, familiarity with the general principles for diagnosis and supportive management in leukodystrophies is important for all pediatricians. The primary take-home message is that recognizing and diagnosing a leukodystrophy is important, because some leukodystrophies require urgent treatment.

CATEGORIES AND DISEASES

What is a leukodystrophy? Broadly speaking, it is any genetic disease affecting the myelin of the central nervous system (CNS). Table 1 presents a list of commonly used terms, definitions, and abbreviations used in leukodystrophies. Leukodystrophies fall into broad categories: (1) hypomyelination, in which there is absent or diminished myelin production; (2) dysmyelination, in which there is abnormal myelin development; or (3) demyelination, in which there is loss and/or destruction of previously established myelin. Demyelinating leukodystrophies tend to be the more well-known leukodystrophies, including Krabbe disease, X-ALD, and metachromatic leukodystrophy (MLD). Better-known hypomyelinating leukodystrophies include Pelizaeus-Merzbacher disease (PMD), RNA polymerase III–related leukodystrophies/4-H syndrome (hypomyelination, hypogonadotropic hypogonadism, and hypodontia), and hypomyelination with atrophy of the basal ganglia and cerebellum. A single disease can fall into more than one category, even in the same individual. Also, this categorization theme is based mostly on the appearance of the leukodystrophy by using MRI, which can be subjective.

There is disagreement over the exact definition of a leukodystrophy and whether certain conditions meet required criteria.[2,3] Further complicating this lack of consensus are differences in the severity of the disease. For example, the exact same genetic mutation of *ABCD1* (the gene responsible for X-ALD) in twin brothers can lead to rapid cerebral demyelination in childhood or to a slow and chronic effect mostly of the peripheral nerves. Finally, next-generation sequencing techniques are revealing complex genotype-phenotype disease relationships of leukodystrophy genes, which were unsuspected and unknown 5 years ago.

One standard for definition of leukodystrophies was published in 2015 based on the consensus opinion of a panel of inherited white matter disease experts.[23] The group classified 30 diseases as leukodystrophies, defined as heritable disorders affecting the white matter of the CNS with or without peripheral nervous system involvement.[23] This does not include acquired CNS myelin disorders, such as multiple sclerosis, and related acquired CNS demyelinating processes. Inborn errors of metabolism, in which the clinical

TABLE 1 Definitions and Terms Used in the Text

Brainstem auditory evoked potential: A test for intactness of the auditory nerve and CNS auditory centers.
BMT: often used interchangeably with HSCT or UCB transplant. Used as a treatment of certain leukodystrophies.
CNS: including the brain, spinal cord, retina, and optic and olfactory nerves.
Demyelination: loss and/or destruction of previously established myelin.
Dysmyelination: abnormal myelin development.
EMG: typically performed with NCS, to evaluate muscle and nerve function.
HSCT: transplant of cells derived from a healthy donor source of hematopoietic lineages is curative for a few leukodystrophies (see Table 2). Types, technical aspects, benefits, and risks of transplant vary. The transplant source can be peripheral blood, BMT, or UCB transplant.
Hypomyelination: absent or diminished myelin production.
Leukodystrophy: a heritable disorder affecting the white matter of the CNS with or without peripheral nervous system involvement.[22] This does not include acquired CNS myelin disorders, such as multiple sclerosis and related acquired CNS demyelinating processes.
Leukoencephalopathy (genetic): a disease that may reveal significant white matter changes in the brain but the predominant symptoms of the disease are considered to arise from the gray matter or other organ systems.
MRI: important imaging tool for diagnosis and evaluation of leukodystrophy. Aspects of MRI analysis that may be helpful for diagnosis include T1, T2, and diffusion weighted imaging. For a few leukodystrophies, the specific findings on MRI can help make a diagnosis.
Myelin: the lipid layer providing insulation and support for axons and neurons in the CNS (the white matter of the CNS).
NBS: newborn screen.
NCS: to evaluate peripheral nerve function; often performed with EMG.
NGS: new, advanced, rapid sequence techniques including gene panel tests, WES, and WGS.
Visual evoked potential: a test for intactness of nerve pathways for vision.
WES: a type of NGS that analyzes all of the exons (coding sequences).
WGS: a type of NGS that analyzes all of the DNA.

Specific leukodystrophy diseases and their abbreviations are listed in Table 2. UCB, umbilical cord blood; BMT, bone marrow transplant; NGS, next-generation sequencing.

manifestations of systemic illness predominate, even with significant white matter abnormalities in the brain, were also excluded from characterization as leukodystrophies. These, as well as other genetic diseases, such as neuronal ceroid lipofuscinosis and mitochondrial diseases, were termed "genetic leukoencephalopathies." Although leukoencephalopathies may reveal significant white matter changes in the brain, the predominant symptoms of the disease are considered to arise from the gray matter or other organ systems.

CLINICAL PRESENTATION

The age of onset of symptoms in leukodystrophies may vary from prenatal to adult. In neonates and infants, presenting symptoms can include encephalopathy or developmental delay. In children, adolescents, and adults, symptoms can be more insidious, ranging from behavioral or psychiatric changes; loss of formerly achieved milestones; or deterioration in skills, vision changes, or ataxia or gait changes (often from spasticity). Attention-deficit/hyperactivity disorder and other subtle cognitive changes may be the presenting symptoms and often precede motor dysfunction in leukodystrophies with late childhood or juvenile onset.[24] In general, hypomyelinating leukodystrophies present more often with motor delay versus motor regression typically seen in demyelinating leukodystrophies.

Seizures are much more common than previously realized in children with leukodystrophies and affect up to 49% of children with the disease.[2] In rare cases, seizures may be the presenting symptom, such as in Alexander disease. Epilepsy is a common feature of Krabbe disease, megalencephalic leukoencephalopathy with subcortical cysts, sialic acid storage disorders, peroxisomal disorders, and L-2-hydroxyglutaric aciduria.[16]

A few leukodystrophies are more likely to have classic presentations. In a child with acute deterioration of neurologic status, particularly after a febrile illness or head injury, mitochondrial disease or vanishing white matter (VWM) disease are considerations. Infants with PMD often present at birth or within the first 2 months of life with hypotonia, rotary nystagmus, head titubation, and sometimes stridor attributable to vocal cord paralysis.[25] Macrocephaly is a common feature in megalencephalic leukoencephalopathy with subcortical cysts (MLC), Canavan disease, and Alexander disease, and microcephaly is a feature of Aicardi-Goutières syndrome and RNAse T2-deficient leukoencephalopathy.[16] In the neonatal period, Aicardi-Goutières syndrome may often be confused with a congenital cytomegalovirus infection shared symptoms of intracranial calcifications and microcephaly and, in some, hepatosplenomegaly and thrombocytopenia.[26] X-ALD can be considered in a school-aged boy with skin color changes and/or adrenal insufficiency (eg, Addison disease). Children with 4-H syndrome or RNA polymerase III–related leukodystrophies may be identified by their other systemic symptoms including dental abnormalities, progressive myopia (nearsightedness), and hypogonadotropic hypogonadism.[16]

The age of onset of symptoms and/or developmental regression may also help narrow the differential diagnosis. Although most leukodystrophies have both infantile and juvenile or adult forms, one of these groups is typically predominant. The most common forms of Aicardi-Goutières syndrome and PMD display symptoms from birth or within the first few months of life.[25,26] Ninety percent of patients with Krabbe disease are of infantile onset with symptoms presenting between 6 and 12 months of life.[27] The most common form of MLD is the late-infantile form with onset of symptoms between 1 and 2 years of age. Neurologic symptoms in boys with X-ALD occur most often in the elementary school years, between 4 and 10 years of age.

Developmental regression and loss of previously attained milestones can be a presentation of some leukodystrophies and is often the symptom that brings the child to medical attention. In this situation, an urgent evaluation with a pediatric neurologist should be considered.

MRI AND NEUROIMAGING

An MRI of the brain is the gold standard investigation in a patient with a suspected leukodystrophy or leukoencephalopathy.[16] Although computed tomography (CT) can indicate abnormal signal quality in the CNS myelin, the more detailed signal characteristics of an MRI can provide potentially diagnostic information. Furthermore, MRI is preferable to CT for visualizing abnormal signal and because it involves less radiation exposure. Many publications have identified MRI patterns in leukodystrophies that can be used for diagnosis.[28–33] Key features on MRI include the presence of contrast enhancement, the presence of cysts, calcifications, or more subtle structural abnormalities.[34] The predominant location, confluent versus multifocal nature of the white matter abnormalities, and signal changes, including hypomyelination versus high T2 signal abnormality and the relative T1 signal hyper- or hypointensity, are the primary discriminating MRI characteristics.[16,28] Although MRI algorithms are helpful for diagnosis,[28] there are limitations on their sensitivity and specificity, and they require skilled radiologic interpretation and experience.[29]

The changing appearance and characteristics of myelin with normal development can also cause complexity in interpreting MRIs.[35] There is a range of normal development of myelin appearance on MRI, and at age 2 years some children will not be fully myelinated. Hypomyelination can also be a result or accompanying feature of other genetic diseases, systemic disorders, or illnesses.[36,37] MRI interpretation is also complicated by normal developmental features: the T1 and T2 signal characteristics of myelin change between birth and 1 year; myelination proceeds from central brain structures to more peripheral white matter and posteriorly to anteriorly. In particular, until the age of 2 years, the CNS of children is normally relatively hypomyelinated compared with adults. Therefore, in a child younger than 1 year with possible hypomyelination, a follow-up MRI of the brain after 24 months, or serial MRIs every 6 to 12 months, is recommended to establish the diagnosis of hypomyelination.[16]

Despite these caveats, some leukodystrophies have key features on MRI, which can suggest a diagnosis for classic presentations (Fig 1, Table 2).[16,38,39] Although not completely sensitive and specific, multiple sclerosis (Fig 1) and other mimicking conditions (such as periventricular leukomalacia from prematurity) typically have different MRI features. Overall, the MRI findings should be interpreted in concert with the findings of the clinical history and physical examination.

DIAGNOSIS

A genetic diagnosis offers affected families a variety of important options, including disease-specific therapies in some cases and family planning advice in all cases. For a few leukodystrophies, early diagnosis can lead to a halt in disease progression and, in some instances, a cure.

After a diagnosis is suspected on the basis of clinical presentation and MRI findings, biochemical and/or genetic studies are required for a final determination. Depending on available expertise, early referral and involvement of a pediatric neurologist, geneticist, and genetic counselor are important for guiding diagnostic testing, care, and potential further referral (for example, if HSCT is indicated). However, in situations in which timely diagnosis is important, with appropriate guidance, a primary physician can initiate diagnostic tests. Further referral to a clinician or clinical center with expertise in leukodystrophy care can be helpful. For example, online leukodystrophy support groups such as the United Leukodystrophy Foundation or the Leukodystrophy Care Network can direct patients toward centers with leukodystrophy expertise.

Testing of other organ systems may provide additional information to help confirm a diagnosis or differentiate it from others.[40] Possible testing includes an ophthalmologic examination for indications of ocular involvement; electromyography (EMG) to evaluate

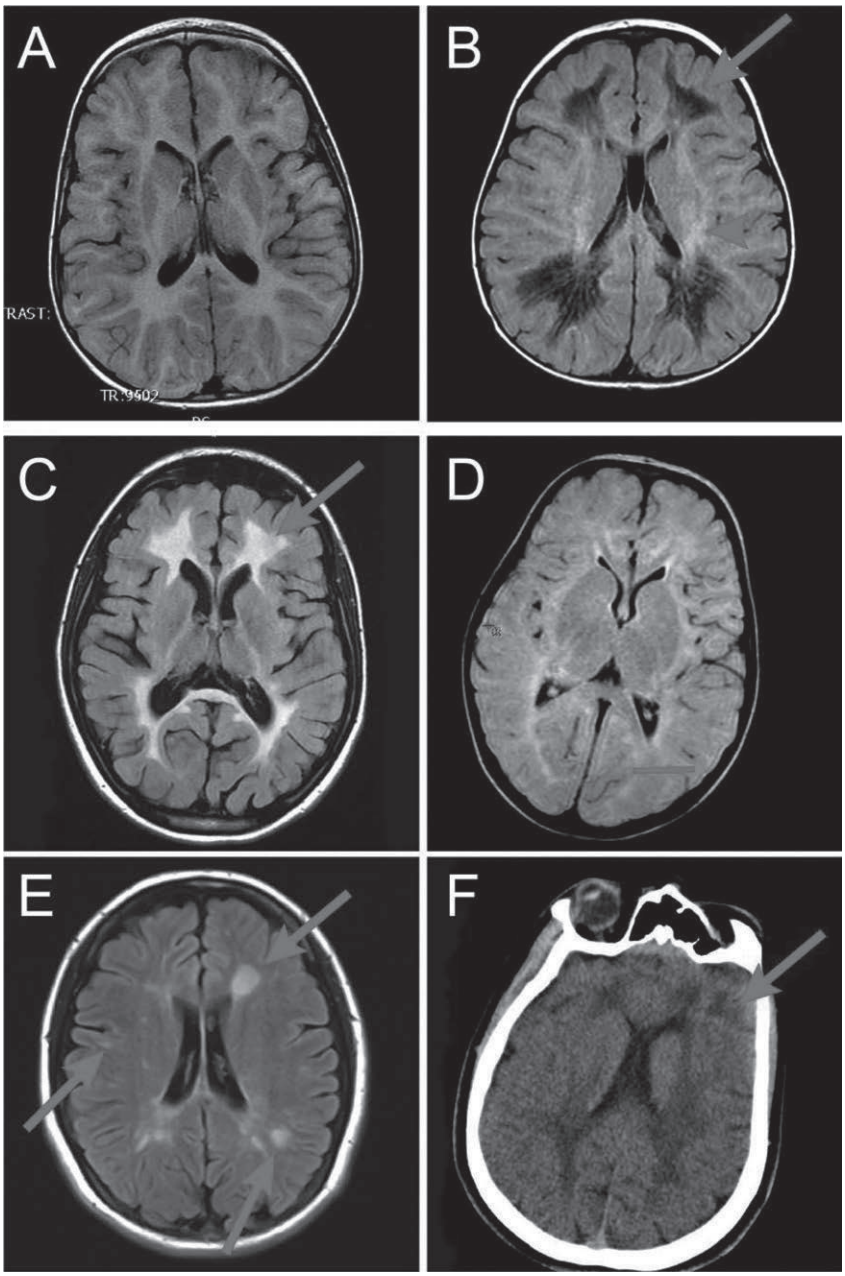


FIGURE 1 Illustrative examples of MRIs of different leukodystrophies and of leukodystrophy mimics. Images are axial slices. A, T2 image of normal brain. B, T2 MRI image of VWM disease; arrow points to hypodense (dark color) white matter; arrowhead points to abnormal hyperintense (bright) white matter. C, T2 image of MLD, with hyperintense (bright) signal in the white matter (arrow). D, T2 image of a hypomyelinating leukodystrophy, PMD, in which the relative paucity of myelin is seen (red line, compare with normal MRI of A). E, T2 image of multiple sclerosis, with scattered areas of hyperintense signal (arrows). F, CT image of VWM disease; abnormal signal in white matter is present (arrow) but is much easier to see on MRI (B).

for myopathies; a nerve conduction study (NCS), which may reveal a peripheral neuropathy; brainstem auditory evoked potential to evaluate for hearing loss; and visual evoked potentials to examine vision.[40] Lumbar punctures with cerebrospinal fluid (CSF) analysis may show protein elevation in active demyelination or a lactic acid elevation in mitochondrial disease. CSF leukocytosis and elevated interferon-α and neopterin suggest Aicardi-Goutières syndrome. Lastly, CSF N-acetyl aspartate (NAA) is elevated in Canavan disease.[16]

The Global Leukodystrophy Initiative published a clinical approach to diagnosis of patients with leukodystrophies in 2015. Its approach combines 3 elements: (1) testing for treatable diseases; (2) testing based on MRI features; and (3) next-generation sequencing technologies, particularly gene panel-based approaches and whole-exome sequencing (WES).[16] There is utility in making an expedient diagnosis by excluding treatable forms of leukodystrophies, curtailing other expensive and lengthy testing, and providing valuable reassurance and prognostic information to the patient and family.[16]

Steady advances in next-generation sequencing technologies are making WES a first-tier option for diagnosis of complex genetic disorders with reported yields of 25%.[41] Unbiased genome-wide approaches exemplified by WES or whole-genome sequencing (WGS) provide the potential for diagnosis of known diseases without stepwise ordering of multiple individual tests. Furthermore, genome-wide sequencing can contribute to ongoing discovery of novel disease genes. This testing and assistance with interpretation of results can be facilitated with the help of a geneticist and/or genetic counselor.

Next-generation sequencing technologies provide the potential for unbiased diagnosis of known diseases without individual ordering of multiple individual tests and will contribute to discovery of novel disease genes. However, continued limitations and problems associated with this technology

TABLE 2 Representative Leukodystrophies: Disease; Gene; Classic Features, Including Age at Onset, Symptoms, and MRI Findings; NBS; and Treatment (ERT, HSCT)

Disease	Gene	Typical Age at Onset	Classic Symptoms	Classic MRI Finding?	NBS?	Treatment?
Aicardi-Goutières	Multiple	Birth to 6 y	Microcephaly, seizures	Calcifications	—	—
Alexander disease	GFAP	Birth to 2 y	Delay, regression	—	—	—
Canavan disease	ASPA	3 mo to 1 y	Delay, macrocephaly	—	—	—
Gaucher disease	GBA	Birth to 6 mo	Seizures, spasticity	—	—	ERT
Krabbe (Globoid cell)	GALC1	2–6 mo	Regression, irritability	—	Yes	HSCT
MLD	ARSA	Birth to adult	Varies	—	—	HSCT
PMD	PLP1	Birth to 6 mo	Hypotonia, nystagmus, titubation	Hypomyelination	—	—
VWM	EIF2B	4 mo to 10 y	Symptoms after minor illness	"Stranding"	—	—
X-ALD	ABCD1	4–10 y	ADHD, school problems, Addison	Contrast enhancement	Yes	HSCT, hormones

ADHD, attention-deficit/hyperactivity disorder; GFAP, glial fibrillary acidic protein; —, not applicable.

include (1) substantial cost (up to $15 000 to $20 000), although these numbers are rapidly decreasing; (2) potential for identifying unanticipated disease variants unrelated to the test indication; (3) potential false-negative results because of imperfect exome coverage; and (4) methodologic limitations in the interpretation phase if a clear disease-associated variant is not identified. This fourth problem is significant because of the large number of deleterious gene variants in all humans that could plausibly be related to a phenotype (especially in the CNS), which could yield false-positive associations.

WES continues to become more accessible and may become the method of choice for the diagnosis of leukodystrophies, because it can avoid the diagnostic odyssey faced by many patients.[42,43] Researchers in a recent study used WES on a cohort of 71 patients with persistently unresolved white matter abnormalities with a suspected diagnosis of leukodystrophy or genetic leukoencephalopathy. Diagnostic pathogenic variants were identified in 35% (25 of 71) of patients and potentially pathogenic variants were found in clinically relevant genes in an additional 7% (5 of 71) of cases, giving a total yield of clinical diagnoses in 42% of individuals.[17] Sequencing is as cost-effective as a brain MRI and, with improved data analysis, will become as rapid. However, even after in-depth biochemical and genetic testing, a portion (around 25% to 40%) of leukodystrophy cases can remain undiagnosed.

There are important current limitations to use of next-generation sequencing approaches. There are unanswered questions about the disconnect between the underlying gene or biochemical defect, as in X-ALD or Krabbe disease, and actually developing the disease.[44,45] Additionally, WES does have caveats for diagnosis, including copy number variation mutations, mitochondrial genome mutations, and insufficient coverage of some exons to reliably call heterozygous variants. WGS is also becoming clinically available. It provides nearly complete information of DNA sequences but until recently has only been available in research studies. Some recent work suggests that WGS may be useful as a first-line diagnosis tool.[46] However, unresolved ethical questions surround the implementation of WGS as a screening or general diagnostic tool.[47,48] These ethical concerns include that WGS can reveal information unrelated to the patients' current symptoms but that may affect the health of the patient and his or her family, could reveal future health issues before the patient having decision-making capacity, could affect health insurance coverage, or could reveal unexpected issues such as consanguinity or unexpected parentage.[40]

NBS

NBS for selected leukodystrophies is being developed in several states.[44,49] X-ALD NBS has been added to the US Health and Human Services RUSP. X-ALD is the only leukodystrophy included (at the time of this publication) on the RUSP. X-ALD is gradually being added to state NBS panels, including (at the time of this publication) 18 states, Puerto Rico, and the District of Columbia.[22,50,51] There are a variety of resources for management of results, and a flow diagram of management for X-ALD (from the California Department of Public Health) is provided in Fig 2.

Krabbe disease has been included in NBS on the basis of legislative mandate in 7 states; Krabbe screening was not recommended by the ACHDNC.[44,49] Addition of conditions outside the ACHDNC process, such as occurred for Krabbe disease, has been controversial. Krabbe disease was proposed for inclusion on the RUSP, but it was not confirmed because of a lack of evidence of an effective treatment. In Krabbe disease, mutational analysis and residual

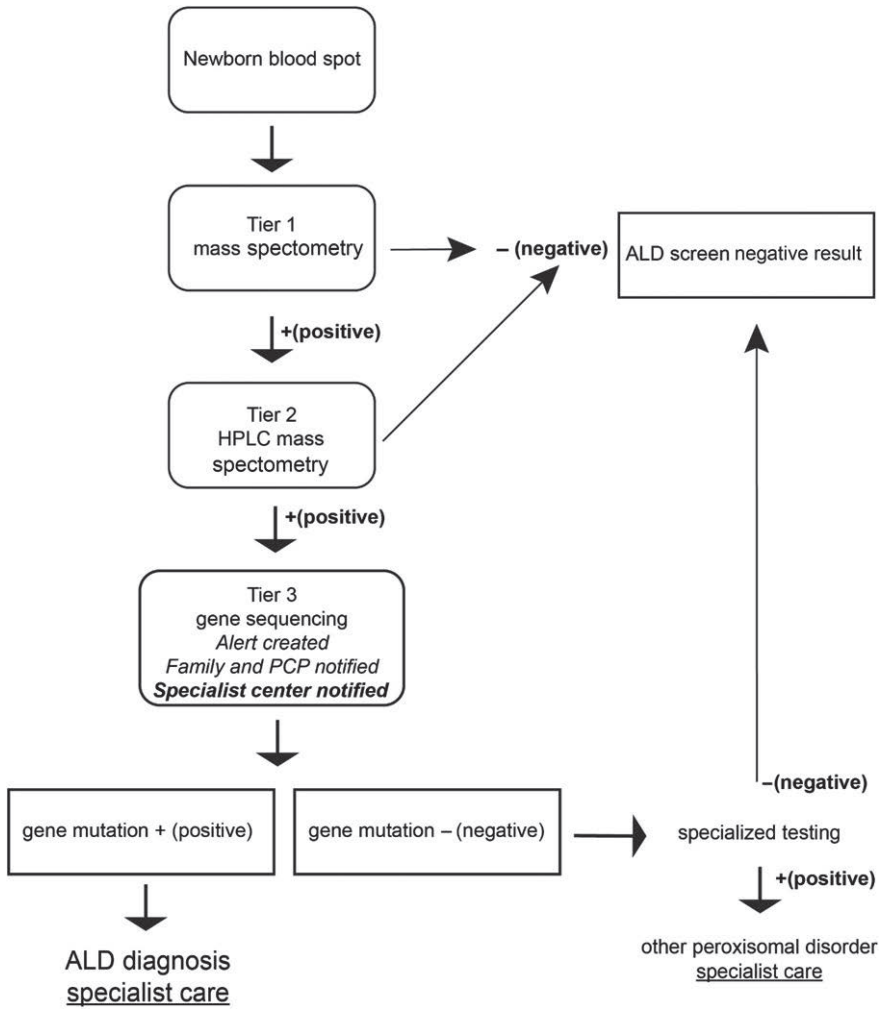


FIGURE 2 Simplified protocol for X-ALD NBS protocol (schematized from the California Department of Public Health). HPLC, high-performance liquid chromatography; PCP, primary care provider.

galactosylceramidase enzyme activity have only limited ability to predict age of disease onset and whether disease will occur.[45] In the first 8 years Krabbe disease was included in NBS in New York state, most of the infants judged to be high risk on the basis of screening protocols did not develop the infantile form of the disease and have remained asymptomatic.[52] Therefore, referring all high-risk infants for transplant would expose many of them to unnecessary risk, because HSCT is associated with significant morbidity and mortality. However, efforts are continuing to help identify which patients with Krabbe disease are most at risk, for example, incorporating measurement of psychosine by using liquid chromatography tandem mass spectrometry as a second-tier test. Psychosine is one of several substrates of the galactosylceramidase enzyme, and its accumulation may cause or contribute to the demyelination and neurodegeneration in patients with Krabbe disease.[53]

Despite the controversies highlighted by NBS for Krabbe disease, as technology advances and new therapies emerge, it is highly likely that other leukodystrophies will be considered for NBS. Factors affecting recommendation for NBS include variability in disease course, variability in penetrance and disease progression, and limited treatment options.[54–56] Generally, criteria for inclusion in NBS include availability of an appropriate test, a clinical history that includes a potential for impact with early intervention, and an effective therapy. As new therapies become available, additional conditions may become potential targets for NBS implementation. Once NBS is implemented, there is variability in each state as to the testing methodology used, the value or cutoff reported as positive, and means of

confirmatory and secondary testing. Finally, because treatments such as HSCT for Krabbe disease can be expensive or carry risk or have limited efficacy, a decision to implement NBS requires careful consideration of pros, cons, risks, benefits, and costs.[55]

Even for diseases with an available treatment, such as cerebrotendinous xanthomatosis, identifying a testing algorithm with a low false-positive rate and the ability to use existing equipment has been an ongoing area of development.[57,58] Additionally, the cost of test implementation and the development and organization of resources for the evaluation and treatment of identified affected children have been road blocks in NBS for leukodystrophies. Further debate revolves around the potential harm to families of children who have false-positive test results.

Screening for X-ALD is aimed at identifying infants before the onset of neurologic symptoms associated with the cerebral form of the disease, because early treatment with HSCT can prevent severe disability and death. Even for patients who do not develop cerebral disease, early identification can be life-saving by preventing adrenal crisis, because adrenal dysfunction occurs in approximately 90% of patients with X-ALD. For asymptomatic boys in childhood, endocrine monitoring is suggested with an annual clinical evaluation and with serum adrenocorticotropic hormone and cortisol tests every 6 months.

An annual neurologic evaluation is also recommended for X-ALD.[59] Approximately 30% to 40% of patients with X-ALD will go on to develop the cerebral form of the disease.[60,61] Because of the risk of morbidity and mortality with HSCT, boys do not receive transplants unless there is evidence of cerebral involvement.[59] Protocols have been developed to monitor for cerebral involvement with serial MRIs recommended every 6 months from 1 to 12 years of age. After 12 years of age, MRIs are performed yearly. If an abnormality is detected on MRI, the MRI is scored by using a specialized scoring system (Loes score) to determine if HSCT is appropriate.[58] HSCT is typically considered appropriate if the Loes score is less than 9, with a performance IQ of greater than 80.[59,62] HSCT in children in whom the Loes score is greater than 9 and who have significant neurologic involvement including IQ less than 80 is not recommended because of poor outcomes.

NBS for X-ALD can also identify other peroxisomal disorders such as Zellweger spectrum disorder, acyl-CoA oxidase deficiency, and D-bifunctional protein deficiency. Unfortunately, at this time, only supportive care is available for treatment of these other peroxisomal disorders.[61] As data from the experience of NBS for X-ALD and Krabbe disease from New York state become available, new complications may be identified, but also ways to improve screening, follow-up, and pathways to treatments can be developed.

TREATMENTS

Curative options for leukodystrophies are disappointingly sparse at the current time. The only option is HSCT. HSCT is only effective for a subset of leukodystrophies, chiefly X-ALD, MLD, and Krabbe disease,[63–65] and is only helpful if transplant is performed before substantial disease progression. However, it is important to note that even in the absence of a curative therapy, treatments, such as for spasticity or feeding problems, can improve the lives of children with leukodystrophies.

Although not a cure, HSCT can prolong life and preserve cognitive skills when performed in presymptomatic infants with Krabbe disease.[66,67] However, most treated children still experience spasticity, lower-than-average growth, and difficulties in expressive language, adaptive behavior, and motor function.[66,67] Infants receiving a transplant before 30 days of age, most of whom had Krabbe disease diagnosed in utero because of family history, had better survival and functional outcome than those who received transplants later.[68] Presymptomatic transplant is reported to result in normal receptive language,[40] attenuation of symptom severity,[40] and longer survival compared with untreated infantile Krabbe disease. However, most children have progressive gross motor delays ranging from mild spasticity to inability to walk independently, and a few have acquired microcephaly.[40]

A study performed on the outcomes of HSCT in patients with MLD showed that 7 out of 27 patients died of infection, regimen-related toxicity, or disease progression.[69] The researchers found that patients with motor function symptoms at the time of transplant did not improve after transplant. Transplant fails to correct disease in the peripheral nervous system, because enzyme is not delivered to the peripheral nerves, which greatly affected motor development as peripheral neuropathy can be severe as early as 3 month of age.[69] After HSCT, auditory evoked responses, visual evoked potentials, EEG, and/or peripheral nerve conduction velocities stabilized or improved in juvenile patients with MLD but continued to worsen in most patients with the late-infantile

presentation.[69] Lentiviral gene therapy correction of a patient's own bone marrow stem cells (hematopoietic stem cell gene therapy [HSC-GT], in which a normal copy of the gene is delivered by a lentivirus to replace the patient's mutant copy) appears to be well tolerated, including for infantile MLD.[70] Although lentiviral HSC-GT may offer reduced complications and the potential for improved treatment, outcomes data are not yet available.

HSCT is the only effective therapy for cerebral X-ALD that has been proven to date, and it is more likely to be effective if it is performed at an early stage of neurologic involvement with a light burden of disease on MRI. Favorable baseline disease characteristics for HSCT include one or fewer neurologic deficits and a Loes MRI score <9.[62] HLA antigen–matched siblings are also preferred. To determine if HSCT is indicated, presymptomatic boys are monitored with a yearly neurologic examination and with a brain MRI every 6 months from age 2 years to 12 years and then yearly to evaluate for the development of white matter signal abnormalities and contrast enhancement on MRI. HSCT does not prevent the adrenal involvement or the later development of the spinal cord and peripheral neuropathy (adrenomyeloneuropathy).[62]

Autologous, genetically modified HSCT (using lentiviral delivery of a wild-type copy of the gene into the patient's own cells; HSC-GT) has been studied in patients with X-ALD. Clinically, patients developed mild cognitive or functional deficits after treatment, although these stabilized with longitudinal assessments. On MRI, there was resolution of the contrast enhancement. The investigators concluded that this initial trial had outcomes similar to those observed in standard HSCT with reduced risk of graft-versus-host disease and the potential for improved long-term outcomes.[18]

Patients who undergo HSCT are at high risk for disease progression: first, because there is a time-lag between transplant and effective rescue, and second, because the HSCT process itself appears to accelerate disease progression in some patients. HSCT is not always successful and carries a substantial mortality risk approaching 20%. Donor sources for HSCT include cord blood, bone marrow, or peripheral blood stem cells.[66,71]

Enzyme replacement therapy (ERT) is an option for some of the lysosomal disorders (Gaucher disease, Fabry disease, mucopolysaccharidosis types I, II, and VI, and Pompe disease) which can have leukodystrophy as a component.[71,72] ERT has shown some efficacy in animal models in other leukodystrophies,[73] and clinical trials are being pursued but convincing effectiveness has not yet been shown.

"Lorenzo's oil" is a treatment that has been proposed to reduce progression of X-ALD in its cerebral form.[74] A 4:1 mixture of glyceryl trioleate and glyceryl trierucate, Lorenzo's oil can normalize levels of very-long chain fatty acids in plasma although as previously noted these do not show a correlation with disease progression, and current published data to do not demonstrate efficacy for inhibiting disease progression or altering outcomes.[75–77] In the United States, Lorenzo's oil can be obtained by foreign import via an expanded access program.

Gene therapy is rapidly progressing toward becoming clinically available. Thus far, it has shown promise in MLD and X-ALD.[78,79] A clinical trial of HSC-GT for the treatment of MLD was initiated in Milan, Italy, in 2010. Results showed reconstitution of arylsulfatase A (ARSA) activity in all hematopoietic lineages and in the CSF. The Gross Motor Function Measurement scores also showed that gross motor performance was similar to that of normally developing children for most of the patients who underwent HSC-GT up to the last follow-up. Initial reports indicate gene therapy may have less morbidity and mortality than HSCT while still being effective in halting disease.[80]

Promising clinical trials are ongoing in the treatment of Aicardi-Goutières syndrome with reverse transcriptase inhibitors.[81] In Alexander disease research, antisense oligonucleotides were used to successfully suppress glial fibrillary acidic protein in mouse models, resulting in improved body condition and rescue of hippocampal neurogenesis.[82] There is significant interest in using stem cells or modified induced pluripotent stem cells for the treatment of leukodystrophies.[83] Although of great potential, practical use still does not seem imminent. Novel drug discovery, or repurposing of known drugs, is another promising avenue of current therapies for several leukodystrophies.[77,84,85] Other possible disease-modifying treatments, such as vitamin D treatment of X-ALD, are also being studied.

Common challenges with rare disease research include the recruitment of adequate numbers of patients, obtaining natural history data, and identifying biomarkers for use in later clinical trials. The clinician plays an important role in helping patients and families with rare diseases connect to research and clinical trials. Although the

Internet and social media have increased awareness of clinical trials and research, clinicians can discuss with families the utility of natural history studies and other research, which may not directly benefit their child but will help children in the future.

THE ROLE OF PEDIATRICIANS IN CARE OF PATIENTS WITH LEUKODYSTROPHIES

Although there are significant limitations in the treatment of leukodystrophies, there are tremendous opportunities for improving the care of patients.[86] It is important to stress that not all leukodystrophies are progressive or worsen with time, an incorrect and formerly commonly held view. A patient-centric approach can prompt and facilitate discussions between the clinician and patient and family about what care and treatment is most important and most helpful. As has been demonstrated for other currently incurable genetic conditions (eg, cystic fibrosis), the strategies of routine symptomatic care can have a profound effect on both the quality and the duration of a patient's life.[87] Nationally and internationally, there is a wide variability in the care and costs of care or treatment of leukodystrophy patients: a greater than sevenfold difference in costs across children's hospitals in the United States.[88]

Complications of disease, even if the disease itself is not progressive, can lead to progressive disability requiring assistance for mobility and activities of daily living as well as surgery.[89,90] Patients with leukodystrophy can have significant health care requirements and costs, driven largely by inpatient admissions.[2,91] As expected, patients who undergo HSCT have much higher costs. However, even taking into account HSCT, patients with infections and patients needing mechanical ventilation have higher costs and health care needs.[91] Building from this analysis of health care use, a recent study showed that infection rates in patients with leukodystrophy correlate with potentially modifiable risk factors.[20] For example, failure to vaccinate annually against seasonal influenza significantly increases the risk for hospitalization with influenza, and urinary tract infections are associated with the presence of indwelling urinary catheters. Although these issues are common sense, they also outline a path for potential clinical care guidelines that could be implemented at this time to reduce hospitalizations and improve care.

Several organizations have been developed in concert between families, researchers, and clinicians to advance the recognition, diagnosis, treatment, and care of children with leukodystrophies. Preventive and symptomatic care guidelines for patients with leukodystrophies were first published in 2015 by Van Haren et al as part of an effort from the Global Leukodystrophy Initiative.[86] An updated consensus statement was published in 2017.[92] Additionally, guidelines in several areas of care for children with leukodystrophies are under development from the Leukodystrophy Care Network.

Pediatricians play a key role in the care of patients with leukodystrophy by providing an overall view of the patient from a multisystem approach. As possible, referral to a multidisciplinary clinic, as well as use of a team-based approach, offers potential improvement in patient care and facilitates the health care journey experienced by families.[93] Travel to see specialists can be difficult for patients with disabilities, so the local pediatrician becomes increasingly important for recognizing and preventing complications. Children with leukodystrophies benefit from referrals for occupational, physical, and speech therapy, as well as caregiver instructions for stretching and repositioning. Immunizations should be administered on a standard schedule unless otherwise contraindicated (for example, a patient who is immunosuppressed for a bone marrow transplant). In conjunction with referrals for orthotics and mobility equipment, these measures can have significant effects on the patient's quality of life and prevention of contractures and pressure ulcers.[94] Use of speech augmentative devices and teaching Braille or sign language in children with hearing and vision impairment can also improve quality of life and simplify caregiving.

Monitoring for feeding difficulties can help with the overall health and nutrition of the patient but also prevent complications such as aspiration pneumonia.[94] Constipation is a common complication for children with limited mobility. Medications used to treat spasticity and dystonia may also further compound the problem. Gastrointestinal tract motility may also be impaired and may be related to the brain injury from the disease.[67] Symptoms of constipation in a nonverbal disabled child can include irritability, vomiting, and/or urinary tract infections.

Other potential complications that require monitoring and treatment as the disease progresses include urinary retention, eye dryness and corneal abrasions from decreased blinking, and temperature instability. Irritability can be a presenting symptom of patients with Krabbe disease. Evaluating for the source of pain or discomfort is recommended, including urinary

tract infections, constipation, pressure sores, muscle spasms, and corneal abrasions. Medications such as gabapentin can be used, but nonpharmacologic techniques such as music and repositioning are also encouraged. Peripheral neuropathy can also cause pain in patients with mitochondrial diseases, MLD, and Krabbe disease.[16] Patients with some leukodystrophies including Krabbe disease and Aicardi-Goutières syndrome may develop autonomic instability including periodic fevers not associated with infection or have difficulty maintaining an adequate temperature.[16]

Early referral to specialists, such as pulmonologists, is recommended to help treat sialorrhea, increased lung secretions, and pulmonary insufficiency/weak cough, which can lead to pneumonia.[94] Chest physiotherapy, postural drainage techniques, and home suction machines can help extend life and improve the quality of life. To avoid respiratory infections, an annual influenza vaccination is also recommended.[94] Physiatry and/or orthopedics referral can be considered for spasticity management or monitoring and prevention of complications for hypotonia including scoliosis and hip dysplasia. Endocrinology consultation is necessary for some leukodystrophies such as X-ALD, Aicardi-Goutières syndrome, and 4-H syndrome.[16] Neurology may be involved with the initial evaluation and diagnosis but can also help with ongoing management of neurologic symptoms including seizures, spasticity, and pain and irritability. Palliative care can also be a valuable resource for patients and their families to provide additional support throughout the disease continuum.[95] Where available, pediatric palliative care teams can assist with pain and symptom management and advance care planning and can help maintain a focus on the child's quality of life. When clinically indicated, palliative care may also include hospice to provide end-of-life care and to ensure the comfort and dignity of children with these terminal illnesses.

An area of treatment that is often forgotten is the mental health of the family and caregivers. The leukodystrophy and its complications puts significant financial, physical, and mental stress on the family. Social workers or case managers can be extremely helpful to families by providing contact information on counselors and psychiatrists, financial services, respite care, and grief counseling. Family disease-specific organizations, local or via the Internet, can also provide resources and support. Importantly, stressors and mental health issues specific to leukodystrophies, as well as common to having a chronic disease, can affect children, adolescents, and adults with leukodystrophies. Mental health supports and services may be necessary for some patients.

CONCLUSIONS

The field of leukodystrophies has experienced a great expansion in interest and knowledge in the last decade. Collaboration between researchers, clinicians, and patient organizations has helped to organize and focus efforts in patient care and research. Excitement and opportunities have been created by the expanding genetic testing, accelerating gene and disease discovery, improved diagnosis and understanding of the mechanism of disease, and availability of novel treatment options. Leukodystrophies can affect children from all racial, ethnic, and socioeconomic backgrounds, and recognizing disparities is important to help all children with leukodystrophy receive a diagnosis and appropriate care.[96,97] It remains important to combine this excitement and hope with attention to currently available high-quality clinical care that will greatly improve the lives of patients with leukodystrophy and their families.

RECOMMENDATIONS FOR PEDIATRICIANS

1. Be aware of leukodystrophies as a disease entity and that treatments are available for some leukodystrophies.
2. Know that treatment of some leukodystrophies is urgent, because the stage of disease may determine the efficacy of treatment.
3. Recognize common presentations for leukodystrophies, including developmental delay or regression in early-onset cases and cognitive changes in older presentations.
4. Recognize disease-specific symptoms that suggest further evaluation, including neurologic deterioration in the setting of a febrile illness or head injury, as in the case of VWM disease and mitochondrial diseases, and skin color changes or Addison disease in a school-aged boy in the case of X-ALD.
5. Be aware that an MRI of the brain is a first step in evaluation for leukodystrophy. There can be characteristic MRI patterns that may help to determine the specific type of leukodystrophy.
6. Recognize the need for partnering with a specialist who is familiar with the diagnosis and care of patients with leukodystrophies, typically a pediatric neurologist and/or geneticist.

7. Ensure that a patient with a newly diagnosed or newly suspected leukodystrophy is referred urgently for diagnosis or has an urgent diagnostic evaluation overseen by a specialist.
8. Know that some leukodystrophies, including X-ALD and Krabbe disease, can be detected by using NBS.
9. Know that it is critical for patients with leukodystrophies to receive standard pediatric care, including immunizations.
10. Recognize that treatment and prevention of disease complications improves the quality of life and longevity of patients with leukodystrophy.

LEAD AUTHORS

Joshua L. Bonkowsky, MD, PhD, FAAP
Stephanie Keller, MD, FAAP

SECTION ON NEUROLOGY, 2018–2019

Joshua L. Bonkowsky, MD, PhD, FAAP
Jamie K. Capal, MD, FAAP
Timothy Lotze, MD, FAAP
Renée A. Shellhaas, MD, FAAP
David K. Urion, MD, FAAP

STAFF

Paul Spire

COUNCIL ON GENETICS, 2018–2019

Emily Chen, MD, PhD, FAAP, Co-Chairperson
Tracy L. Trotter, MD, FAAP, Co-Chairperson
Susan A. Berry, MD, FAAP
Leah W. Burke, MD, FAAP
Timothy A. Geleske, MD, FAAP
Rizwan Hamid, MD, FAAP
Robert J. Hopkin, MD, FAAP
Wendy J. Introne, MD, FAAP
Michael J. Lyons, MD, FAAP
Angela E. Scheuerle, MD, FAAP
Joan M. Stoler, MD, FAAP

LIAISONS

Katrina M. Dipple, MD, PhD, FAAP – *American College of Medical Genetics*
Melissa A. Parisi, MD, PhD, FAAP – *Eunice Kennedy Shriver National Institute of Child Health and Human Development*
Britton D. Rink, MD – *American College of Obstetricians and Gynecologists*
Joan A. Scott, MS, CGC – *Health Resources and Services Administration, Maternal and Child Health Bureau*
Stuart K. Shapira, MD, PhD – *Centers for Disease Control and Prevention*

STAFF

Paul Spire

ABBREVIATIONS

ACHDNC: Advisory Committee on Heritable Disorders in Newborns and Children
CNS: central nervous system
CSF: cerebrospinal fluid
CT: computed tomography
EMG: electromyography
ERT: enzyme replacement therapy
HSC-GT: hematopoietic stem cell gene therapy
HSCT: hematopoietic stem cell transplant
MLD: metachromatic leukodystrophy
NBS: newborn screening
NCS: nerve conduction study
PMD: Pelizaeus-Merzbacher disease
RUSP: Recommended Uniform Screening Panel
VWM: vanishing white matter
WES: whole-exome sequencing
WGS: whole-genome sequencing
X-ALD: X-linked adrenoleukodystrophy

POTENTIAL CONFLICTS OF INTEREST: Dr Bonkowsky discloses the following: consultant relationships with bluebird bio, Inc, Calico, LLC, Denali Therapeutics, and Enzyvant; Board of Directors relationship with wFluidx, Inc; general stock ownership in Orchard Corp, and royalties (spouse) with BioFire Diagnostics, LLC; and Dr Keller has indicated she has no potential conflicts of interest to disclose.

REFERENCES

1. Heim P, Claussen M, Hoffmann B, et al. Leukodystrophy incidence in Germany. *Am J Med Genet.* 1997;71(4):475–478
2. Bonkowsky JL, Nelson C, Kingston JL, Filloux FM, Mundorff MB, Srivastava R. The burden of inherited leukodystrophies in children. *Neurology.* 2010;75(8):718–725
3. Vanderver A, Hussey H, Schmidt JL, Pastor W, Hoffman HJ. Relative incidence of inherited white matter disorders in childhood to acquired pediatric demyelinating disorders. *Semin Pediatr Neurol.* 2012;19(4):219–223
4. Soderholm HE, Chapin AB, Bayrak-Toydemir P, Bonkowsky JL. Elevated leukodystrophy incidence predicted from genomics databases. *Pediatr Neurol.* 2020;111:66–69
5. Duffner PK, Barczykowski A, Jalal K, Yan L, Kay DM, Carter RL. Early infantile Krabbe disease: results of the World-Wide Krabbe Registry. *Pediatr Neurol.* 2011;45(3):141–148
6. Lynch DS, Rodrigues Brandão de Paiva A, Zhang WJ, et al. Clinical and genetic characterization of leukoencephalopathies in adults. *Brain.* 2017;140(5):1204–1211
7. Kaul R, Gao GP, Aloya M, et al. Canavan disease: mutations among Jewish and non-Jewish patients. *Am J Hum Genet.* 1994;55(1):34–41
8. Coelho JC, Wajner M, Burin MG, Vargas CR, Giugliani R. Selective screening of 10,000 high-risk Brazilian patients for the

detection of inborn errors of metabolism. *Eur J Pediatr.* 1997;156(8):650–654

9. Amin M, Elsayed L, Ahmed AE. Clinical and genetic characteristics of leukodystrophies in Africa. *J Neurosci Rural Pract.* 2017;8(Suppl 1):S89–S93
10. Ashrafi MR, Rezaei Z, Heidari M, et al. The first report of relative incidence of inherited white matter disorders in an Asian country based on an Iranian bioregistry system. *J Child Neurol.* 2018;33(4):255–259
11. Holve S, Hu D, McCandless SE. Metachromatic leukodystrophy in the Navajo: fallout of the American-Indian wars of the nineteenth century. *Am J Med Genet.* 2001;101(3):203–208
12. Gulati S, Jain P, Chakrabarty B, Kumar A, Gupta N, Kabra M. The spectrum of leukodystrophies in children: Experience at a tertiary care centre from North India. *Ann Indian Acad Neurol.* 2016;19(3):332–338
13. Ji H, Li D, Wu Y, et al. Hypomyelinating disorders in China: The clinical and genetic heterogeneity in 119 patients. *PLoS One.* 2018;13(2):e0188869
14. Young RS, Osbakken MD, Alger PM, Ramer JC, Weidner WA, Daigh JD. Magnetic resonance imaging in leukodystrophies of childhood. *Pediatr Neurol.* 1985;1(1):15–19
15. Barkovich AJ. Magnetic resonance techniques in the assessment of myelin and myelination. *J Inherit Metab Dis.* 2005;28(3):311–343
16. Parikh S, Bernard G, Leventer RJ, et al; GLIA Consortium. A clinical approach to the diagnosis of patients with leukodystrophies and genetic leukoencephelopathies. *Mol Genet Metab.* 2015; 114(4):501–515
17. Vanderver A, Simons C, Helman G, et al; Leukodystrophy Study Group. Whole exome sequencing in patients with white matter abnormalities. *Ann Neurol.* 2016;79(6):1031–1037
18. Eichler F, Duncan C, Musolino PL, et al. Hematopoietic stem-cell gene therapy for cerebral adrenoleukodystrophy. *N Engl J Med.* 2017;377(17): 1630–1638
19. Smyth AR, Bell SC, Bojcin S, et al; European Cystic Fibrosis Society. European Cystic Fibrosis Society standards of care: best practice guidelines. *J Cyst Fibros.* 2014;13(suppl 1):S23–S42
20. Anderson HM, Wilkes J, Korgenski EK, et al. Preventable infections in children with leukodystrophy. *Ann Clin Transl Neurol.* 2014;1(5):370–374
21. Health Resources and Services Administration. Recommended Uniform Screening Panel. Available at: https://www.hrsa.gov/advisory-committees/heritable-disorders/rusp/index.html.
22. Salzman R, Kemp S. Newborn screening. 2018. Available at: https://adrenoleukodystrophy.info/clinical-diagnosis/newborn-screening. Accessed June 19, 2019
23. Vanderver A, Prust M, Tonduti D, et al; GLIA Consortium. Case definition and classification of leukodystrophies and leukoencephalopathies. *Mol Genet Metab.* 2015;114(4):494–500
24. Cox CS, Dubey P, Raymond GV, Mahmood A, Moser AB, Moser HW. Cognitive evaluation of neurologically asymptomatic boys with X-linked adrenoleukodystrophy. *Arch Neurol.* 2006;63(1):69–73
25. Hobson GM, Garbern JY. Pelizaeus-Merzbacher disease, Pelizaeus-Merzbacher-like disease 1, and related hypomyelinating disorders. *Semin Neurol.* 2012;32(1):62–67
26. Goutières F. Aicardi-Goutières syndrome. *Brain Dev.* 2005;27(3):201–206
27. Wasserstein MP, Andriola M, Arnold G, et al. Clinical outcomes of children with abnormal newborn screening results for Krabbe disease in New York State. *Genet Med.* 2016;18(12):1235–1243
28. Schiffmann R, van der Knaap MS. Invited article: an MRI-based approach to the diagnosis of white matter disorders. *Neurology.* 2009;72(8):750–759
29. Steenweg ME, Vanderver A, Blaser S, et al. Magnetic resonance imaging pattern recognition in hypomyelinating disorders. *Brain.* 2010;133(10):2971–2982
30. La Piana R, Tonduti D, Gordish Dressman H, et al. Brain magnetic resonance imaging (MRI) pattern recognition in Pol III-related leukodystrophies. *J Child Neurol.* 2014;29(2):214–220
31. Yang E, Prabhu SP. Imaging manifestations of the leukodystrophies, inherited disorders of white matter. *Radiol Clin North Am.* 2014;52(2):279–319
32. La Piana R, Uggetti C, Roncarolo F, et al. Neuroradiologic patterns and novel imaging findings in Aicardi-Goutières syndrome. *Neurology.* 2016;86(1):28–35
33. van der Knaap MS, Valk J, de Neeling N, Nauta JJ. Pattern recognition in magnetic resonance imaging of white matter disorders in children and young adults. *Neuroradiology.* 1991; 33(6):478–493
34. van der Knaap MS, Ramesh V, Schiffmann R, et al. Alexander disease: ventricular garlands and abnormalities of the medulla and spinal cord. *Neurology.* 2006;66(4):494–498
35. Welker KM, Patton A. Assessment of normal myelination with magnetic resonance imaging. *Semin Neurol.* 2012;32(1):15–28
36. van der Knaap MS, Valk J, Bakker CJ, et al. Myelination as an expression of the functional maturity of the brain. *Dev Med Child Neurol.* 1991; 33(10):849–857
37. Pujol J, López-Sala A, Sebastián-Gallés N, et al. Delayed myelination in children with developmental delay detected by volumetric MRI. *Neuroimage.* 2004; 22(2):897–903
38. Jones BV, Barron TF, Towfighi J. Optic nerve enlargement in Krabbe's disease. *AJNR Am J Neuroradiol.* 1999; 20(7):1228–1231
39. Nandhagopal R, Krishnamoorthy SG. Neurological picture. Tigroid and leopard skin pattern of dysmyelination in metachromatic leucodystrophy. *J Neurol Neurosurg Psychiatry.* 2006;77(3):344
40. Ashrafi MR, Tavasoli AR. Childhood leukodystrophies: A literature review of updates on new definitions, classification, diagnostic approach and management. *Brain Dev.* 2017;39(5):369–385
41. Yang Y, Muzny DM, Reid JG, et al. Clinical whole-exome sequencing for the diagnosis of mendelian disorders. *N Engl J Med.* 2013;369(16):1502–1511
42. Németh AH, Kwasniewska AC, Lise S, et al; UK Ataxia Consortium. Next generation sequencing for molecular diagnosis of neurological disorders using ataxias as a model. *Brain.* 2013;136 (Pt 10):3106–3118
43. Purnell SM, Bleyl SB, Bonkowsky JL. Clinical exome sequencing identifies a

novel TUBB4A mutation in a child with static hypomyelinating leukodystrophy. *Pediatr Neurol.* 2014;50(6):608–611

44. Raymond GV, Jones RO, Moser AB. Newborn screening for adrenoleukodystrophy: implications for therapy. *Mol Diagn Ther.* 2007;11(6):381–384
45. Jalal K, Carter R, Yan L, Barczykowski A, Duffner PK. Does galactocerebrosidase activity predict Krabbe phenotype? *Pediatr Neurol.* 2012;47(5):324–329
46. Ostrander BEP, Butterfield RJ, Pedersen BS, et al. Whole-genome analysis for effective clinical diagnosis and gene discovery in early infantile epileptic encephalopathy. *NPJ Genom Med.* 2018;3:22
47. May T, Zusevics KL, Strong KA. On the ethics of clinical whole genome sequencing of children. *Pediatrics.* 2013;132(2):207–209
48. Knoppers BM, Sénécal K, Borry P, Avard D. Whole-genome sequencing in newborn screening programs. *Sci Transl Med.* 2014;6(229):229cm2
49. Orsini JJ, Martin MM, Showers AL, et al. Lysosomal storage disorder 4 + 1 multiplex assay for newborn screening using tandem mass spectrometry: application to a small-scale population study for five lysosomal storage disorders. *Clin Chim Acta.* 2012;413(15–16):1270–1273
50. Duffner PK, Caggana M, Orsini JJ, et al. Newborn screening for Krabbe disease: the New York State model. *Pediatr Neurol.* 2009;40(4):245–252; discussion 253–255
51. Orsini JJ, Morrissey MA, Slavin LN, et al. Implementation of newborn screening for Krabbe disease: population study and cutoff determination. *Clin Biochem.* 2009;42(9):877–884
52. Orsini JJ, Kay DM, Saavedra-Matiz CA, et al; New York State Krabbe Disease Consortium. Newborn screening for Krabbe disease in New York State: the first eight years' experience. *Genet Med.* 2016;18(3):239–248
53. Kwon JM, Matern D, Kurtzberg J, et al. Consensus guidelines for newborn screening, diagnosis and treatment of infantile Krabbe disease. *Orphanet J Rare Dis.* 2018;13(1):30
54. Waggoner DJ, Tan CA. Expanding newborn screening for lysosomal disorders: opportunities and challenges. *Dev Disabil Res Rev.* 2011;17(1):9–14
55. Lantos JD. Dangerous and expensive screening and treatment for rare childhood diseases: the case of Krabbe disease. *Dev Disabil Res Rev.* 2011; 17(1):15–18
56. Nakamura K, Hattori K, Endo F. Newborn screening for lysosomal storage disorders. *Am J Med Genet C Semin Med Genet.* 2011;157C(1):63–71
57. Vaz FM, Bootsma AH, Kulik W, et al. A newborn screening method for cerebrotendinous xanthomatosis using bile alcohol glucuronides and metabolite ratios. *J Lipid Res.* 2017; 58(5):1002–1007
58. Bleyle L, Huidekoper HH, Vaz FM, Singh R, Steiner RD, DeBarber AE. Update on newborn dried bloodspot testing for cerebrotendinous xanthomatosis: an available high-throughput liquid-chromatography tandem mass spectrometry method. *Mol Genet Metab Rep.* 2016;7:11–15
59. Loes DJ, Hite S, Moser H, et al. Adrenoleukodystrophy: a scoring method for brain MR observations. *AJNR Am J Neuroradiol.* 1994;15(9):1761–1766
60. Moser HW, Smith KD, Moser AB. X-linked adrenoleukodystrophy. In: Scriber CR, ed. *The Metabolic and Molecular Bases of Inherited Disease.* New York, NY: McGraw-Hill; 1995:2325–2349
61. Vogel BH, Bradley SE, Adams DJ, et al. Newborn screening for X-linked adrenoleukodystrophy in New York State: diagnostic protocol, surveillance protocol and treatment guidelines. *Mol Genet Metab.* 2015;114(4):599–603
62. van Geel BM, Poll-The BT, Verrips A, Boelens JJ, Kemp S, Engelen M. Hematopoietic cell transplantation does not prevent myelopathy in X-linked adrenoleukodystrophy: a retrospective study. *J Inherit Metab Dis.* 2015;38(2):359–361
63. Boelens JJ. Trends in haematopoietic cell transplantation for inborn errors of metabolism. *J Inherit Metab Dis.* 2006;29(2-3):413–420
64. Sevin C, Aubourg P, Cartier N. Enzyme, cell and gene-based therapies for metachromatic leukodystrophy. *J Inherit Metab Dis.* 2007;30(2):175–183
65. Orchard PJ, Tolar J. Transplant outcomes in leukodystrophies. *Semin Hematol.* 2010;47(1):70–78
66. Escolar ML, Poe MD, Provenzale JM, et al. Transplantation of umbilical-cord blood in babies with infantile Krabbe's disease. *N Engl J Med.* 2005;352(20):2069–2081
67. Escolar ML, West T, Dallavecchia A, Poe MD, LaPoint K. Clinical management of Krabbe disease. *J Neurosci Res.* 2016;94(11):1118–1125
68. Duffner PK, Caviness VS Jr, Erbe RW, et al. The long-term outcomes of presymptomatic infants transplanted for Krabbe disease: report of the workshop held on July 11 and 12, 2008, Holiday Valley, New York. *Genet Med.* 2009;11(6):450–454
69. Martin HR, Poe MD, Provenzale JM, Kurtzberg J, Mendizabal A, Escolar ML. Neurodevelopmental outcomes of umbilical cord blood transplantation in metachromatic leukodystrophy. *Biol Blood Marrow Transplant.* 2013; 19(4):616–624
70. Sessa M, Lorioli L, Fumagalli F, et al. Lentiviral haemopoietic stem-cell gene therapy in early-onset metachromatic leukodystrophy: an ad-hoc analysis of a non-randomised, open-label, phase 1/2 trial. *Lancet.* 2016;388(10043):476–487
71. Martin PL, Carter SL, Kernan NA, et al. Results of the cord blood transplantation study (COBLT): outcomes of unrelated donor umbilical cord blood transplantation in pediatric patients with lysosomal and peroxisomal storage diseases. *Biol Blood Marrow Transplant.* 2006;12(2):184–194
72. Valayannopoulos V. Enzyme replacement therapy and substrate reduction therapy in lysosomal storage disorders with neurological expression. *Handb Clin Neurol.* 2013;113:1851–1857
73. Stroobants S, Gerlach D, Matthes F, et al. Intracerebroventricular enzyme infusion corrects central nervous system pathology and dysfunction in a mouse model of metachromatic leukodystrophy. *Hum Mol Genet.* 2011;20(14):2760–2769
74. Moser HW, Raymond GV, Lu SE, et al. Follow-up of 89 asymptomatic patients with adrenoleukodystrophy treated with

Lorenzo's oil. *Arch Neurol.* 2005; 62(7):1073–1080

75. Aubourg P, Adamsbaum C, Lavallard-Rousseau MC, et al. A two-year trial of oleic and erucic acids ("Lorenzo's oil") as treatment for adrenomyeloneuropathy. *N Engl J Med.* 1993;329(11):745–752
76. Moser HW, Moser AB, Hollandsworth K, Brereton NH, Raymond GV. "Lorenzo's oil" therapy for X-linked adrenoleukodystrophy: rationale and current assessment of efficacy. *J Mol Neurosci.* 2007;33(1):105–113
77. Berger J, Pujol A, Aubourg P, Forss-Petter S. Current and future pharmacological treatment strategies in X-linked adrenoleukodystrophy. *Brain Pathol.* 2010;20(4):845–856
78. Biffi A, Montini E, Lorioli L, et al. Lentiviral hematopoietic stem cell gene therapy benefits metachromatic leukodystrophy. *Science.* 2013; 341(6148):1233158
79. Cartier N, Hacein-Bey-Abina S, Bartholomae CC, et al. Hematopoietic stem cell gene therapy with a lentiviral vector in X-linked adrenoleukodystrophy. *Science.* 2009;326(5954):818–823
80. Penati R, Fumagalli F, Calbi V, Bernardo ME, Aiuti A. Gene therapy for lysosomal storage disorders: recent advances for metachromatic leukodystrophy and mucopolysaccaridosis I. *J Inherit Metab Dis.* 2017;40(4):543–554
81. Vanderver A, Adang L, Gavazzi F, et al. Janus kinase inhibition in the Aicardi-Goutières Syndrome. *N Engl J Med.* 2020;383(10):986–989
82. Hagemann TL, Connor JX, Messing A. Alexander disease-associated glial fibrillary acidic protein mutations in mice induce Rosenthal fiber formation and a white matter stress response. *J Neurosci.* 2006;26(43):11162–11173
83. Koç ON, Day J, Nieder M, Gerson SL, Lazarus HM, Krivit W. Allogeneic mesenchymal stem cell infusion for treatment of metachromatic leukodystrophy (MLD) and Hurler syndrome (MPS-IH). *Bone Marrow Transplant.* 2002;30(4):215–222
84. Morató L, Galino J, Ruiz M, et al. Pioglitazone halts axonal degeneration in a mouse model of X-linked adrenoleukodystrophy. *Brain.* 2013;136(Pt 8): 2432–2443
85. Saher G, Rudolphi F, Corthals K, et al. Therapy of Pelizaeus-Merzbacher disease in mice by feeding a cholesterol-enriched diet. *Nat Med.* 2012;18(7):1130–1135
86. Van Haren K, Bonkowsky JL, Bernard G, et al; GLIA Consortium. Consensus statement on preventive and symptomatic care of leukodystrophy patients. *Mol Genet Metab.* 2015;114(4):516–526
87. Cohen-Cymberknoh M, Shoseyov D, Kerem E. Managing cystic fibrosis: strategies that increase life expectancy and improve quality of life. *Am J Respir Crit Care Med.* 2011;183(11):1463–1471
88. Brimley CJ, Lopez J, van Haren K, et al. National variation in costs and mortality for leukodystrophy patients in US children's hospitals. *Pediatr Neurol.* 2013;49(3):156–162.e1
89. Barrell C. Juvenile metachromatic leukodystrophy: understanding the disease and implications for nursing care. *J Pediatr Oncol Nurs.* 2007;24(2):64–69
90. Holmes L, Cornes MJ, Foldi B, Miller F, Dabney K. Clinical epidemiologic characterization of orthopaedic and neurological manifestations in children with leukodystrophies. *J Pediatr Orthop.* 2011;31(5):587–593
91. Nelson C, Mundorff MB, Korgenski EK, Brimley CJ, Srivastava R, Bonkowsky JL. Determinants of health care use in a population-based leukodystrophy cohort. *J Pediatr.* 2013;162(3):624–628.e1
92. Adang LA, Sherbini O, Ball L, et al; Global Leukodystrophy Initiative (GLIA) Consortium. Revised consensus statement on the preventive and symptomatic care of patients with leukodystrophies. *Mol Genet Metab.* 2017;122(1–2):18–32
93. Council on Children with Disabilities and Medical Home Implementation Project Advisory Committee. Patient- and family-centered care coordination: a framework for integrating care for children and youth across multiple systems. *Pediatrics.* 2014;133(5). Available at: www.pediatrics.org/cgi/content/full/133/5/e1451
94. Wusthoff CJ, Shellhaas RA, Licht DJ. Management of common neurologic symptoms in pediatric palliative care: seizures, agitation, and spasticity. *Pediatr Clin North Am.* 2007;54(5):709–733, xi
95. Section on Hospice and Palliative Medicine; Committee on Hospital Care. Pediatric palliative care and hospice care commitments, guidelines, and recommendations. *Pediatrics.* 2013; 132(5):966–972
96. Bonkowsky JL, Wilkes J, Bardsley T, Urbik VM, Stoddard G. Association of diagnosis of leukodystrophy with race and ethnicity among pediatric and adolescent patients. *JAMA Netw Open.* 2018;1(7):e185031
97. Grineski S, Morales DX, Collins T, Wilkes J, Bonkowsky JL. Geographic and specialty access disparities in US pediatric leukodystrophy diagnosis. *J Pediatr.* 2020;220:193–199

Long-term Follow-up Care for Childhood, Adolescent, and Young Adult Cancer Survivors

- *Clinical Report*
  - *PPI: AAP Partnership for Policy Implementation*
    See Appendix 1 for more information.

CLINICAL REPORT Guidance for the Clinician in Rendering Pediatric Care

American Academy of Pediatrics
DEDICATED TO THE HEALTH OF ALL CHILDREN™

Long-term Follow-up Care for Childhood, Adolescent, and Young Adult Cancer Survivors

Melissa M. Hudson, MD,[a] Smita Bhatia, MD, MPH,[b] Jacqueline Casillas, MD, MSHS,[c] and Wendy Landier, PhD, RN, CPNP,[b]
SECTION ON HEMATOLOGY/ONCOLOGY, CHILDREN'S ONCOLOGY GROUP, AMERICAN SOCIETY OF PEDIATRIC HEMATOLOGY/ONCOLOGY

Progress in therapy has made survival into adulthood a reality for most children, adolescents, and young adults with a cancer diagnosis today. Notably, this growing population remains vulnerable to a variety of long-term therapy-related sequelae. Systematic ongoing follow-up of these patients is, therefore, important to provide for early detection of and intervention for potentially serious late-onset complications. In addition, health counseling and promotion of healthy lifestyles are important aspects of long-term follow-up care to promote risk reduction for physical and emotional health problems that commonly present during adulthood. Both general and subspecialty health care providers are playing an increasingly important role in the ongoing care of childhood cancer survivors, beyond the routine preventive care, health supervision, and anticipatory guidance provided to all patients. This report is based on the guidelines that have been developed by the Children's Oncology Group to facilitate comprehensive long-term follow-up of childhood, adolescent, and young adult cancer survivors (www.survivorshipguidelines.org).

BACKGROUND INFORMATION

Cancer is diagnosed in approximately 20 000 children and 80 000 adolescents and young adults annually in the United States.[1] Before 1970, almost all children, adolescents, and young adults with cancer died of their primary disease. However, rapid improvements in multimodal treatment regimens (chemotherapy, radiotherapy, surgery, and immunotherapy), coupled with aggressive supportive-care regimens, have resulted in survival rates that continue to increase. The current estimated 5-year overall survival rate for childhood, adolescent, and young adult malignancies exceeds 80%,[2] which translates into increasing numbers of long-term survivors, now estimated to approach 500 000 in the United States, who may seek ongoing care from

abstract

[a]*Department of Oncology, St Jude Children's Research Hospital, Memphis, Tennessee;* [b]*Division of Pediatric Hematology/Oncology, Department of Pediatrics, University of Alabama at Birmingham, Birmingham, Alabama; and* [c]*Department of Pediatrics, University of California, Los Angeles, Los Angeles, California*

All authors contributed to the concept and design, interpretation of data, and drafting of the manuscript; and all authors approved the final manuscript as submitted.

DOI: https://doi.org/10.1542/peds.2021-053127

Address correspondence to Melissa M. Hudson, MD. E-mail: melissa.hudson@stjude.org

PEDIATRICS (ISSN Numbers: Print, 0031-4005; Online, 1098-4275).

To cite: Hudson M M, Bhatia S, Casillas J, et al. Long-term Follow-up Care for Childhood, Adolescent, and Young Adult Cancer Survivors. *Pediatrics*. 2021;148(3):e2021053127

community primary and subspecialty providers.[3] The Childhood Cancer Survivor Study, the largest and most extensively characterized cohort of 5-year survivors of childhood cancer in North America, reported that survivors receive most of their care from primary care providers.[4] Furthermore, the proportion of survivors reporting survivor-focused care that includes regular risk-based surveillance and prevention strategies related to their previous cancer and its treatment decreases with increasing time from cancer diagnosis. Thus, primary care providers (pediatricians, family practitioners, internists, practitioners trained in internal medicine and pediatrics, and advanced practice providers) are likely to have an increasingly vital role in caring for this rapidly growing population.

STATEMENT OF PROBLEM

Cancer and its treatment may result in a variety of physical and psychosocial effects that predispose long-term survivors to excess morbidity and early mortality when compared with the general population.[5–10] Virtually every organ system can be affected by the chemotherapy, radiation, surgery, and/or immunotherapy required to achieve a cure. Late complications of treatment may include problems with organ function, growth and development, neurocognitive function and academic achievement, and the potential for additional cancers. Cancer and its treatment also have psychosocial consequences that may adversely affect family and/or peer relationships, educational attainment (both formal and practical knowledge gained from real-world experience), vocational and employment opportunities, and insurance and health care access. In addition, survivors may experience troubling body image changes or suffer from chronic symptoms (eg, fatigue, dyssomnia, pain) that adversely affect emotional health and quality of life. A young person's and a family's lives are forever changed when touched by the cancer experience, and it is critical to provide rehabilitation services to survivors who highly value good health and unrestricted performance status. Equally important is reaching out to young adult survivors who may be separated from their families and face more challenges in adhering to healthy lifestyles and accessing health care services.

Late effects after childhood, adolescent, and young adult cancer are common. Two of every 3 childhood cancer survivors will develop at least 1 late-onset therapy-related complication; in 1 of every 4 cases, the complication will be severe or life-threatening.[6,11] Among clinically ascertained cohorts, the prevalence of late effects is higher because of the subclinical and undiagnosed conditions detected by screening and surveillance measures.[8] Childhood, adolescent, and young adult cancer survivors, therefore, require ongoing comprehensive long-term follow-up care to optimize long-term outcomes by successfully monitoring for and treating the late effects that may occur as a result of previous cancer therapies, as well as anticipatory guidance and health promotion efforts addressing primary and secondary prevention of chronic disease. Access to care and services that address health risks predisposed by cancer and its treatment can optimize achievement of independent living, employment, and insurance access, which is particularly important for a population at risk for multimorbidity.

Because health risks associated with cancer are unique to the age at treatment and specific therapeutic modality, it is important that follow-up evaluations and health screening be individualized on the basis of treatment history. To facilitate comprehensive and systematic follow-up of childhood, adolescent, and young adult cancer survivors, the Children's Oncology Group (COG) organized exposure-based health screening guidelines. This clinical report presents pediatricians and other health care professionals with guidance for providing high-quality long-term follow-up care and health supervision for survivors of pediatric, adolescent, and young adult malignancies by incorporating long-term follow-up guidelines developed by the COG into their practice[12] and by maintaining ongoing interaction with oncology subspecialists to facilitate communication regarding any changes in follow-up recommendations specific to the cancer survivors under their care.

METHODS: DEVELOPMENT OF LONG-TERM FOLLOW-UP GUIDELINES

The COG is a cooperative clinical trials group supported by the National Cancer Institute with more than 200 member institutions. In January 2002, at the request of the Institute of Medicine (now the National Academy of Medicine), a multidisciplinary panel within the COG initiated the process of developing comprehensive risk-based, exposure-related recommendations for screening and management of late treatment-related complications potentially resulting from therapy for childhood, adolescent, and young adult cancers. The resulting comprehensive resource, the *Children's Oncology Group Long-Term Follow-Up Guidelines for Survivors of Childhood, Adolescent, and Young Adult Cancers (COG LTFU Guidelines)*,[12] is designed to raise awareness of the risk of late

treatment-related sequelae to facilitate early identification and intervention for these complications, standardize follow-up care, improve quality of life, and provide guidance to health care professionals, including pediatricians, who supervise the ongoing care of young cancer survivors.

The *COG LTFU Guidelines* are designed for use in asymptomatic childhood, adolescent, and young adult survivors presenting for routine health maintenance at least 2 years after completion of cancer-directed therapy (eg, surgery, chemotherapy, radiation, immunotherapy), whether the survivor is receiving care in a pediatric cancer center, a specialized adolescent-young adult program, an adult-focused oncology program, a long-term follow-up program, or community primary care practice. The guidelines are not designed for primary cancer-related surveillance, which is an important component of survivorship care that generally continues under the guidance of the treating oncologist throughout the period when the patient remains at highest risk of relapse but may ultimately be transferred to community primary care providers (pediatricians, family physicians, internists, practitioners trained in internal medicine and pediatrics, and advanced practice providers). This period of risk varies depending on diagnosis and is generally highest in the first few years, with the risk decreasing significantly as time from diagnosis lengthens.

COG LTFU Guidelines Methodology

The methodology used in developing these guidelines has been described elsewhere.[12] Briefly, evidence for development of the *COG LTFU Guidelines* was collected by conducting a complete search of the medical literature for the previous 20 years via Medline. A panel of experts in the late effects of childhood and adolescent cancer treatment then reviewed and scored the guidelines using a modified version of the National Comprehensive Cancer Network Categories of Consensus system. Task forces within the COG monitor the literature on an ongoing basis and provide recommendations for guideline revision as new information becomes available. These task forces include general pediatricians and other primary care providers to incorporate a primary care perspective and facilitate effective dissemination of these guidelines into the real-world setting.

The *COG LTFU Guidelines* are updated on an every-5-year cycle to ensure that recommendations reflect currently available evidence published in peer-reviewed journals. Multidisciplinary system-based task forces (>160 COG members) are responsible for monitoring the late effects literature, performing systematic searches, summarizing and evaluating the evidence, and presenting recommendations for guideline revisions to a multidisciplinary panel of late effects experts. Task force activities involve senior leaders who mentor early career physicians and other health care professionals in acquiring the leadership and methodologic skills to sustain guideline activities as a task force chair or member. A formal training program has been developed that includes a series of webinars (available live and recorded and archived on COG Web site) and one-on-one mentorship activities with *COG LTFU Guideline* task force chairs and leadership.

COG LTFU Guidelines Version 5.0

The *COG LTFU Guidelines* is an online resource (available at www.survivorshipguidelines.org). The *COG LTFU Guidelines* Version 5.0 features 165 sections of risk-based exposure-related clinical practice guidelines for screening and management of late effects resulting from treatment of pediatric malignancies related to any cancer experience, blood product transfusion, specific chemotherapeutic agents, radiation exposures to targeted tissues and/or organs, hematopoietic cell transplant (as well as transplant with chronic graft-versus-host disease), specific surgical procedures, and adult-onset cancer screening for standard and high-risk groups. Version 5.0 features key changes, including guideline recommendations and content based on new research related to thresholds and risk factors for cardiovascular toxicity after treatment with anthracycline chemotherapy and chest radiation, prevalence data regarding pregnancy-associated cardiomyopathy, prevalence data related to occurrence of multiple hormonal deficiencies among survivors treated with cranial irradiation, and improved risk estimates about the contribution of radiation dose and treatment volume to risk of developing subsequent breast and colorectal carcinomas. In addition, previous radiation threshold doses linked to specific screening recommendations have been removed for all but 5 sections because organ dosimetry is often not available to guide implementation of screening. This approach provides uniform screening recommendations for survivors with target organs receiving radiation exposure at any dose, which the expert panel agreed was reasonable considering that the screening recommendations focus primarily on history and physical examination, with only limited recommendation for laboratory or other diagnostic evaluations. Finally, the guideline format has been substantially simplified to provide clinical users with concise presentation of specific therapeutic exposures,

potential late effects, screening recommendations, and relevant counseling and educational resources for the provider and survivors. Each guideline section features a brief summary of patient characteristics (eg, age, sex, preexisting or comorbid conditions, behavioral, etc) that have been reported to modify the risk of specific late effects and cancer- and treatment-related factors important for consideration in the delivery of personalized survivor-focused care,[13] clarifying information about the potential late effect or surveillance recommendations and representative references. The simplified guideline content is also featured in the Passport for Care, a Web--based resource that facilitates the generation of a personalized surveillance plan based on the *COG LTFU Guidelines* available at https://cancersurvivor.passportforcare.org/.[14]

This revised clinical report, "Long-term Follow-up Care for Childhood, Adolescent, and Young Adult Cancer Survivors," has been updated to enhance awareness among health care providers about the content and scope of this comprehensive resource and to offer time-efficient methods of using the large amount of valuable information in the *COG LTFU Guidelines* to streamline the provision of care for these survivors. Table 1 provides a summary of selected treatment exposures and associated late effects by organ system as outlined in the *COG LTFU Guidelines*. Figure 1 provides an example of an exposure-based recommendation from the *COG LTFU Guidelines*. Full details about 155 cancer treatment–related potential biomedical and psychosocial late effects, surveillance recommendations, patient educational materials, and other resources and Web sites pertinent to the specific health risks are available at www.survivorshipguidelines.org.

CLINICAL APPLICATION OF *COG LTFU GUIDELINES*

Malignancies presenting in childhood, adolescence, and young adulthood encompass a spectrum of diverse histologic subtypes that have been managed with heterogeneous and evolving treatment approaches. Over the last 20 years, treatment protocols for localized and biologically favorable presentations of cancers have been modified substantially to reduce the risk of therapy-related complications. Conversely, therapy has been intensified for many advanced and biologically unfavorable cancers to optimize disease control and long-term survival. Thus, not all childhood, adolescent, and young adult cancer survivors have similar risks of late treatment effects, including those with the same diagnosis. Importantly, cancer treatment strategies continue to evolve as a result of discoveries in cancer biology and therapeutics as well as improved understanding about late effects.

Evaluating a Survivor's Risk of Late Effects

In general, the risk of late effects is directly proportional to the intensity of therapy required to achieve and maintain disease control. Longer treatment with higher cumulative doses of chemotherapy and radiation, multimodal therapy, and relapse therapy increases the risk of late treatment effects. Specifically, the risk of late effects is related to the type and intensity of cancer therapy (eg, surgery, radiotherapy, chemotherapy, immunotherapy, and hematopoietic stem cell transplant) and the patient's age at the time of treatment. Chemotherapy most often results in acute effects, some of which may persist and cause problems as the survivor ages. Many radiation-related effects on growth and development, organ function, and carcinogenesis may not manifest until many years after cancer treatment. The young child is especially at risk for delayed treatment toxicity, affecting linear growth, skeletal maturation, intellectual function, sexual development, and organ function. It is important that health care professionals who provide care across a continuum of developmental periods also recognize that childhood cancer survivors face unique vulnerabilities related to their age at diagnosis and treatment. Table 2 provides examples of clinical and treatment factors that influence the risk of specific late effects after treatment of a common childhood (acute lymphoblastic leukemia) and adolescent-young adult (osteosarcoma) cancer. The diversity and potential interplay of factors contributing to cancer-related morbidity are further illustrated in the case presentations summarized in Table 3.

Using the *COG LTFU Guidelines* to Plan Survivorship Care

Risk-based care involving a systematic plan for lifelong screening, surveillance, and prevention that incorporates risks on the basis of previous cancer, cancer therapy, genetic predispositions, lifestyle behaviors, and comorbid health conditions is recommended for all survivors.[13] Information critical to the coordination of risk-based care includes the date of cancer diagnosis, cancer histology, organs and/or tissues affected by cancer, and specific treatment modalities (such as surgical procedures, chemotherapeutic agents, and radiation treatment fields and doses) and history of bone marrow or stem cell transplant and blood

TABLE 1 Potential Late Effects of Selected Therapeutic Interventions for Childhood, Adolescent, and Young Adult Cancer by Organ

	Therapeutic Exposures			
Organ	Chemotherapy	Radiotherapy Field(s)	Surgery	Potential Late Effect
Any organ or tissue		All fields		Subsequent neoplasms (skin, breast, thyroid, brain, colon, bone, soft tissues, etc)
Bones	Corticosteroids, methotrexate	—	—	Osteopenia or osteoporosis, osteonecrosis
Bones and/or soft tissues	—	All fields	—	Reduced or uneven growth; reduced function or mobility; hypoplasia, fibrosis; radiation-induced fracture; scoliosis or kyphosis (trunk fields only)
Bones and/or soft tissues	—	—	Amputation, limb sparing	Reduced or uneven growth, reduced function or mobility, chronic pain
Bowel	—	Abdomen, pelvis, spine (lumbar, sacral, whole)	Laparotomy, pelvic or spinal surgery	Chronic enterocolitis, GI tract strictures, adhesions or obstruction, fecal incontinence
Bladder	Cyclophosphamide, ifosfamide	Pelvic, spine (sacral, whole)	Spinal surgery, cystectomy	Hemorrhagic cystitis, bladder fibrosis, dysfunctional voiding, neurogenic bladder
Brain (cognitive function)	Methotrexate (intrathecal administration or IV doses $\geq$1000 mg/m^2), cytarabine (IV doses $\geq$1000 mg/m^2)	Head and/or brain, total body	Neurosurgery	Neurocognitive deficits (executive function, attention, memory, processing speed, visual motor integration), learning deficits, diminished IQ
Brain (motor and sensory function)	Methotrexate, cytarabine (intrathecal administration or IV doses $\geq$1000 mg/m^2)	Head and/or brain	Neurosurgery	Cranial nerve dysfunction; motor and sensory deficits, including paralysis; cerebellar dysfunction; seizures
Brain (hypothalamic-pituitary axis)	—	Head and/or brain, total body	Neurosurgery	Growth hormone deficiency, precocious puberty (altered gonadotropin secretion),

TABLE 1 Continued

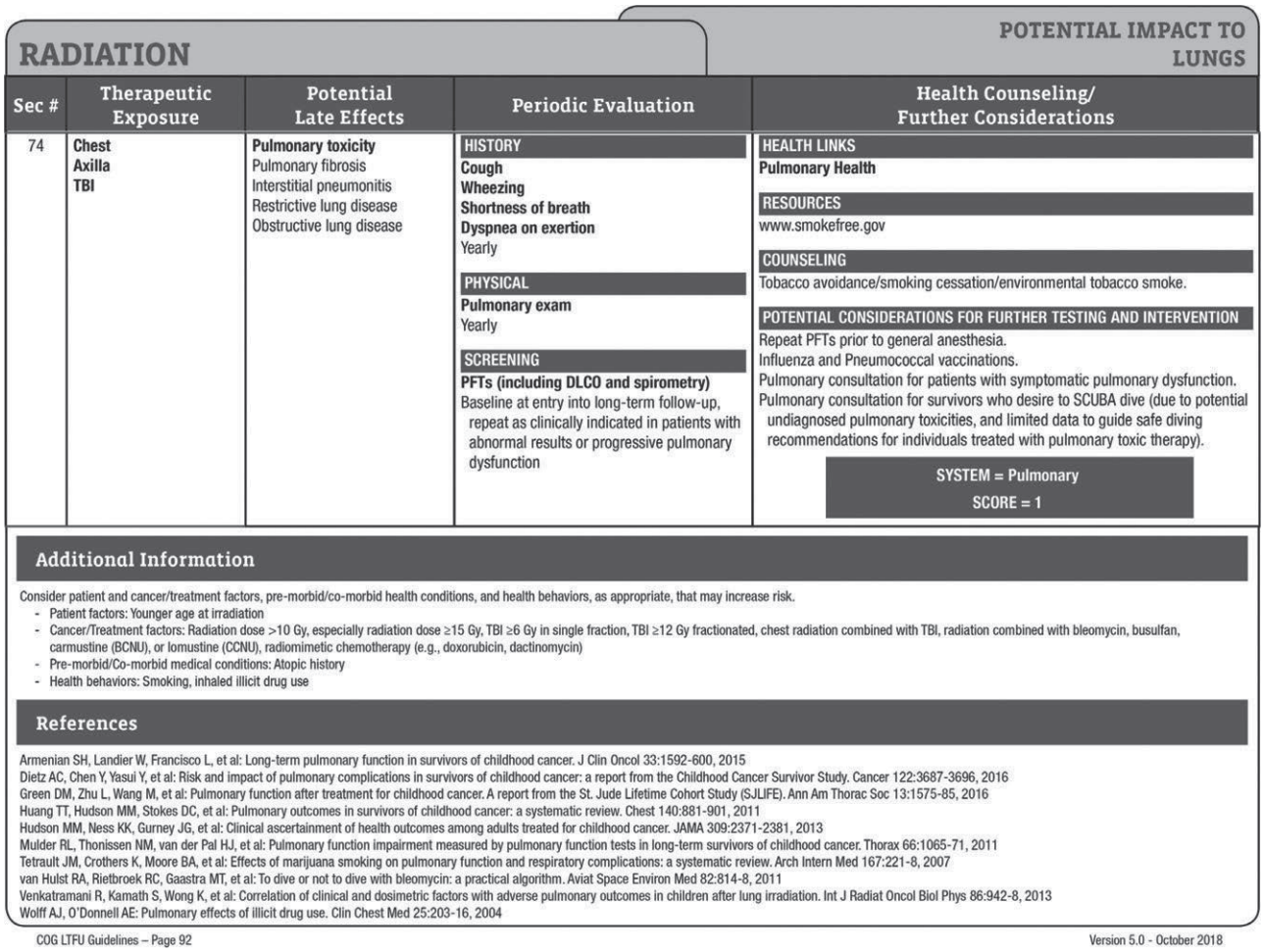
Organ	Therapeutic Exposures			Potential Late Effect
	Chemotherapy	Radiotherapy Field(s)	Surgery	
				gonadotropin insufficiency, central adrenal insufficiency (XRT ≥30 Gy)
Brain (vascular)	—	Head and/or brain	Neurosurgery	Cerebrovascular complications (stroke, Moyamoya, occlusive cerebral vasculopathy)
Breast	—	Chest, axilla, total body	—	Breast tissue hypoplasia, breast cancer
Ear	Cisplatin, carboplatin (in myeloablative doses only)	Head and/or brain	—	Sensorineural hearing loss (XRT doses ≥30 Gy), conductive hearing loss (XRT only), eustachian tube dysfunction (XRT only)
Esophagus	—	Neck, chest, abdomen, spine (cervical, thoracic, whole)	—	Esophageal stricture
Eye	Busulfan, corticosteroids	Head and/or brain, total body	Neurosurgery	Cataracts, retinopathy (XRT only), ocular nerve palsy (neurosurgery only)
Heart	Anthracycline agents (eg, doxorubicin, daunorubicin)	Chest, abdomen, spine (thoracic, whole), total body	—	Cardiomyopathy, congestive heart failure, arrhythmia, subclinical left ventricular dysfunction, XRT only: valvular disease, atherosclerotic heart disease, myocardial infarction, pericarditis, pericardial fibrosis
Kidney	Cisplatin, carboplatin, ifosfamide, methotrexate	Abdomen, total body	Nephrectomy	Glomerular toxicity, tubular dysfunction, renal insufficiency, hypertension
Liver and biliary tract	Antimetabolites (mercaptopurine, thioguanine, methotrexate)	Abdomen	—	Hepatic dysfunction; veno-occlusive disease; hepatic fibrosis, cirrhosis; cholelithiasis
Lungs	Bleomycin, busulfan, carmustine, lomustine	Chest, axilla, total body	Pulmonary resection, lobectomy	Pulmonary fibrosis, interstitial pneumonitis, restrictive or obstructive lung disease, pulmonary dysfunction

TABLE 1 Continued

Organ	Therapeutic Exposures			Potential Late Effect
	Chemotherapy	Radiotherapy Field(s)	Surgery	
Nerves (peripheral)	Plant alkaloids (vincristine, vinblastine), cisplatin, carboplatin	—	Spinal surgery	Peripheral sensory or motor neuropathy
Ovary	Alkylating agents (eg, busulfan, carmustine, lomustine, cyclophosphamide, mechlorethamine, melphalan, procarbazine)	Pelvis, spine (sacral, whole), total body	Oophorectomy	Ovarian hormone insufficiency, delayed or arrested puberty, premature menopause, diminished ovarian reserve, infertility, uterine vascular insufficiency (XRT only), vaginal fibrosis or stenosis (XRT only)
Skin	—	All fields	—	Permanent alopecia, altered skin pigmentation, telangiectasias, fibrosis, dysplastic nevi
Spleen	—	Abdomen (doses ≥40 Gy)	Splenectomy	Life-threatening infection related to functional or anatomic asplenia[a]
Teeth	Any chemotherapy before development of secondary dentition	Head and/or brain, neck, spine (cervical, whole), total body	—	Dental maldevelopment (tooth and/or root agenesis, microdontia, enamel dysplasia), periodontal disease, dental caries, osteoradionecrosis (XRT doses ≥40 Gy)
Testes	Alkylating agents (eg, busulfan, carmustine, lomustine, cyclophosphamide, mechlorethamine, melphalan, procarbazine)	Testes, total body	Pelvic or spinal surgery, orchiectomy	Testosterone insufficiency, delayed or arrested puberty, impaired spermatogenesis, infertility, erectile or ejaculatory dysfunction
Thyroid	—	Head and/or brain, neck, spine (cervical, whole), total body	Thyroidectomy	Hypothyroidism, hyperthyroidism, thyroid nodules (XRT only)

This table briefly summarizes potential late effects for selected therapeutic exposures only; the complete set of long-term follow-up guidelines from the COG, including screening recommendations, is available at www.survivorshipguidelines.org. In addition to organ- or tissue-specific late effects, any cancer experience may increase the risk of adverse psychosocial and quality-of-life outcomes summarized at www.survivorshipguidelines.org (sections 1–6). Children's Oncology Group. Long-Term Follow-Up Guidelines for Survivors of Childhood, Adolescent and Young Adult Cancers, Version 5.0. Monrovia, CA: Children's Oncology Group; October 2018. Available at: www.survivorshipguidelines.org. Accessed April 21, 2021. GI, gastrointestinal; IV, intravenous; XRT, radiotherapy; —, not applicable.

[a] Functional asplenia can also occur as a consequence of active chronic graft-versus-host disease after hematopoietic stem cell transplant.



RADIATION — POTENTIAL IMPACT TO LUNGS

Sec #	Therapeutic Exposure	Potential Late Effects	Periodic Evaluation	Health Counseling/ Further Considerations
74	**Chest** **Axilla** **TBI**	**Pulmonary toxicity** Pulmonary fibrosis Interstitial pneumonitis Restrictive lung disease Obstructive lung disease	**HISTORY** **Cough** **Wheezing** **Shortness of breath** **Dyspnea on exertion** Yearly **PHYSICAL** **Pulmonary exam** Yearly **SCREENING** **PFTs (including DLCO and spirometry)** Baseline at entry into long-term follow-up, repeat as clinically indicated in patients with abnormal results or progressive pulmonary dysfunction	**HEALTH LINKS** **Pulmonary Health** **RESOURCES** www.smokefree.gov **COUNSELING** Tobacco avoidance/smoking cessation/environmental tobacco smoke. **POTENTIAL CONSIDERATIONS FOR FURTHER TESTING AND INTERVENTION** Repeat PFTs prior to general anesthesia. Influenza and Pneumococcal vaccinations. Pulmonary consultation for patients with symptomatic pulmonary dysfunction. Pulmonary consultation for survivors who desire to SCUBA dive (due to potential undiagnosed pulmonary toxicities, and limited data to guide safe diving recommendations for individuals treated with pulmonary toxic therapy). **SYSTEM = Pulmonary** **SCORE = 1**

Additional Information

Consider patient and cancer/treatment factors, pre-morbid/co-morbid health conditions, and health behaviors, as appropriate, that may increase risk.
- Patient factors: Younger age at irradiation
- Cancer/Treatment factors: Radiation dose >10 Gy, especially radiation dose ≥15 Gy, TBI ≥6 Gy in single fraction, TBI ≥12 Gy fractionated, chest radiation combined with TBI, radiation combined with bleomycin, busulfan, carmustine (BCNU), or lomustine (CCNU), radiomimetic chemotherapy (e.g., doxorubicin, dactinomycin)
- Pre-morbid/Co-morbid medical conditions: Atopic history
- Health behaviors: Smoking, inhaled illicit drug use

References

Armenian SH, Landier W, Francisco L, et al: Long-term pulmonary function in survivors of childhood cancer. J Clin Oncol 33:1592-600, 2015
Dietz AC, Chen Y, Yasui Y, et al: Risk and impact of pulmonary complications in survivors of childhood cancer: a report from the Childhood Cancer Survivor Study. Cancer 122:3687-3696, 2016
Green DM, Zhu L, Wang M, et al: Pulmonary function after treatment for childhood cancer. A report from the St. Jude Lifetime Cohort Study (SJLIFE). Ann Am Thorac Soc 13:1575-85, 2016
Huang TT, Hudson MM, Stokes DC, et al: Pulmonary outcomes in survivors of childhood cancer: a systematic review. Chest 140:881-901, 2011
Hudson MM, Ness KK, Gurney JG, et al: Clinical ascertainment of health outcomes among adults treated for childhood cancer. JAMA 309:2371-2381, 2013
Mulder RL, Thonissen NM, van der Pal HJ, et al: Pulmonary function impairment measured by pulmonary function tests in long-term survivors of childhood cancer. Thorax 66:1065-71, 2011
Tetrault JM, Crothers K, Moore BA, et al: Effects of marijuana smoking on pulmonary function and respiratory complications: a systematic review. Arch Intern Med 167:221-8, 2007
van Hulst RA, Rietbroek RC, Gaastra MT, et al: To dive or not to dive with bleomycin: a practical algorithm. Aviat Space Environ Med 82:814-8, 2011
Venkatramani R, Kamath S, Wong K, et al: Correlation of clinical and dosimetric factors with adverse pulmonary outcomes in children after lung irradiation. Int J Radiat Oncol Biol Phys 86:942-8, 2013
Wolff AJ, O'Donnell AE: Pulmonary effects of illicit drug use. Clin Chest Med 25:203-16, 2004

FIGURE 1 Example of an exposure-based recommendation from the *COG LTFU Guidelines*. (Reprinted with permission from Children's Oncology Group. *Long-Term Follow-Up Guidelines for Survivors of Childhood, Adolescent and Young Adult Cancers*. Version 5.0. Monrovia, CA: Children's Oncology Group; 2018. Available at: www.survivorshipguidelines.org. Accessed April 21, 2021) BCNU, carmustine; CCNU, lomustine; DLCO, diffusing capacity of carbon monoxide; PFT, pulmonary function testing; SCUBA, self-contained underwater breathing apparatus; TBI, total body irradiation.

product transfusion. Knowledge of cumulative chemotherapy dosages (eg, for anthracycline agents), or dose intensity of administration (eg, for methotrexate), also is important in estimating risk and screening frequency. This pertinent clinical information can be organized into a treatment summary that interfaces with the *COG LTFU Guidelines* to facilitate identification of potential late complications and recommended follow-up care (Fig 2). Because of the diversity and complexity of childhood, adolescent, and young adult cancer therapies, the treating oncology center represents the optimal resource for this treatment information. Furthermore, the need for ongoing, open lines of communication between the cancer center and the primary care provider is critical.

Coordination of risk-based care for childhood, adolescent, and young adult cancer survivors requires a working knowledge about cancer-related health risks and appropriate screening evaluations or access to a resource that contains this information. Often, late effects present as a distinct clinical entity (eg, growth failure, heart failure, academic underachievement, etc) remote from cancer diagnosis and treatment. The primary care physician should consistently consider the contribution of cancer and its treatment to physical and emotional health conditions presenting in survivors, use the *COG LTFU Guidelines* to identify linkages of late effects and therapeutic exposures, and consult with local pediatric oncologists and/or late effects specialists to develop a strategy for further investigation. The *COG LTFU Guidelines* represent a comprehensive resource that can be used to plan cancer survivorship care, as outlined in Fig 3. Individualized recommendations for long-term follow-up care of childhood, adolescent, and young adult cancer survivors can be customized from the *COG LTFU*

TABLE 2 Clinical and Treatment Factors Influencing Risk of Late Effects After Childhood, Adolescent, and Young Adult Cancer

Factor	Reason	Example(s)
Age at diagnosis of cancer	Age at diagnosis influences vulnerability to specific cancer treatment–related complications.	Young children experience a higher risk of neurocognitive deficits after cranial irradiation compared with adolescents.[37] Young girls, compared with older adolescents, are less vulnerable to alkylating agent–induced ovarian insufficiency because of their larger primordial follicular pool.[38]
Sex	The risk of some cancer treatment–related toxicities varies by sex.	Boys are more sensitive to gonadal injury after alkylating agents compared with girls.[39] Breast cancer risk in women treated with chest radiation is comparable to *BRCA* mutation carriers and warrants early initiation of breast cancer surveillance.[40]
Tissues and organs involved by cancer	Malignant infiltration of normal tissues may result in permanent deficits.	Survivors of central nervous system tumors may have long-term neurologic, neurosensory, or neuroendocrine late effects related to tumor location.[41] Survivors of retroperitoneal tumors (eg, Wilms tumor, neuroblastoma) experience increase risk of scoliosis.[42]
Surgery	Specific surgical procedures may be associated with increased risks for chronic symptoms or health conditions.	Sarcoma survivors treated with limb-sparing surgeries may have chronic pain or performance restrictions.[43] Survivors of Wilms tumor have an increased risk of hypertension after nephrectomy.[44]
Chemotherapeutic agents	Chemotherapeutic agents have unique organ and/or tissue toxicity profiles, many of which are dose related. Knowledge of specific chemotherapy agents received is needed to determine type and magnitude of late effects risk.	Anthracyclines are associated with increased risk of cardiomyopathy.[45] Cisplatin increases the risk of hearing loss and renal dysfunction.[46] Alkylating agents increase the risk of gonadal injury and infertility.[38]
Radiotherapy	The potential for radiation injury to normal tissues is directly related to the organs and tissues in the radiation treatment field and dose delivered.	HPA dysfunction is common after cranial radiation. HPA systems affected show relationships to dose, with growth hormone deficiency presenting at much lower dose exposure compared with gonadotropin deficiency.[47]
Hematopoietic cell transplant	In addition to risks associated with chemotherapy and radiation, survivors may experience health risks associated with immune system alterations after hematopoietic cell transplant.	Survivors who are transplant recipients have higher risks of subsequent malignancies involving epithelial and mucosal tissues.[48]
Preexisting and comorbid conditions	Common comorbid conditions can exacerbate cancer treatment–related toxicity. Management of ongoing comorbidities should be addressed during follow-up visits.	Hypertension potentiates anthracycline-associated risk for heart failure.[49] Diabetes and hypertension potentiate radiation-associated risk for stroke.[50]
Health behaviors and lifestyle	Health behaviors can mitigate or magnify risk of cancer treatment–related toxicities.	Adherence to recommended levels of moderate to vigorous physical activity reduces risk of major cardiac events and mortality in childhood cancer survivors.[51,52] Smoking increases the risk of pulmonary function deficits and subsequent malignancies.[53]
Psychosocial	Sociodemographic factors may affect survivors' access to health care and resources to prevent or remediate late effects. Premorbid and comorbid emotional health conditions are associated with adverse outcomes.	Survivors with (of those from households with) lower income and educational levels are more vulnerable to impaired health status and financial toxicity.[9,54] Survivors experiencing psychological distress are more likely to participate in health-risking behaviors (eg, tobacco, alcohol, and substance use).[55,56]
Genetics	Cancer predisposition genes as well as common genetic variants (single-nucleotide polymorphisms) are associated with increased risk of subsequent neoplasms and other treatment-related organ dysfunction.	Survivors of retinoblastoma with *RB1* mutation (all bilateral and familial cases) have an increased risk of subsequent malignant neoplasms, especially osteosarcoma.[57] Several genetic variations that may modify risk for cardiomyopathy in anthracycline-exposed survivors (eg, *SLC28A3, UGT1A6, RARG, CELF4, HAS3*) have been identified.[58]

HPA, hypothalamic-pituitary axis.

TABLE 3 Examples of 2 Survivors: Factors Contributing to Cancer-Related Morbidity After Childhood and Adolescent-Young Adult Cancer

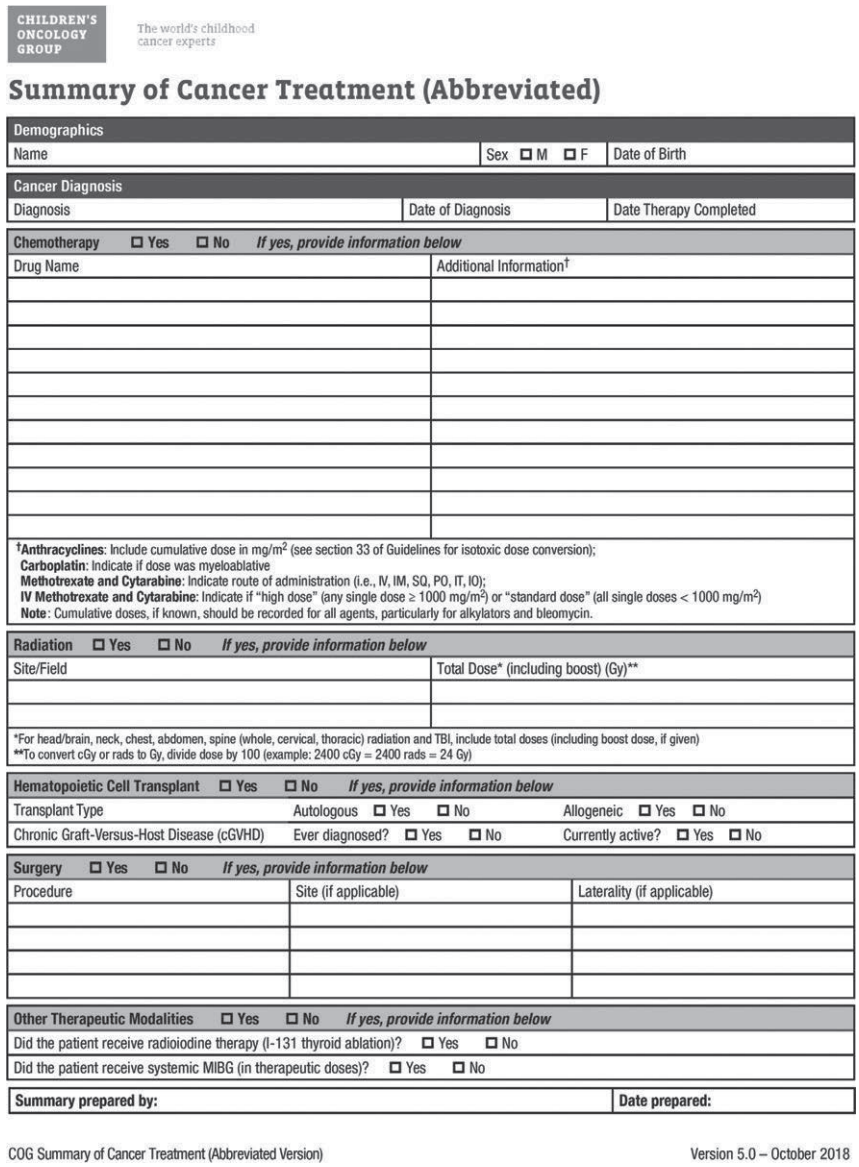
Factor	Example 1: Leukemia	Example 2: Solid Tumor
Patient	3-y-old boy	16-y-old girl
Tumor	Acute lymphoblastic leukemia, B lineage, average risk, without CNS involvement	Embryonal rhabdomyosarcoma of the chest wall, stage II
Treatment	Antimetabolites (by mouth, IV, intrathecal), asparaginase, corticosteroids, cyclophosphamide (moderate dose), doxorubicin (low dose), vincristine	Dactinomycin, vincristine, chest radiation (36 Gy)
Potential late effects	Peripheral neuropathy; osteopenia or osteoporosis; osteonecrosis (rare for this age); cataracts (rare); hepatic dysfunction (very rare); renal insufficiency (very rare); neurocognitive deficits; leukoencephalopathy; hemorrhagic cystitis, bladder malignancy (very rare); secondary myelodysplasia or myeloid leukemia (very rare); gonadal dysfunction (rare); cardiomyopathy, congestive heart failure, arrhythmia (very rare); dental maldevelopment, periodontal disease, excessive dental caries	Peripheral neuropathy, subclavian artery disease, cardiac complications (cardiomyopathy, congestive heart failure, arrhythmia, subclinical left ventricular dysfunction, valvular disease, atherosclerotic heart disease, myocardial infarction, pericarditis, pericardial fibrosis), pulmonary complications (fibrosis, interstitial pneumonitis, restrictive or obstructive lung disease), esophageal stricture, breast tissue hypoplasia, breast cancer, scoliosis or kyphosis, shortened trunk height, secondary benign or malignant neoplasms in radiation field
Genetics and familial	Diabetes mellitus, type 2	Hypertension, early coronary artery disease
Comorbid conditions	Obesity, anxiety	Hypertension, depression
Health behaviors	Sedentary lifestyle	Smoker
Aging	Reduced bone mineral density	Cardiomyopathy

Recognition of dose-related toxicities has resulted in modification of therapies and has substantially reduced risk of some late effects. CNS, central nervous system; IV, intravenous.

Guidelines on the basis of each patient's treatment history, age, and sex into a survivorship care plan that is ideally developed by, or in coordination with, the oncology subspecialist. The survivorship care plan is a living document that is meant to be reviewed by survivors and their health care providers at least yearly and updated as new health conditions emerge and health behaviors change over time. In addition, the *COG LTFU Guidelines* provide information to assist with risk stratification, allowing the health care provider to address specific treatment-related health risks that may be magnified in individual patients because of familial or genetic predisposition, sociodemographic factors, or maladaptive health behaviors. The patient education materials, known as "health links," that accompany the *COG LTFU Guidelines*, are specifically tailored to enhance health supervision and promotion in this population by providing simplified explanations of guideline-specific topics in lay language.[15] The *COG LTFU Guidelines*, associated patient education materials, and supplemental resources to enhance guideline application, including clinical summary templates, can be downloaded from www.survivorshipguidelines.org. A Web--based platform that generates online therapeutic summaries with simultaneous output of patient-specific guidelines on the basis of exposure history, age, and sex is now accessible to institutions providing pediatric oncology follow-up care (https://cancersurvivor.passportforcare.org/).[14]

DISCUSSION AND RECOMMENDATIONS

Pediatricians and other primary care health care professionals are uniquely qualified to deliver ongoing health care to childhood, adolescent, and young adult cancer survivors, because they are already familiar with health maintenance and supervision for healthy populations and provide care for patients with complex chronic medical conditions. The concept of the medical home has been endorsed by the American Academy of Pediatrics as an effective model for coordinating the complex health care requirements of children with special needs, such as childhood cancer survivors, to provide care and preventive services that are accessible, continuous, comprehensive, family centered, coordinated, compassionate, and culturally effective.[16] Within this framework, the pediatrician is able to view the cancer survivor in the context of the family and to assist not only the survivor but also the parents and siblings in adapting to the new normal of cancer survivorship. The focus of care for the childhood cancer survivor seen in a primary care practice is not the cancer from which the patient has now recovered but, rather, the actual and potential physical and psychosocial sequelae of cancer and its therapy and its impact on family functioning. Childhood, adolescent, and young adult cancer survivors are at a substantially increased risk of morbidity and mortality when compared with the general population.[5–10] This updated clinical report delineates recommendations that are aimed at facilitating this vulnerable population's access to high-quality survivorship.



CHILDREN'S ONCOLOGY GROUP
The world's childhood cancer experts

Summary of Cancer Treatment (Abbreviated)

Demographics		
Name	Sex ☐ M ☐ F	Date of Birth

Cancer Diagnosis		
Diagnosis	Date of Diagnosis	Date Therapy Completed

Chemotherapy ☐ Yes ☐ No *If yes, provide information below*

Drug Name	Additional Information†

†**Anthracyclines**: Include cumulative dose in mg/m^2 (see section 33 of Guidelines for isotoxic dose conversion);
Carboplatin: Indicate if dose was myeloablative
Methotrexate and Cytarabine: Indicate route of administration (i.e., IV, IM, SQ, PO, IT, IO);
IV Methotrexate and Cytarabine: Indicate if "high dose" (any single dose ≥ 1000 mg/m^2) or "standard dose" (all single doses < 1000 mg/m^2)
Note: Cumulative doses, if known, should be recorded for all agents, particularly for alkylators and bleomycin.

Radiation ☐ Yes ☐ No *If yes, provide information below*

Site/Field	Total Dose* (including boost) (Gy)**

*For head/brain, neck, chest, abdomen, spine (whole, cervical, thoracic) radiation and TBI, include total doses (including boost dose, if given)
**To convert cGy or rads to Gy, divide dose by 100 (example: 2400 cGy = 2400 rads = 24 Gy)

Hematopoietic Cell Transplant ☐ Yes ☐ No *If yes, provide information below*		
Transplant Type	Autologous ☐ Yes ☐ No	Allogeneic ☐ Yes ☐ No
Chronic Graft-Versus-Host Disease (cGVHD)	Ever diagnosed? ☐ Yes ☐ No	Currently active? ☐ Yes ☐ No

Surgery ☐ Yes ☐ No *If yes, provide information below*

Procedure	Site (if applicable)	Laterality (if applicable)

Other Therapeutic Modalities ☐ Yes ☐ No *If yes, provide information below*
Did the patient receive radioiodine therapy (I-131 thyroid ablation)? ☐ Yes ☐ No
Did the patient receive systemic MIBG (in therapeutic doses)? ☐ Yes ☐ No

Summary prepared by:	Date prepared:

COG Summary of Cancer Treatment (Abbreviated Version) Version 5.0 – October 2018

FIGURE 2 Sample template for cancer treatment summary containing essential data elements necessary for generating long-term follow-up guidelines. (Reprinted with permission from Children's Oncology Group. *Long-Term Follow-Up Guidelines for Survivors of Childhood, Adolescent and Young Adult Cancers*. Version 5.0. Monrovia, CA: Children's Oncology Group; 2018. Available at: www.survivorshipguidelines.org. Accessed April 21, 2021) TBI, total body irradiation.

Recommendation 1: Primary Health Care Professionals Should Work Collaboratively With the Oncology Subspecialist to Develop and Implement the Survivorship Care Plan and Coordinate Survivorship Care

Ideally, the survivorship care plan is developed through a shared partnership that includes the primary care and oncology subspecialty providers, the survivor, and the family. Community providers can request a cancer treatment summary and survivorship care plan from the oncology center if this is not provided at the time that the survivor transitions back to the primary care setting. If a survivorship care plan is not provided by the primary oncology team, COG-affiliated subspecialty survivorship clinics can be consulted for assistance in coordinating survivorship care.[17] In addition to the *COG LTFU Guideline* recommendations for late effects screening, the ideal survivorship care plan delineates provider(s) who will be coordinating the indicated screening evaluations and identifies provider(s) responsible for communicating and explaining the results to the patient and/or caregivers.

- Request a cancer treatment summary and survivorship care plan from the survivors' oncology team if possible.
- Request medical records to organize a cancer treatment summary and survivorship care plan if a care plan is not provided by the oncology team.
- Use the summary of cancer treatment template at www.survivorshipguidelines.org or https://cancersurvivor.passportforcare.org/ to develop the survivorship care plan.
- Identify patient (eg, age at diagnosis, sex), cancer (eg, histology, involved organs and/or tissues), and treatment (surgery, chemotherapy, radiotherapy, hematopoietic cell transplant) details that may influence the risk of late effects.
- Consult the *COG LTFU Guidelines* at www.survivorshipguidelines.org to determine health risks associated with specific exposures and recommended health screening. Use the bookmark feature to identify the guideline sections pertinent to your survivor.
- Consider patient- and cancer treatment–related factors, preexisting and/or comorbid health conditions, and health behaviors, as appropriate, that may increase risk listed under "Additional Information" of each guideline section.
- Use the *COG LTFU Guidelines* health links and other educational resources listed under "Further Considerations."
- Address psychosocial factors that can affect access to health care and resources to prevent or remediate late effects.
- Contact an established long-term follow-up childhood cancer survivor program for assistance in managing complex survivorship-related needs and identifying survivorship resources. COG-affiliated subspecialty survivorship clinics are available at https://cogmembers.org/public/lateeffects/default.aspx.

FIGURE 3 How to use the *COG LTFU Guidelines* to plan cancer survivorship care.

Recommendation 2: The *COG LTFU Guidelines* Should Be Used to Guide the Development of an Individualized Follow-up Plan (Survivorship Care Plan) Based on the Childhood, Adolescent, or Young Adult Survivor's Specific Cancer Treatment and Risk of Late Complications

Although late treatment effects can be anticipated in many cases on the basis of therapeutic exposures, the risk to an individual patient is modified by multiple factors. The patient with cancer may present with premorbid health conditions that influence tolerance to therapy and increase the risk of treatment-related toxicity. Cancer-related factors, including histology, tumor site, and tumor biology and/or response, often dictate treatment modality and intensity. Patient-related factors, such as age at diagnosis and sex, may affect the risk of several treatment-related complications. Sociodemographic factors, such as household income, educational attainment, and socioeconomic status, often influence access to health insurance, remedial services, and appropriate risk-based health care. Organ senescence in aging survivors may accelerate presentation of age-related health conditions in survivors with subclinical organ injury or dysfunction resulting from cancer treatment. Genetic or familial characteristics may also enhance susceptibility to treatment-related complications. Problems experienced during and after treatment may further increase morbidity. Health behaviors, including tobacco and alcohol use, sun exposure, and dietary and exercise habits, may increase the risk of specific therapy-related complications. The *COG LTFU Guidelines* can assist the physician in maintaining a balance between overscreening (which could potentially cause undue fear of unlikely but remotely plausible complications as well as higher medical costs resulting from unnecessary screening) and underscreening (which could miss potentially life-threatening complications, thus resulting in lost opportunities for early intervention that could minimize morbidity).

Recommendation 3: The Survivorship Care Plan Should Include Screening for Potential Adverse Medical and Psychosocial Effects of the Cancer Experience

The follow-up evaluations of childhood, adolescent, and young adult cancer survivors should be individualized on the basis of their treatment history and may include screening for such potential complications as thyroid or cardiac dysfunction, second malignant neoplasms, neurocognitive difficulties, and many others.[13] In addition, providers should be mindful of the psychosocial late

effects experienced by youth treated for cancer, particularly those that may affect educational and vocational progress, because provider advocacy and intervention can facilitate survivor access to remedial resources and programs in 504 and individual education plans and vocational training.[18] Likewise, because emotional health and family functioning may be affected by the cancer experience, proactive assessment of and referral to mental health services are important to optimize the quality of survivorship. Finally, personalized risk assessment would not be complete without consideration of socioeconomic and community factors that may affect access to survivorship resources and health care.

Recommendation 4: The Survivorship Care Plan Should Address the Contribution of Comorbid Health Conditions, Familial and Genetic Factors, and Health Behaviors That Affect the Risk of Chronic Disease and Provide Interventions and Resources to Remediate and Prevent Late Effects of Cancer and Promote Healthy Lifestyle Behaviors

In addition to screening for late effects predisposed by previous therapeutic exposures, promotion of physical and mental health and well-being as part of a healthy lifestyle is an important aspect of long-term follow-up care in this population. Numerous investigations have shown that survivors of childhood, adolescent, and young adult cancer have a high rate of chronic health conditions when followed long-term,[6,8] yet many lack awareness of their treatment-related health risks.[19–21] For this reason, it is recommended that health care professionals provide anticipatory guidance regarding health promotion and disease prevention aimed at minimizing the risk of future morbidity and mortality attributable to chronic physical and mental health conditions. For example, counseling survivors who are at risk for obesity, cardiovascular disease, and osteoporosis about the importance of adhering to healthful dietary guidelines, limiting sedentary lifestyle with or without screen time, and having regular physical activity is important. Education about cancer- and disease-prevention benefits offered through vaccination can also reduce health risks.

Recommendation 5: Primary Health Care Professionals Should Work Collaboratively With the Oncology Subspecialist to Educate Survivors and Their Families About Cancer Treatment–Related Health Risks, Recommended Health Screening, and Methods for Risk Reduction

Adolescent and young adult survivors need appropriate knowledge, skills, and opportunities to learn and make decisions about their own health maintenance needs, their potential physical and mental health risks, recommended health screening related to these risks, the impact of health behaviors on physical and mental health risks, and strategies to reduce health risks. Collaboration between the oncology and primary care teams can help to ensure that survivors' educational needs are addressed. Innovative electronic and mobile health platforms represent evolving technologies that can be leveraged to educate and empower survivors preparing for health care transitions by promoting self-management of chronic health conditions and connecting them with survivorship communities and resources.[22] The *COG LTFU Guidelines* can be used as a resource to facilitate targeted education regarding cancer and treatment-related health risks and health promotion. The *COG LTFU Guideline* health links (available at www.survivorshipguidelines.org) can be printed for distribution in the primary care office setting and are available for viewing by patients and their caregivers on the Internet.[15] In this process, it is important for health care professionals to be aware that some survivors, given their young age at diagnosis, may not remember their cancer diagnosis or the treatment that they received or may not have been told about their cancer history.[23–25]

Recommendation 6: Primary Health Care Professionals Should Work Collaboratively With the Oncology Subspecialist to Prepare Survivors and Their Families for Health Care Transitions

Ensuring a smooth transition from pediatric to adult-oriented health care services poses additional challenges in the care of childhood cancer survivors as they age out of the pediatric health care system. Because adults treated for childhood cancer represent a rare population in primary care practices, practical and educational efforts of clinicians may be focused on more prevalent primary care issues. Consequently, family physicians, internists, practitioners trained in internal medicine and pediatrics, and advanced practice providers, who ultimately assume care of most adults treated for childhood cancer, endorse low comfort levels and a desire for resources and guidance in managing survivors.[26,27] These data underscore the importance of communication between oncology and primary care providers in health care transition planning. Pretransition planning is a critical element in the successful transition from pediatric to adult-oriented health care for all adolescents and young adults with special health care needs, including cancer survivors. The medical home model provides a strong foundation for this planning.[28] The updated American Academy of Pediatrics clinical report "Supporting the Health Care

Transition From Adolescence to Adulthood in the Medical Home" emphasizes the critical role of adult care clinicians in accepting and partnering with young adults to optimize health care transitions.[29] In addition, the report provides practical guidance on the key elements of transition planning and implementation for medically vulnerable populations. For childhood cancer survivors, a pretransition plan ideally outlines the roles of the patient, family, subspecialty, and community health care providers in the ongoing care of the survivor to ensure a successful transition. Importantly, in this process, providers should respect the evolving autonomy and privacy concerns of adolescents and young adults in health care discussions and decision-making, particularly related to sexual and reproductive health, which may be adversely affected by the cancer experience in some survivors.[30,31]

Recommendation 7: Primary Health Care Professionals Should Work Collaboratively With the Oncology Subspecialist to Educate Survivors and Their Families About Resources to Facilitate Their Access to Survivorship Care

Laws that extend medical coverage into young adulthood can facilitate survivors' access to timely, high-quality, and affordable survivorship care.[32] This is particularly relevant because survivors experience increased risk for multimorbidity as they age, and health conditions often present at a younger age at onset compared with individuals who have not had cancer. For example, primary care providers may not be aware of the need for early initiation of breast cancer surveillance among young adult women treated with chest radiation for childhood cancer. Delineating this risk in the survivorship care plan and providing appropriate letters of medical necessity can facilitate awareness by providers and insurance coverage of recommended surveillance imaging.[33] Finally, considering research demonstrating that a substantial proportion of young adult survivors are uninsured or underinsured, transition planning should identify community resources to address medical needs, including emotional health and rehabilitation services. Payers should facilitate communication among providers in the design of their provider networks and by adequate payment for care coordination.[34]

SUMMARY

Given the high incidence of late effects experienced by cancer survivors, individuals treated for cancer during childhood, adolescence, or young adulthood require long-term follow-up care from knowledgeable providers so that their care is appropriately tailored to their specific treatment-related risk factors. Models of survivorship care vary substantially across clinical settings on the basis of resource availability. Because multidisciplinary late effects clinics are not consistently accessible to or used by cancer survivors, pediatricians and other primary care providers represent critical participants in delivery of survivorship care.[35,36] The *COG LTFU Guidelines* provide a readily accessible resource to address knowledge deficits related to health risks associated with treatment of childhood, adolescent, or young adult cancer. Availability of this resource is particularly important as the population of long-term survivors continues to increase as a result of the effectiveness of contemporary treatment approaches.

Ultimately, the goal of this clinical report from the American Academy of Pediatrics is to increase the awareness of general pediatricians and other primary health care professionals regarding the readily available resource of the *COG LTFU Guidelines* and the ability to consult with multidisciplinary long-term follow-up clinics for childhood, adolescent, and young adult cancer survivors. These guidelines can, in turn, be used to develop a comprehensive yet individualized survivorship care plan for each cancer survivor who can be supported to work toward a planned transition to adult health care providers in primary and specialty care.

The survivorship care plan is a road map for primary health care professionals for providing risk-based long-term follow-up care in the community setting. Ongoing communication between the cancer center and the primary care provider is the cornerstone for providing high-quality care to this vulnerable patient population.

LEAD AUTHORS

Smita Bhatia, MD, MPH
Jacqueline Casillas, MD, MSHS
Melissa M. Hudson, MD, FAAP
Wendy Landier, PhD, RN, CPNP

CHILDREN'S ONCOLOGY GROUP

Smita Bhatia, MD, MPH
Jacqueline Casillas, MD, MSHS
Melissa M. Hudson, MD
Wendy Landier, PhD, RN, CPNP

SECTION ON HEMATOLOGY/ONCOLOGY EXECUTIVE COMMITTEE, 2019–2020

Zora R. Rogers, MD, FAAP, Chairperson
Carl Allen, MD, PhD, FAAP
James Harper, MD, FAAP
Jeffrey Hord, MD, FAAP
Juhi Jain, MD, FAAP
Anne Warwick, MD, MPH, FAAP
Cynthia Wetmore, MD, PhD, FAAP
Amber Yates, MD, FAAP

ABBREVIATIONS

COG: Children's Oncology Group
COG LTFU Guidelines: *Children's Oncology Group Long-Term Follow-Up Guidelines for Survivors of Childhood, Adolescent, and Young Adult Cancers*

FINANCIAL DISCLOSURE: The authors have indicated they have no financial relationships relevant to this article to disclose.

FUNDING: Supported by the National Clinical Trials Network Operations Center grant (U10CA180886; principal investigator: Adamson) and by the St Baldrick's Foundation. Dr Hudson is also supported by the Cancer Center Support grant CA 21765 from the National Cancer Institute and by the American Lebanese Syrian Associated Charities. Funded by the National Institutes of Health (NIH).

POTENTIAL CONFLICT OF INTEREST: Dr Landier has a relationship with Merck Sharp & Dohme as a principal investigator; and Drs Hudson, Bhatia, and Casillas have indicated they have no potential conflicts of interest to disclose.

REFERENCES

1. Howlader N, Noone AM, Krapcho M, et al. SEER cancer statistics review, 1975-2014. Available at: https://seer.cancer.gov/csr/1975_2014/. Accessed April 21, 2021
2. Siegel RL, Miller KD, Jemal A. Cancer statistics, 2018. *CA Cancer J Clin.* 2018;68(1):7–30
3. Robison LL, Hudson MM. Survivors of childhood and adolescent cancer: life-long risks and responsibilities. *Nat Rev Cancer.* 2014;14(1):61–70
4. Casillas J, Oeffinger KC, Hudson MM, et al. Identifying predictors of longitudinal decline in the level of medical care received by adult survivors of childhood cancer: a report from the Childhood Cancer Survivor Study. *Health Serv Res.* 2015;50(4):1021–1042
5. Armstrong GT, Chen Y, Yasui Y, et al. Reduction in late mortality among 5-year survivors of childhood cancer. *N Engl J Med.* 2016;374(9):833–842
6. Armstrong GT, Kawashima T, Leisenring W, et al. Aging and risk of severe, disabling, life-threatening, and fatal events in the childhood cancer survivor study. *J Clin Oncol.* 2014;32(12):1218–1227
7. Fidler MM, Reulen RC, Winter DL, et al; British Childhood Cancer Survivor Study Steering Group. Long term cause specific mortality among 34 489 five year survivors of childhood cancer in Great Britain: population based cohort study. *BMJ.* 2016;354:i4351
8. Hudson MM, Ness KK, Gurney JG, et al. Clinical ascertainment of health outcomes among adults treated for childhood cancer. *JAMA.* 2013;309(22):2371–2381
9. Hudson MM, Oeffinger KC, Jones K, et al. Age-dependent changes in health status in the Childhood Cancer Survivor cohort. *J Clin Oncol.* 2015;33(5):479–491
10. Phillips SM, Padgett LS, Leisenring WM, et al. Survivors of childhood cancer in the United States: prevalence and burden of morbidity. *Cancer Epidemiol Biomarkers Prev.* 2015;24(4):653–663
11. Oeffinger KC, Mertens AC, Sklar CA, et al; Childhood Cancer Survivor Study. Chronic health conditions in adult survivors of childhood cancer. *N Engl J Med.* 2006;355(15):1572–1582
12. Landier W, Bhatia S, Eshelman DA, et al. Development of risk-based guidelines for pediatric cancer survivors: the Children's Oncology Group Long-Term Follow-Up Guidelines from the Children's Oncology Group Late Effects Committee and Nursing Discipline. *J Clin Oncol.* 2004;22(24):4979–4990
13. Dixon SB, Bjornard KL, Alberts NM, et al. Factors influencing risk-based care of the childhood cancer survivor in the 21st century. *CA Cancer J Clin.* 2018;68(2):133–152
14. Poplack DG, Fordis M, Landier W, Bhatia S, Hudson MM, Horowitz ME. Childhood cancer survivor care: development of the Passport for Care. *Nat Rev Clin Oncol.* 2014;11(12):740–750
15. Eshelman D, Landier W, Sweeney T, et al. Facilitating care for childhood cancer survivors: integrating children's

oncology group long-term follow-up guidelines and health links in clinical practice. *J Pediatr Oncol Nurs.* 2004;21(5):271–280

16. Hudson SV, Miller SM, Hemler J, et al. Cancer survivors and the patient-centered medical home. *Transl Behav Med.* 2012;2(3):322–331
17. Children's Oncology Group. Late effects directory services. Available at: https://cogmembers.org/public/lateeffects/default.aspx. Accessed April 21, 2021
18. Bitsko MJ, Cohen D, Dillon R, Harvey J, Krull K, Klosky JL. Psychosocial late effects in pediatric cancer survivors: a report from the Children's Oncology Group. *Pediatr Blood Cancer.* 2016;63(2):337–343
19. Cherven B, Mertens A, Meacham LR, Williamson R, Boring C, Wasilewski-Masker K. Knowledge and risk perception of late effects among childhood cancer survivors and parents before and after visiting a childhood cancer survivor clinic. *J Pediatr Oncol Nurs.* 2014;31(6):339–349
20. Ford JS, Chou JF, Sklar CA. Attendance at a survivorship clinic: impact on knowledge and psychosocial adjustment. *J Cancer Surviv.* 2013;7(4):535–543
21. Landier W, Chen Y, Namdar G, et al. Impact of tailored education on awareness of personal risk for therapy-related complications among childhood cancer survivors. *J Clin Oncol.* 2015;33(33):3887–3893
22. Casillas JN, Schwartz LF, Crespi CM, et al. The use of mobile technology and peer navigation to promote adolescent and young adult (AYA) cancer survivorship care: results of a randomized controlled trial. *J Cancer Surviv.* 2019;13(4):580–592
23. Kadan-Lottick NS, Robison LL, Gurney JG, et al. Childhood cancer survivors' knowledge about their past diagnosis and treatment: Childhood Cancer Survivor Study. *JAMA.* 2002;287(14):1832–1839
24. Lindell RB, Koh SJ, Alvarez JM, et al. Knowledge of diagnosis, treatment history, and risk of late effects among childhood cancer survivors and parents: the impact of a survivorship clinic. *Pediatr Blood Cancer.* 2015;62(8):1444–1451
25. Syed IA, Klassen AF, Barr R, et al. Factors associated with childhood cancer survivors' knowledge about their diagnosis, treatment, and risk for late effects. *J Cancer Surviv.* 2016;10(2):363–374
26. Henderson TO, Hlubocky FJ, Wroblewski KE, Diller L, Daugherty CK. Physician preferences and knowledge gaps regarding the care of childhood cancer survivors: a mailed survey of pediatric oncologists. *J Clin Oncol.* 2010;28(5):878–883
27. Suh E, Daugherty CK, Wroblewski K, et al. General internists' preferences and knowledge about the care of adult survivors of childhood cancer: a cross-sectional survey. *Ann Intern Med.* 2014;160(1):11–17
28. Cooley WC, Sagerman PJ; American Academy of Pediatrics; American Academy of Family Physicians; American College of Physicians; Transitions Clinical Report Authoring Group. Supporting the health care transition from adolescence to adulthood in the medical home. *Pediatrics.* 2011;128(1):182–200
29. White PH, Cooley WC; Transitions Clinical Report Authoring Group; American Academy of Pediatrics; American Academy of Family Physicians; American College of Physicians. Supporting the health care transition from adolescence to adulthood in the medical home [published correction appears in *Pediatrics.* 2019;143(2):e20183610]. *Pediatrics.* 2018;142(5):e20182587
30. Klipstein S, Fallat ME, Savelli S; Committee on Bioethics; Section on Hematology/Oncology; Section on Surgery. Fertility preservation for pediatric and adolescent patients with cancer: medical and ethical considerations. *Pediatrics.* 2020;145(3):e20193994
31. Marcell AV, Burstein GR; Committee on Adolescence. Sexual and reproductive health care services in the pediatric setting. *Pediatrics.* 2017;140(5):e20172858
32. Park ER, Kirchhoff AC, Perez GK, et al. Childhood Cancer Survivor Study participants' perceptions and understanding of the Affordable Care Act. *J Clin Oncol.* 2015;33(7):764–772
33. Oeffinger KC, Ford JS, Moskowitz CS, et al. Promoting breast cancer surveillance: the EMPOWER study, a randomized clinical trial in the Childhood Cancer Survivor Study. *J Clin Oncol.* 2019;37(24):2131–2140
34. Committee on Child Health Financing. Guiding principles for managed care arrangements for the health care of newborns, infants, children, adolescents, and young adults. *Pediatrics.* 2013;132(5). Available at: www.pediatrics.org/cgi/content/full/132/5/e1452
35. Eshelman-Kent D, Kinahan KE, Hobbie W, et al. Cancer survivorship practices, services, and delivery: a report from the Children's Oncology Group (COG) nursing discipline, adolescent/young adult, and late effects committees. *J Cancer Surviv.* 2011;5(4):345–357
36. Nathan PC, Agha M, Pole JD, et al. Predictors of attendance at specialized survivor clinics in a population-based cohort of adult survivors of childhood cancer. *J Cancer Surviv.* 2016;10(4):611–618
37. Merchant TE, Conklin HM, Wu S, Lustig RH, Xiong X. Late effects of conformal radiation therapy for pediatric patients with low-grade glioma: prospective evaluation of cognitive, endocrine, and hearing deficits. *J Clin Oncol.* 2009;27(22):3691–3697
38. van Santen HM, van den Heuvel-Eibrink MM, van de Wetering MD, Wallace WH. Hypogonadism in children with a previous history of cancer: endocrine management and follow-up. *Horm Res Paediatr.* 2019;91(2):93–103
39. Hudson MM. Reproductive outcomes for survivors of childhood cancer. *Obstet Gynecol.* 2010;116(5):1171–1183
40. Armstrong GT, Sklar CA, Hudson MM, Robison LL. Long-term health status among survivors of childhood cancer: does sex matter? *J Clin Oncol.* 2007;25(28):4477–4489
41. King AA, Seidel K, Di C, et al. Long-term neurologic health and psychosocial function of adult survivors of childhood medulloblastoma/PNET: a report from the Childhood Cancer Survivor Study. *Neuro Oncol.* 2017;19(5):689–698
42. Gawade PL, Hudson MM, Kaste SC, et al. A systematic review of selected

musculoskeletal late effects in survivors of childhood cancer. *Curr Pediatr Rev.* 2014;10(4):249–262

43. Fernandez-Pineda I, Hudson MM, Pappo AS, et al. Long-term functional outcomes and quality of life in adult survivors of childhood extremity sarcomas: a report from the St. Jude Lifetime Cohort Study. *J Cancer Surviv.* 2017;11(1):1–12
44. Gibson TM, Li Z, Green DM, et al. Blood pressure status in adult survivors of childhood cancer: a report from the St. Jude Lifetime Cohort Study. *Cancer Epidemiol Biomarkers Prev.* 2017;26(12):1705–1713
45. Mulrooney DA, Armstrong GT, Huang S, et al. Cardiac outcomes in adult survivors of childhood cancer exposed to cardiotoxic therapy: a cross-sectional study. *Ann Intern Med.* 2016;164(2): 93–101
46. Clemens E, de Vries AC, Pluijm SF, et al; DCOG-LATER, The Netherlands. Determinants of ototoxicity in 451 platinum-treated Dutch survivors of childhood cancer: a DCOG late-effects study. *Eur J Cancer.* 2016;69:77–85
47. Chemaitilly W, Armstrong GT, Gajjar A, Hudson MM. Hypothalamic-pituitary axis dysfunction in survivors of childhood CNS tumors: importance of systematic follow-up and early endocrine consultation. *J Clin Oncol.* 2016;34(36):4315–4319
48. Leisenring W, Friedman DL, Flowers ME, Schwartz JL, Deeg HJ. Nonmelanoma skin and mucosal cancers after hematopoietic cell transplantation. *J Clin Oncol.* 2006;24(7):1119–1126
49. Armstrong GT, Oeffinger KC, Chen Y, et al. Modifiable risk factors and major cardiac events among adult survivors of childhood cancer. *J Clin Oncol.* 2013;31(29):3673–3680
50. Mueller S, Fullerton HJ, Stratton K, et al. Radiation, atherosclerotic risk factors, and stroke risk in survivors of pediatric cancer: a report from the Childhood Cancer Survivor Study. *Int J Radiat Oncol Biol Phys.* 2013;86(4):649–655
51. Jones LW, Liu Q, Armstrong GT, et al. Exercise and risk of major cardiovascular events in adult survivors of childhood Hodgkin lymphoma: a report from the Childhood Cancer Survivor Study. *J Clin Oncol.* 2014;32(32):3643–3650
52. Scott JM, Li N, Liu Q, et al. Association of exercise with mortality in adult survivors of childhood cancer. *JAMA Oncol.* 2018;4(10):1352–1358
53. Oancea SC, Gurney JG, Ness KK, et al. Cigarette smoking and pulmonary function in adult survivors of childhood cancer exposed to pulmonary-toxic therapy: results from the St. Jude lifetime cohort study. *Cancer Epidemiol Biomarkers Prev.* 2014;23(9):1938–1943
54. Huang IC, Bhakta N, Brinkman TM, et al. Determinants and consequences of financial hardship among adult survivors of childhood cancer: a report from the St. Jude Lifetime Cohort Study. *J Natl Cancer Inst.* 2019;111(2):189–200
55. Klosky JL, Howell CR, Li Z, et al. Risky health behavior among adolescents in the childhood cancer survivor study cohort. *J Pediatr Psychol.* 2012;37(6): 634–646
56. Lown EA, Hijiya N, Zhang N, et al. Patterns and predictors of clustered risky health behaviors among adult survivors of childhood cancer: a report from the Childhood Cancer Survivor Study. *Cancer.* 2016;122(17):2747–2756
57. Wong JR, Morton LM, Tucker MA, et al. Risk of subsequent malignant neoplasms in long-term hereditary retinoblastoma survivors after chemotherapy and radiotherapy. *J Clin Oncol.* 2014;32 (29):3284–3290
58. Armenian S, Bhatia S. Predicting and preventing anthracycline-related cardiotoxicity. *Am Soc Clin Oncol Educ Book.* 2018;38:3–12

Maltreatment of Children With Disabilities

- *Clinical Report*

CLINICAL REPORT Guidance for the Clinician in Rendering Pediatric Care

American Academy of Pediatrics

DEDICATED TO THE HEALTH OF ALL CHILDREN®

Maltreatment of Children With Disabilities

Lori A. Legano, MD, FAAP,[a] Larry W. Desch, MD, FAAP,[b] Stephen A. Messner, MD, FAAP,[c] Sheila Idzerda, MD, FAAP,[d] Emalee G. Flaherty, MD, FAAP,[e] COUNCIL ON CHILD ABUSE AND NEGLECT, COUNCIL ON CHILDREN WITH DISABILITIES

Over the past decade, there have been widespread efforts to raise awareness about maltreatment of children. Pediatric providers have received education about factors that make a child more vulnerable to being abused and neglected. The purpose of this clinical report is to ensure that children with disabilities are recognized as a population at increased risk for maltreatment. This report updates the 2007 American Academy of Pediatrics clinical report "Maltreatment of Children With Disabilities." Since 2007, new information has expanded our understanding of the incidence of abuse in this vulnerable population. There is now information about which children with disabilities are at greatest risk for maltreatment because not all disabling conditions confer the same risks of abuse or neglect. This updated report will serve as a resource for pediatricians and others who care for children with disabilities and offers guidance on risks for subpopulations of children with disabilities who are at particularly high risk of abuse and neglect. The report will also discuss ways in which the medical home can aid in early identification and intervene when abuse and neglect are suspected. It will also describe community resources and preventive strategies that may reduce the risk of abuse and neglect.

INTRODUCTION

The maltreatment of children, including those with disabilities, is a critical public health issue. For the purposes of this report, children with disabilities include the full spectrum of children and adolescents with any significant impairment in any area of motor, sensory, social, communicative, cognitive, or emotional functioning. Children and youth with special health care needs is a broader group that shares some of the same risks as children with disabilities. These children have chronic medical issues that may cause impairment and, as a group, require significantly more health care than typically developing children.

abstract

[a]Department of Pediatrics, Grossman School of Medicine, New York University, New York, New York; [b]Department of Pediatrics, Chicago Medical School, Rosalind Franklin University of Medicine and Science and Advocate Children's Hospital, Oak Lawn, Illinois; [c]Stephanie V. Blank Center for Safe and Healthy Children, Children's Healthcare of Atlanta, Department of Pediatrics, Emory University School of Medicine, Atlanta, Georgia; [d]Billings Clinic, Department of Medicine, University of Washington School of Medicine, Bozeman, Montana; and [e]Department of Pediatrics, Northwestern University Feinberg School of Medicine, Chicago, Illinois

DOI: https://doi.org/10.1542/peds.2021-050920

Address correspondence to Lori Legano, MD. Email: lori.legano@nyulangone.org

PEDIATRICS (ISSN Numbers: Print, 0031-4005; Online, 1098-4275).

To cite: Legano LA, Desch LW, Messner SA, et al. AAP COUNCIL ON CHILD ABUSE AND NEGLECT, AAP COUNCIL ON CHILDREN WITH DISABILITIES. Maltreatment of Children With Disabilities. *Pediatrics.* 2021;147(5):e2021050920

Current data on incidence and prevalence of maltreatment in children with disabilities are limited by varying definitions of disability and lack of uniform methods of classifying maltreatment. There is concern that the incidence of child abuse and neglect is underreported in part because many children with disabilities have communication difficulties and cannot directly report problems.[1,2] Nonetheless, children with disabilities and special health care needs are at increased risk of child maltreatment. This report updates the previous clinical report published in 2007, "Assessment of Maltreatment of Children With Disabilities."[1]

The US Children's Bureau reported that an estimated 678 000 children were determined to be victims of abuse or neglect in 2018.[3] Three-fifths (60.8%) of child victims experienced neglect, 10.7% were physically abused, and 7.0% were sexually abused; 15.5% of these children suffered from 2 or more maltreatment types.[3] The 2010 reauthorization of the Child Abuse Prevention and Treatment Act (CAPTA) improved the data collection from states on children with disabilities by mandating that states report the number of children younger than 3 years who are involved in a substantiated case of child maltreatment and are eligible to be referred for early intervention services and the number of children who were actually referred for those services.[4] It did not require collecting information regarding types of disabilities or the number of children with disabilities who are older than 3 years when they enter the child welfare system.[4]

On the basis of national data from 2015, child victims with a disability accounted for 14.1% of all victims of abuse and neglect.[4] In that report, children with the following conditions were considered to have a disability: intellectual disability (ID), severe emotional disturbance, visual or hearing impairment, learning disability, physical disability, behavior problem, or a few other chronic medical conditions. It was believed that children with such conditions are undercounted because not every child received a clinical diagnostic assessment when child maltreatment was suspected. A recent study of the data from the National Survey of Child and Adolescent Well-Being II, which included children older than 3 years, found that nearly one-half of children investigated by child protective services (CPS) were not typically developing.[5]

Child abuse and neglect is reported in 3% to 10% of the population with disabilities.[6–10] The rate of child abuse and neglect is at least 3 times higher in children with disabilities than in the typically developing population.[11] In a recent study by the Federal Bureau of Justice Statistics, during the period from 2011 to 2015, among all people older than 12 years who had disabilities, people between 12 and 15 years of age had the highest rate of violent victimization.[8]

Using data from the National Child Abuse and Neglect Data System, Kistin et al[12] evaluated the incidence and timing of rereferral to CPS, substantiated maltreatment, determined foster care placement for children who had been reported to CPS and had unsubstantiated neglect, and compared typically developing children and children with disabilities. Children with disabilities were re-referred to CPS more frequently, were found to have been abused more frequently, and were more often subsequently placed in foster care.[12] Once placed in foster care, children with ID were more likely to experience placement instability[13] and were more likely to have adoption disruption and less likely to be reunified with a parent or other family member.[13]

A systematic review of violence against children with disabilities revealed that, overall, children with disabilities are more likely to be victims of violence than their peers without disabilities. However, the authors of that review reported limitations in the literature because of a lack of well-designed research studies, with poor standards of measurement of disability and violence and insufficient exploration about whether violence preceded the disability.[11]

Child maltreatment may result in the development of disabilities, which in turn can precipitate further abuse. Abusive head trauma, for example, is known to cause disabilities in children.[14] The majority of survivors of abusive head trauma have developmental delays, seizures, motor impairments, feeding difficulties, and later behavioral and educational dysfunction, with only 28% having no impairment.[15] Vision loss can result from occipital cortical injury and optic nerve injury.[16] Neglect is associated with short-term and long-term effects on children's cognitive, socioemotional, and behavioral development.[17,18] Neglect that occurs early in life can have more profound effects on development.

Injury from abuse is augmented by the impact it has on the cortisol stress response and consequent physiologic impact. Adverse childhood experiences, including child abuse and neglect, cause physiologic disruptions that can persist into adulthood and lead to lifelong poor physical and mental health.[19] Exposure to traumatic events is associated with significant negative effects on long-term cognitive development, such as IQ scores, language development, and academic achievement.[20] Specifically, witnessing intimate partner violence in early childhood, particularly during the first 2 years of life, is associated with decreased cognitive scores later in childhood.[21]

FACTORS THAT INCREASE THE RISK OF CHILD ABUSE AND NEGLECT

In general, the causes of abuse and neglect of children with disabilities are the same as those for all children; however, several elements may increase the risk of abuse for children with disabilities. Children with chronic illnesses or disabilities sometimes can place higher emotional, physical, economic, and social demands on their families.[22] The financial stress of raising a child with disabilities is often high, and this contributes significantly to family stress.[23,24] Other studies have found that families of children with disabilities have significantly more out-of-pocket costs for health care expenditures.[24,25] Caregivers may feel more overwhelmed and unable to cope with the care and supervision responsibilities that are required.[25] Lack of respite or other breaks in child care responsibilities for caregivers may contribute to an increased risk of abuse and neglect in children with disabilities. Neglect, the most common form of child maltreatment, is more prevalent in children with disabilities than in children without disabilities.[7] The complex needs of children with disabilities, in both special health care and educational needs, may result in the failure of the child to receive essential medications, therapies, and appropriate educational placement.[24,26]

A substance use disorder in the mother is a risk factor for child maltreatment[27] and may be the cause of the child's disability. Fetal alcohol spectrum disorder (FASD) is a classic example. The use of alcohol or other substances during pregnancy can cause a range of lifelong physical and behavioral disabilities and IDs.[28] Children with FASD often have learning problems and speech and language issues and are typically impulsive, lack focus, and have poor judgment. These problems can be extremely frustrating for any caregiver of a child with FASD. Parents with ongoing substance use disorders may also be less able to handle their children's challenging behaviors and be more punitive to their children.[29]

Parenting a child with disabilities is often challenging. Some children with disabilities may not respond to traditional means of reinforcement, and sometimes their behaviors, such as aggressiveness, noncompliance, and communication problems, can become frustrating, thus increasing caregiver stress.[30] These behavioral challenges can increase the risk of physical abuse by children's caregivers.[26]

Parents of a child with a disability may also overestimate their child's capabilities. In one study from the United States, parents of children with disabilities sometimes held unrealistically high expectations for their children.[9] Unrealistic expectations were also associated with a decreased degree of empathetic awareness of their child's limitations. Parents of children with intellectual or communication problems may sometimes turn to inappropriate physical punishment because of frustration about what they perceive as stubbornness or intentional failure to respond to verbal guidance.[31] Inappropriate expectations and ignorance of challenges a child with a disability might face can be linked to a higher risk for maltreatment. Pediatric providers can intervene by providing reasonable expectations for parents regarding their children with disabilities.[9] Parents need information and support to understand their child's abilities and challenges. They also need knowledge about proper strategies to use that are appropriate for the disability-related problems and the developmental status of their child.[25]

Although the use of aversive procedures and restraints for children who have disabilities has fortunately been diminishing, in part because of legislative changes (eg, modifications of the Individuals with Disabilities Education Act [Pub L No. 108-446 (2004)]), these practices are still sometimes used in homes, schools, programs, nursing homes, group homes, and other institutions.[32] Aversive techniques are procedures that use painful or unpleasant stimuli (such as biting the child, administering a noxious electric stimulus, or applying hot sauce to mucosal surfaces) to modify a behavior, and these techniques are always unacceptable or inappropriate. Restraints are physical measures (such as tie-downs or prolonged seclusion) used to prevent something physical from happening or for punishment. Physical restraints include forced holding, a technique that has been repudiated as being harmful.[33]

State laws are often unclear, contradictory, and varied regarding aversive and restraint techniques and do not always consider the techniques maltreatment.[34] Pediatricians and others can find additional information about the problems occurring from the use of aversive procedures or the use of restraints from the Web site Stop Hurting Kids (http://stophurtingkids.com/resources/). Over the past 20 years, research has demonstrated the effectiveness of alternative measures, commonly called "positive behavioral supports," to change behavior.[9] Pediatricians are encouraged to advocate for this approach. Information about positive behavioral support guidelines is available from a US Department of Education-funded program, the Technical Assistance Center on Positive Behavioral Interventions and Supports, at www.pbis.org, as well as other national and international programs. The American Academy of Child and Adolescent Psychiatry also provides

guidance on this subject (https://www.aacap.org).

The presence of multiple caregivers can either increase or decrease the risk of abuse of children with disabilities. Children with disabilities who require multiple caregivers or providers may have contact with numerous individuals, thereby increasing the opportunity for abuse. However, advantages to having a large number of caregivers are that there are more individuals who may detect the injuries or signs of abuse, and the additional assistance may actually decrease the amount of stress placed on the primary caregivers. Risk may be minimized by careful screening and selection of caregivers, sporadic and unscheduled monitoring of care, and recognizing that any child may become a victim of child abuse and neglect.

Children with disabilities may be unintentionally conditioned to comply with authority, which could result in them failing to recognize abusive behaviors as maltreatment.[35] Children with disabilities are often perceived as easy targets because their intellectual limitations may prevent them from being able to discern the experience as abuse and their impaired communication abilities may prevent them from disclosing abuse. Because some forms of therapy may be painful (eg, injections or manipulation as part of physical therapy), a child may not be able to differentiate appropriate pain from inappropriate pain.

ASSOCIATION BETWEEN DISABILITY TYPE AND FORM OF ABUSE

Recent research has evaluated how differences in risk of abuse and neglect correlated with the type and severity of the child's disability. The World Health Organization describes disabilities by the domains of function that are affected (ie, cognition, mobility, self-care, getting along, life activities, and participation).[36] The most severely affected children are at a lower risk of maltreatment than mobile, verbal children who are still delayed, especially those with cognitive disabilities.[37] Children who are nonverbal or hearing impaired are more likely than others to experience neglect or sexual abuse.[4]

In an Australian study, researchers examined the relationship between different types of disabilities (eg, Down syndrome, autism) and the rate of substantiated maltreatment allegations.[10] The authors found that children with ID, mental or behavioral problems, or conduct disorder had an increased risk of an abuse allegation and for a substantiated allegation. In contrast, children with autism had a lower risk than children with Down syndrome, and those with birth defects or cerebral palsy had the same risk as children without disability after adjusting for child, family, and neighborhood risk factors. The type of abuse was not specified.

In another study from South Carolina, researchers examined the relationship between autism spectrum disorder (ASD) and ID and child maltreatment.[38] There were higher odds of reported and substantiated maltreatment among children with ASD only, ASD plus ID, and ID only, compared with a control group after controlling for sociodemographic factors. In a 2018 study from Tennessee, children with ASD had more referrals to a child abuse hotline than those without ASD, although substantiation rates were similar between the 2 groups.[39] In a 2018 study using data from the National Survey of Child and Adolescent Well-Being II data, children with multiple developmental delays were more likely to have recurrence of child abuse reporting.[40]

Physical Abuse

Sullivan and Knutson found that children with a disability were 3.79 times more likely to be physically abused than those without a disability.[41] Helton and Cross[37] also found that there is an association between disability and physical abuse. Rather than comparing children on the basis of diagnosis, they compared children on the basis of their level of functioning. The highest rates of physical abuse were in children with mild cognitive disabilities and no motor disability. Paradoxically, children whose disabilities are less severe are more likely to be the victims of physical abuse. These authors stated,

> "Conceptually, we can hypothesize that children with minor impairment are at greater risk because they have a complicated mix of dysfunctionality and functionality. Their dysfunctionality increases the probability that they will act in a way that elicits a negative reaction from parents, while their functionality increases their parents' expectations of them and increase their ability to take actions that may frustrate their parents."[37]

Harsh discipline, whether physical or verbal, can negatively affect children emotionally. Therefore, it is important to counsel parents of children with and without special needs about methods of discipline specifically as they relate to the developmental level of their child.[42]

Neglect

In their study, Van Horne et al followed the risks of substantiated maltreatment in a cohort of children younger than 2 years with cleft lip and palate, Down syndrome, and spina bifida. In this study, the authors found that, although children with Down syndrome had the same rate of overall substantiated maltreatment as typically developing peers, children with cleft lip and palate and spina bifida had 2 times the rate of maltreatment. However, the risk of medical neglect was significantly greater among all 3 birth defect groups than in the unaffected group of children. The medical complexity of these children may account for the

increase in medical neglect.[7] In a follow-up study by Van Horne et al[43] on children aged 2 to 10 years with the same disabilities, children with cleft lip and palate, Down syndrome, and spina bifida all had a higher rate of medical neglect compared with children who were unaffected. In a study by McDonnell et al,[38] children with ASD alone, ASD plus ID, and ID alone were found to be at greater risk of physical neglect. Children with disabilities and unsubstantiated referrals for neglect experienced future maltreatment sooner and more often than other children.[12]

Sexual Abuse

In addition to physical abuse and neglect, children with disabilities are at an increased risk for being sexually abused.[41,44] Caldas and Bensy[44] studied children aged 6 to 17 years in the school setting and examined types of abuse, profiles of the victims of abuse, and profiles of the abusers. They found that children with disabilities are at 3 times the risk of sexual abuse compared with typically developing peers. The children with the greatest risk of abuse were children who had special education classroom supports. One-half of these abused children were victimized by peers, and one-half were victimized by school personnel. In a 2007 study from Israel, researchers found that children with disabilities were more likely to suffer more severe forms of sexual abuse.[45]

Multiple factors have been found to contribute to this increased rate of sexual abuse in children with disabilities, including the increased number of caregivers that children with disabilities encounter and limited access to information and training on personal safety and sexual abuse prevention.[44,46] Parents support education on human sexuality but are uncertain of how this topic should be presented to their child with IDs or communicative or motor disabilities.[47]

It is also important to recognize that health care providers have been implicated in sexual abuse of children with disabilities.[48] Data about the incidence and prevalence of sexual abuse by health care providers are sparse and do not allow a thorough analysis of the incidence of the types of abuse or the types of perpetrators because the terms "health care provider" or "health care worker" encompass many subgroups, including physicians, nurses, and therapists. Given the increased number of health care providers that children with disabilities routinely encounter, it is essential that the prohibition of sexual abuse and exploitation be discussed and taught during the training of all health care providers. The 2011 American Academy of Pediatrics (AAP) policy statement "Protecting Children From Sexual Abuse by Health Care Providers" is an excellent resource to help with this training.[48]

Emotional Abuse

In a study from the United Kingdom, children with conduct disorder, nonconduct psychological disorders, or speech and language difficulties were associated with a higher likelihood of child protection registration for emotional abuse.[49] Children with a psychiatric diagnosis are at higher risk for psychological maltreatment and emotional abuse.[50] In a study from Turkey, children with attention-deficit/hyperactivity disorder (ADHD) were found to have higher rates of emotional abuse than controls.[51] In a retrospective study of adults with and without ADHD, adults with ADHD reported higher rates of emotional abuse experienced as children when compared with adults who did not have ADHD.[52]

PEDIATRICIAN'S ROLE

Pediatricians and other health care providers need to be actively involved in the prevention, identification, and assessment of possible maltreatment of children with disabilities. Recognizing that these children are at a much higher risk is essential. It is important to assess whether immunizations and other well-child care are up to date and to ensure that necessary appointments with specialists or for illness or injuries are kept. Many children with disabilities have a team of professionals (including but not limited to teachers, paraprofessionals, and medical providers) who regularly interact with them and have direct knowledge about the limitations, abilities, and behaviors of that individual child. By working closely with these professionals, the pediatrician can gather additional insight into any concerns about maltreatment and use this information to guide the medical evaluation.

Pediatricians and other health care providers play a key role in evaluating and documenting medical conditions that may or may not predispose children with disabilities to injury. For example, documenting the presence of, or a risk for, osteopenia, is helpful in assessing fractures that may occur later. Self-injurious behaviors, such as headbanging and self-scratching, can elicit a CPS referral.[53] Careful and thorough documentation is often key in making a determination about whether an injury is consistent with abuse or is a result of self-injurious behavior. Health care providers can document abnormal physical examination findings, observed behaviors, and reported behaviors to establish the problem list for children with disabilities. Many electronic health records now have the capability to add digital photographs and "for your information" flags and alerts to the charts that can aid in assessing future injuries or changes in behavior based on preexisting conditions. This documentation is

useful for collaboration with in-hospital providers, such as emergency medicine providers, hospitalists, and critical care providers who may also be part of the system of care for children with disabilities who are victims of abuse and neglect.

If abuse or neglect is suspected after a careful assessment, a report must be made to the appropriate CPS agency.[54] Collaboration with a multidisciplinary child abuse team or child abuse pediatrician can provide both technical assistance in the evaluation and guidance with the reporting process. Pediatricians may also need to educate CPS about medical findings to assist with the investigation by CPS. Careful consideration should be given regarding whether the evaluation is best completed in the outpatient versus inpatient setting. There are advantages and disadvantages to both; however, the safety of the child needs to be kept at the forefront in the decision-making process. If there are reports of self-injurious behavior that have not previously been documented or observed by a third party, an inpatient evaluation should be considered to observe the child's behaviors as part of the full medical evaluation.

Appropriate medical treatment can be provided for any identified injuries, infections, or other conditions. Each case of abuse or neglect that is clinically confirmed or strongly suspected requires a multidisciplinary treatment plan. Behavioral health referrals to clinicians experienced with caring for children with disabilities needs to be considered as part of the treatment plan. Evidence-based trauma therapy is available for children with disabilities, although this type of specific therapy may not be available in all communities (https://www.nctsn.org/resources/facts-traumatic-stress-and-children-developmental-disabilities).

Pediatricians are responsible for the transition of care to adult physicians but may continue to manage patients beyond their 18th birthday when they are no longer minors. When patients enter adulthood, abuse concerns are then referred to adult protective services. Pediatricians can familiarize themselves with adult protective services in their state.

Prevention

Support and assistance with parenting skills are often needed by families, and the need is greater for families with children and youth with special health care needs or disabilities. Pediatricians, as trusted family advisors, can acknowledge family needs, provide encouragement, and address parents' physical, social, and mental health needs.[55] They can present disability-specific injury prevention guidelines to help the family minimize injury.[56] The availability of parent support groups, respite care, and home health services should be explored, and referrals may be made when appropriate. Pediatricians can learn about services for parents of children with disabilities, such as respite and medical waiver subsidies and programs specific to each state and how to qualify for such funds.[57] Table 1 lists some resources for families of children with disabilities.

During each health supervision encounter, pediatric providers can address the medical, social, economic, behavioral, and psychological needs of the child and the family. Proactively addressing discipline concerns and encouraging positive parenting are especially needed in this population.[58] The AAP published a report strongly discouraging spanking and providing alternative discipline practices.[42] It is helpful to recognize and support child and family strengths at each encounter.[55] The AAP provides several resources for positive parenting (eg, www.healthychildren.org[59]; *Bright Futures: Guidelines for Health Supervision of Infants, Children, and Adolescents*, Fourth Edition[60]; and Connected Kids[61]). Pediatricians can share other positive parenting resources with families as well, such as the Centers for Disease Control and Prevention's Essentials for Parenting Toddlers and Preschoolers (http://www.cdc.gov/parents/essentials/overview.html).

All children, with or without disabilities, benefit from a medical home consisting of a health care professional who is readily accessible to the family to answer questions, help coordinate care, and discuss concerns.[62] A medical home may incorporate other professionals, including social workers, to help with accessing resources. The medical home can also collaborate with

TABLE 1 Resources for Families of Children With Disabilities

	Resources
Financial	Supplemental Security Income (SSI), Special Supplemental Nutrition Program for Women, Infants, and Children (WIC), Medicaid waiver, therapist fees, Title V maternal and child health services programs for children and youth with special health care needs
Respite or extended care	Respite centers, baby-sitting, after-school programs, emergency respite, residential supports
Specialized medical needs	In-home nursing services, durable medical equipment
Emotional support	Support groups, counseling services for families, family-to-family health information centers
Educational support	IFSPs, IEPs, special education teachers and paraprofessionals
Recreational opportunities	Camps, after-school recreation, sports

IEP, Individualized Education Program; IFSP, Individualized Family Service Plan.

partners from other disciplines, including education, child care, mental health, and faith-based organizations. While working with families of children with disabilities, health care providers can educate and encourage them to work with community agencies that provide the resources and services they need to improve the child's care and the family's coping. Child abuse prevention, including indicators of abuse, can be discussed with parents and caregivers, especially those dealing with children with disabilities, and taking into account the family's language and culture.[55]

Education

In-service training for CPS and adult protective service workers, law enforcement professionals, health care professionals, child care providers, early childhood educators, teachers, and judges is crucial, and protocols are necessary for the identification, reporting, and referral of all cases of suspected child maltreatment in all schools, programs, and institutional settings. Experts in either child maltreatment or childhood disabilities can assist with this educational endeavor. General pediatricians can help local school districts with training in positive behavioral interventions and supports.[32] Education on risk factors for maltreatment of children with disabilities is important.

Pediatricians can be important role models to parents, trainees, and others. Pediatricians and other health care providers who provide care for children with disabilities can avoid using physical restraints during procedures for these children. Often, taking the time to explain procedures in terms appropriate to developmental level or other ways to prepare a child can make restraints unnecessary except in situations when children are dangerous to themselves or others. Even when some types of restraints are needed, such as to prevent a child from scratching at newly repaired lacerations, such restraints should be as comfortable and as minimal as possible and used for the shortest time feasible. Pediatricians can also be flexible about performing procedures, such as delaying blood draws that are not essential.

Pediatricians may also assist in education about child abuse to peers, residents, medical students, and other health care students. All health care professionals need adequate training to monitor children with disabilities for signs of abuse and neglect and to screen suspected victims of child maltreatment for possible delays or disabilities.[63]

Advocacy

The pediatrician, in providing the medical home and acting as the patient's and family's advocate, may review care that is provided by various agencies and resources. Much of this advocacy effort can be performed by coordinating efforts and ensuring that recommendations are implemented.[57] By providing prevention-based continuity of care, additional patient needs, such as changes in services, can be expediently identified and resolved.

Pediatricians play an important advocacy role in their relationships with various governmental and nongovernmental agencies. AAP chapters can also have an influential role in these arenas. State, educational, social, foster care, financial, and health care systems often function in isolation from each other, with little coordination or communication.[35] Foster children with disabilities and their foster parents, for example, often suffer from lack of adequate support systems.[1] Community involvement can often lead to the development of needed resources, including child care and respite services for families with a child with a special health care need.[6] Pediatricians can advocate for the caregivers to receive financial support to access services, such as respite. Communication with schools and other systems with which families interact is another avenue to increase the awareness of the needs of children who have disabilities and/or special health care needs.

As child advocates, pediatricians are in an ideal position to influence public policy by sharing information and giving educational presentations on child maltreatment and the needs of children with disabilities. There can be advocacy for training in recognizing both abuse and findings that mimic abuse for providers of children with disabilities. Pediatricians can advocate for state policies that mandate CPS agencies to gather disability information on child maltreatment cases. Pediatricians can emphasize the devastating costs of child maltreatment to legislators, policy makers, and the public. Pediatricians can advocate for state Medicaid programs to provide prompt automatic Medicaid eligibility at enrollment in foster care, including kinship care. Pediatricians can also advocate for health care not to be disrupted if a child with disabilities is placed into Medicaid managed-care plans that do not have the child's existing specialists in network. Pediatricians can also advocate for proper coverage in both private and public insurance plans. In the case of primary care, there should be a time-limited presumptive authorization extended to a current primary care provider for well visits and timely immunization visits. Pediatricians can advocate that Medicaid programs pay for services necessary for the effective transition of care when there must be a change in specialty providers. Pediatricians can also advocate for screening procedures for potential employees in educational, recreational, and residential settings to help ensure the safety of all children in their care.[32]

SUMMARY

Children with disabilities are a vulnerable population at increased risk of child abuse and neglect and, therefore, merit special attention to reduce this risk. Children with milder forms of disability are at higher risk of abuse and neglect than more profoundly affected children.

Certain types of disabilities are associated with different forms of abuse. Children with behavioral difficulties are at a greater risk for physical abuse. Children who are nonverbal or hearing impaired are more likely to experience neglect or sexual abuse. Children with multiple developmental delays are more at risk for recurrence of child abuse reporting. Conduct disorder, nonconduct psychological disorders, speech and language difficulties, and ADHD are associated with emotional abuse.

Addressing financial struggles, family stress, and the long-term needs of these children can reduce the risk of child abuse and neglect. Pediatricians are a unique resource to children with disabilities through the medical home model and in multidisciplinary teams.

GUIDANCE FOR PEDIATRICIANS

1. Recognize signs and symptoms of child maltreatment in all children and adolescents, including those with disabilities, and understand mandatory, state-specific reporting requirements for child and adult protective services.
2. Use each medical visit as an opportunity to assess family well-being.
3. Understand that families of children with disabilities benefit from assistance in addressing their child's abilities and needs. Provide reasonable expectations for parents regarding their children with disabilities and be prepared to offer concrete suggestions about how to respond to common developmentally based challenges for the child with a disability.
4. Refer families of children with disabilities to available community resources and agencies that provide necessary services designed to aid children with disabilities and their families.
5. Structure discussions about appropriate discipline within well-child visits for the child with a disability. Parents may be uncertain as to how to deal with discipline, especially for children who are verbal but developmentally delayed, so provide guidance on positive parenting. Consider referring these families to specialists with expertise in parenting skills for children with disabilities.
6. Be actively involved with both educational and medical treatment plans developed for children with disabilities and participate in collaborative team approaches.
7. Advocate at the state and local level for system changes that support at-risk children and those with disabilities and their families.

SUGGESTED RESOURCES

A Call to Action: Ending Crimes of Violence against Children and Adults with Disabilities: this report includes recommendations on policy, surveillance systems and data collection, violence prevention, intervention, and research needs. Available at: https://www.aucd.org/docs/annual_mtg_2006/symp_marge2003.pdf.

www.pbis.org: this Web-based resource offers information about programs supporting positive behavioral parenting for families and other caregivers.

Toolkit for medical providers about trauma-informed practice from the National Child Traumatic Stress Network. Available at: http://www.nctsnet.org/trauma-types/pediatric-medical-traumatic-stress-toolkit-for-health-care-providers.

Stop Hurting Kids: this Web site was created by the Alliance to Prevent Restraint, Aversive Interventions, and Seclusion (APRAIS,) a coalition of organizations and advocates who dedicate their time and resources to ending restraint and seclusion abuse in US schools. Available at: http://stophurtingkids.com/resources/.

Hagan JF, Shaw JS, Duncan PM, eds. *Bright Futures: Guidelines for Health Supervision of Infants, Children, and Adolescents.* 4th ed. Elk Grove Village, IL: American Academy of Pediatrics; 2017. Available at: https://brightfutures.aap.org/Pages/default.aspx.

American Academy of Pediatrics. Connected Kids: Safe, Strong, Secure. Available at: https://www.aap.org/en-us/advocacy-and-policy/aap-health-initiatives/Pages/Connected-Kids.aspx.

LEAD AUTHORS

Lori A. Legano, MD, FAAP
Larry W. Desch, MD, FAAP
Stephen A. Messner, MD, FAAP
Sheila Idzerda, MD, FAAP
Emalee G. Flaherty, MD, FAAP

COUNCIL ON CHILD ABUSE AND NEGLECT, 2019–2020

Suzanne B. Haney, MD, FAAP, Chairperson
Andrew P. Sirotnak, MD, FAAP, Immediate Past Chairperson
Amy R. Gavril, MD, MSCI, FAAP
Rebecca Greenlee Girardet, MD, FAAP
Amanda Bird Hoffert Gilmartin, MD, FAAP
Sheila M. Idzerda, MD, FAAP
Antoinette Laskey, MD, MPH, MBA, FAAP
Lori A. Legano, MD, FAAP
Stephen A. Messner, MD, FAAP
Bethany Anne Mohr, MD, FAAP
Shalon Marie Nienow, MD, FAAP
Norell Rosado, MD, FAAP

ABBREVIATIONS

AAP: American Academy of Pediatrics
ADHD: attention-deficit/hyperactivity disorder
ASD: autism spectrum disorder
CPS: child protective services
FASD: fetal alcohol spectrum disorder
ID: intellectual disability

FINANCIAL DISCLOSURE: The authors have indicated they have no financial relationships relevant to this article to disclose.

FUNDING: No external funding.

POTENTIAL CONFLICT OF INTEREST: The authors have indicated they have no potential conflicts of interest to disclose.

REFERENCES

1. Hibbard RA, Desch LW; American Academy of Pediatrics Committee on Child Abuse and Neglect; American Academy of Pediatrics Council on Children With Disabilities. Maltreatment of children with disabilities. *Pediatrics*. 2007;119(5):1018–1025
2. Prkachin KM, Solomon PE, Ross J. Underestimation of pain by health-care providers: towards a model of the process of inferring pain in others. *Can J Nurs Res*. 2007;39(2):88–106
3. US Department of Health and Human Services, Administration for Children and Families, Administration on Children, Youth and Families, Children's Bureau. Child maltreatment 2018. Available at:https://www.acf.hhs.gov/sites/default/files/documents/cb/cm2018.pdf. Accessed July 10, 2020
4. Child Welfare Information Gateway. *The Risk and Prevention of Maltreatment of Children with Disabilities*. Washington, DC: US Department of Health and Human Services, Children's Bureau; 2018
5. Helton JJ, Lightfoot E, Fu QJ, Bruhn CM. Prevalence and severity of child impairment in a US sample of child maltreatment investigations. *J Dev Behav Pediatr*. 2019;40(4):285–292
6. Turner HA, Vanderminden J, Finkelhor D, Hamby S, Shattuck A. Disability and victimization in a national sample of children and youth. *Child Maltreat*. 2011;16(4):275–286
7. Van Horne BS, Moffitt KB, Canfield MA, et al. Maltreatment of children under age 2 with specific birth defects: a population-based study. *Pediatrics*. 2015;136(6). Available at: www.pediatrics.org/cgi/content/full/136/6/e1504
8. Harrell E. *Crime Against People With Disabilities, 2009-2015—Statistical Tables*. Washington, DC: Bureau of Justice Statistics, US Department of Justice; 2017. Available at: www.bjs.gov/index.cfm?ty=pbdetail&iid=5986. Accessed September 9, 2020
9. Zand DH, Pierce KJ, Nibras S, Maxim R. Parental risk for the maltreatment of developmentally delayed/disabled children. *Clin Pediatr (Phila)*. 2015;54(3):290–292
10. Maclean MJ, Sims S, Bower C, Leonard H, Stanley FJ, O'Donnell M. Maltreatment risk among children with disabilities. *Pediatrics*. 2017;139(4):e20161817
11. Jones L, Bellis MA, Wood S, et al. Prevalence and risk of violence against children with disabilities: a systematic review and meta-analysis of observational studies. *Lancet*. 2012;380(9845):899–907
12. Kistin CJ, Tompson MC, Cabral HJ, Sege RD, Winter MR, Silverstein M. Subsequent maltreatment in children

with disabilities after an unsubstantiated report for neglect. *JAMA*. 2016;315(1):85–87

13. Slayter E, Springer C. Child welfare-involved youth with intellectual disabilities: pathways into and placements in foster care. *Intellect Dev Disabil*. 2011;49(1):1–13
14. Frasier LD. Abusive head trauma in infants and young children: a unique contributor to developmental disabilities. *Pediatr Clin North Am*. 2008; 55(6):1269–1285, vii
15. Nuño M, Ugiliweneza B, Zepeda V, et al. Long-term impact of abusive head trauma in young children. *Child Abuse Negl*. 2018;85:39–46
16. Levin AV. Retinal hemorrhages: advances in understanding. *Pediatr Clin North Am*. 2009;56(2):333–344
17. Blaisdell KN, Imhof AM, Fisher PA. Early adversity, child neglect, and stress neurobiology: from observations of impact to empirical evaluations of mechanisms. *Int J Dev Neurosci*. 2019; 78:139–146
18. Maguire SA, Williams B, Naughton AM, et al. A systematic review of the emotional, behavioural and cognitive features exhibited by school-aged children experiencing neglect or emotional abuse. *Child Care Health Dev*. 2015;41(5):641–653
19. Shonkoff JP, Garner AS; Committee on Psychosocial Aspects of Child and Family Health; Committee on Early Childhood, Adoption, and Dependent Care; Section on Developmental and Behavioral Pediatrics. The lifelong effects of early childhood adversity and toxic stress. *Pediatrics*. 2012;129(1). Available at: www.pediatrics.org/cgi/content/full/129/1/e232
20. Pechtel P, Pizzagalli DA. Effects of early life stress on cognitive and affective function: an integrated review of human literature. *Psychopharmacology (Berl)*. 2011;214(1):55–70
21. Enlow MB, Egeland B, Blood EA, Wright RO, Wright RJ. Interpersonal trauma exposure and cognitive development in children to age 8 years: a longitudinal study. *J Epidemiol Community Health*. 2012;66(11):1005–1010
22. Peer JW, Hillman SB. Stress and resilience for parents of children with intellectual and developmental disabilities: a review of key factors and recommendations for practitioners. *J Policy Pract Intell Disabil*. 2014;11(2): 92–98
23. Witt WP, Litzelman K, Mandic CG, et al. Healthcare-related financial burden among families in the U.S.: the role of childhood activity limitations and income. *J Fam Econ Issues*. 2011;32(2): 308–326
24. Murphy N. Maltreatment of children with disabilities: the breaking point. *J Child Neurol*. 2011;26(8):1054–1056
25. Romley JA, Shah AK, Chung PJ, Elliott MN, Vestal KD, Schuster MA. Family-provided health care for children with special health care needs. *Pediatrics*. 2017;139(1):e20161287
26. Goudie A, Narcisse MR, Hall DE, Kuo DZ. Financial and psychological stressors associated with caring for children with disability. *Fam Syst Health*. 2014; 32(3):280–290
27. Dubowitz H, Kim J, Black MM, Weisbart C, Semiatin J, Magder LS. Identifying children at high risk for a child maltreatment report. *Child Abuse Negl*. 2011;35(2):96–104
28. Centers for Disease Control and Prevention. Fetal alcohol spectrum disorders (FASDs). Available at: https://www.cdc.gov/ncbddd/fasd/index.html. Accessed March 22, 2021
29. Miller BA, Smyth NJ, Mudar PJ. Mothers' alcohol and other drug problems and their punitiveness toward their children. *J Stud Alcohol*. 1999;60(5): 632–642
30. Ouyang L, Fang X, Mercy J, Perou R, Grosse SD. Attention-deficit/hyperactivity disorder symptoms and child maltreatment: a population-based study. *J Pediatr*. 2008;153(6): 851–856
31. Scaramella LV, Leve LD. Clarifying parent-child reciprocities during early childhood: the early childhood coercion model. *Clin Child Fam Psychol Rev*. 2004; 7(2):89–107
32. Turnbull HR, Wilcox BL, Stowe M, Raper C, Hedges LP. Public policy foundations for positive behavioral interventions, strategies, and supports. *J Posit Behav Interv*. 2000;2(4):218–230
33. Mohr WK, Petti TA, Mohr BD. Adverse effects associated with physical restraint. *Can J Psychiatry*. 2003;48(5): 330–337
34. Kutz GD. *Seclusions and Restraints: Selected Cases of Death and Abuse at Public and Private Schools and Treatment Centers*. Washington, DC: US Government Accountability Office; 2009. Available at: https://www.gao.gov/products/GAO-09-719T. Accessed September 9, 2020
35. Sullivan P, Cork PM. *Developmental Disabilities Training Project*. Omaha, NE: Center for Abused Children with Disabilities, Boys Town National Research Hospital, Nebraska Department of Health and Human Services; 1996
36. World Health Organization. International classification of functioning, disability and health. Available at: www.who.int/classifications/icf/en/. Accessed September 9, 2020
37. Helton JJ, Cross TP. The relationship of child functioning to parental physical assault: linear and curvilinear models. *Child Maltreat*. 2011;16(2):126–136
38. McDonnell CG, Boan AD, Bradley CC, Seay KD, Charles JM, Carpenter LA. Child maltreatment in autism spectrum disorder and intellectual disability: results from a population-based sample. *J Child Psychol Psychiatry*. 2019;60(5):576–584
39. Fisher MH, Epstein RA, Urbano RC, Vehorn A, Cull MJ, Warren Z. A population-based examination of maltreatment referrals and substantiation for children with autism spectrum disorder. *Autism*. 2019;23(5): 1335–1340
40. Perrigo JL, Berkovits LD, Cederbaum JA, Williams ME, Hurlburt MS. Child abuse and neglect re-report rates for young children with developmental delays. *Child Abuse Negl*. 2018;83:1–9
41. Sullivan PM, Knutson JF. Maltreatment and disabilities: a population-based epidemiological study. *Child Abuse Negl*. 2000;24(10):1257–1273
42. Sege RD, Siegel BS; Council on Child Abuse and Neglect; Committee on Psychosocial Aspects of Child and Family Health. Effective discipline to

raise healthy children. [published correction appears in *Pediatrics*;143(2): e20183609]. *Pediatrics*. 2018;142(6): e20183112

43. Van Horne BS, Caughy MO, Canfield M, et al. First-time maltreatment in children ages 2-10 with and without specific birth defects: a population-based study. *Child Abuse Negl*. 2018;84: 53–63
44. Caldas SJ, Bensy ML. The sexual maltreatment of students with disabilities in American school settings. *J Child Sex Abuse*. 2014;23(4):345–366
45. Hershkowitz I, Lamb ME, Horowitz D. Victimization of children with disabilities. *Am J Orthopsychiatry*. 2007; 77(4):629–635
46. Servais L. Sexual health care in persons with intellectual disabilities. *Ment Retard Dev Disabil Res Rev*. 2006;12(1): 48–56
47. Eastgate G, Scheermeyer E, van Driel ML, Lennox N. Intellectual disability, sexuality and sexual abuse prevention - a study of family members and support workers. *Aust Fam Physician*. 2012; 41(3):135–139
48. Committee on Child Abuse and Neglect. Protecting children from sexual abuse by health care providers. *Pediatrics*. 2011;128(2):407–426
49. Spencer N, Devereux E, Wallace A, et al. Disabling conditions and registration for child abuse and neglect: a population-based study. *Pediatrics*. 2005;116(3):609–613
50. Cuevas CA, Finkelhor D, Ormrod R, Turner H. Psychiatric diagnosis as a risk marker for victimization in a national sample of children. *J Interpers Violence*. 2009;24(4):636–652
51. Sari Gokten E, Saday Duman N, Soylu N, Uzun ME. Effects of attention-deficit/ hyperactivity disorder on child abuse and neglect. *Child Abuse Negl*. 2016;62: 1–9
52. Rucklidge JJ, Brown DL, Crawford S, Kaplan BJ. Retrospective reports of childhood trauma in adults with ADHD. *J Atten Disord*. 2006;9(4):631–641
53. Minshawi NF, Hurwitz S, Fodstad JC, Biebl S, Morriss DH, McDougle CJ. The association between self-injurious behaviors and autism spectrum disorders. *Psychol Res Behav Manag*. 2014;7:125–136
54. Kellogg N; American Academy of Pediatrics Committee on Child Abuse and Neglect. The evaluation of sexual abuse in children. *Pediatrics*. 2005; 116(2):506–512
55. Mattson G, Kuo DZ; Committee on Psychosocial Aspects of Child and Family Health; Council on Children With Disabilities. Psychosocial factors in children and youth with special health care needs and their families. *Pediatrics*. 2019;143(1):e20183171
56. Gaebler-Spira D, Thornton LS. Injury prevention for children with disabilities. *Phys Med Rehabil Clin N Am*. 2002;13(4):891–906
57. Friedman SL, Kalichman MA; Council on Children with Disabilities. Out-of-home placement for children and adolescents with disabilities. *Pediatrics*. 2014; 134(4):836–846
58. Office of Special Education Programs, US Department of Education. Positive behavioral interventions and supports. Available at: https://www.PBIS.org. Accessed October 22, 2018
59. American Academy of Pediatrics. HealthyChildren.org. Available at: www.healthychildren.org/English/Pages/default.aspx. Accessed August 13, 2019
60. Hagan JF, Shaw JS, Duncan PM, eds.. *Bright Futures: Guidelines for Health Supervision of Infants, Children, and Adolescents*, 4th ed. Elk Grove Village, IL: American Academy of Pediatrics; 2017
61. American Academy of Pediatrics. Connected kids: safe, strong, secure. Available at: https://www.aap.org/en-us/advocacy-and-policy/aap-health-initiatives/Pages/Connected-Kids.aspx. Accessed September 9, 2020
62. Medical Home Initiatives for Children With Special Needs Project Advisory Committee. American Academy of Pediatrics. The medical home. *Pediatrics*. 2002;110(1 pt 1):184–186
63. Botash AS, Church CC. Child abuse and disabilities: a medical perspective. *APSAC Advisor*. 1999;12:10–13, 18

Management Principles for Acute Illness in Patients With Medium-Chain Acyl-Coenzyme A Dehydrogenase Deficiency

- *Clinical Report*

CLINICAL REPORT Guidance for the Clinician in Rendering Pediatric Care

American Academy of Pediatrics

DEDICATED TO THE HEALTH OF ALL CHILDREN®

Management Principles for Acute Illness in Patients With Medium-Chain Acyl-Coenzyme A Dehydrogenase Deficiency

Tracy L. McGregor, MD,[a] Susan A. Berry, MD, FAAP,[b] Katrina M. Dipple, MD, PhD, FAAP,[c] Rizwan Hamid, MD, PhD, FAAP,[d] COUNCIL ON GENETICS

Medium-chain acyl-coenzyme A dehydrogenase deficiency (MCADD) is a fatty acid oxidation disorder in which the patient is unable to break down fats to produce energy. This disorder places children at risk for metabolic decompensation during periods of stress, such as routine childhood illnesses. The intent of this clinical report is to provide pediatricians with additional information regarding the acute clinical care of patients with MCADD. Although each patient with MCADD will still be expected to have a primary metabolic physician, the involvement of the primary care provider is crucial as well. Appropriate treatment of children with MCADD can lead to avoidance of morbidity and mortality.

DISEASE DESCRIPTION

Medium-chain acyl-coenzyme A dehydrogenase deficiency (MCADD) is a fatty acid oxidation disorder in which the patient is unable to break down fats to produce energy.[1,2] MCADD is inherited as an autosomal recessive disorder resulting from homozygous or compound heterozygous mutations in the *ACADM* gene.[3] The incidence of MCADD in the United States is between 1:13 000 and 1:19 000.[4,5] Screening for MCADD is now included in all US newborn screening programs.[6] Medium-chain acyl-coenzyme A dehydrogenase is 1 of 4 mitochondrial enzymes that perform the initial steps in fatty acid β-oxidation, resulting in the generation of ketone bodies. Ketone bodies provide a crucial source of energy, particularly for the brain, once hepatic glycogen stores are depleted. During periods of routine childhood illness, when a child develops a negative caloric balance because of a combination of inadequate intake and increased metabolic demand, a biochemically unaffected child will first use stored hepatic glycogen then switch to fatty acid oxidation for

abstract

[a]Division of Medical Genetics and Genomic Medicine, Vanderbilt University Medical Center, Nashville, Tennessee; [b]Division of Genetics and Metabolism, University of Minnesota, Twin Cities, Minneapolis, Minnesota; [c]Division of Genetic Medicine, University of Washington, Seattle, Washington; and [d]Division of Medical Genetics and Genomic Medicine, Vanderbilt University Medical Center, Nashville, Tennessee

Drs McGregor and Hamid conceived the idea for the clinical report; and all authors wrote and edited the manuscript and approved the final manuscript as submitted.

To cite: McGregor TL, Berry SA, Dipple KM, et al. AAP COUNCIL ON GENETICS. Management Principles for Acute Illness in Patients With Medium-Chain Acyl-Coenzyme A Dehydrogenase Deficiency. *Pediatrics*. 2021;147(1): e2020040303

production of ketones as a source of energy. Children with MCADD cannot make this switch when they have exhausted their glucose and glycogen stores. Many of the presenting symptoms of MCADD, such as vomiting, irritability, lethargy, and seizures, are attributable to the ensuing hypoketotic hypoglycemia. If not treated properly and promptly, symptoms can progress relatively rapidly to coma and death.

Children with MCADD may appear normal at birth and classically present with symptoms between 2 months and 2 years of age. However, severe presentations in neonates during the first week of life and at older ages have also been seen.[7–9] The classic presentation of MCADD usually occurs during a routine childhood illness, particularly gastroenteritis. The associated feeding intolerance, secondary to decreased desire for oral intake, paired with emesis can lead to the critical risk factor of prolonged fasting. Some children also present during weaning from nighttime feedings because they are unable to tolerate the longer periods of fasting between feedings. Before inclusion of MCADD in newborn screening panels, up to 18% of patients could have a fatal outcome after the disease is revealed with their first routine childhood illness.[7,10] MCADD is now included in the newborn screening panels in all states.[6] By testing for MCADD in newborn screening programs, providers can institute appropriate avoidance of fasting in affected patients so that catastrophic outcomes can be avoided. Further guidance regarding the evaluation of abnormal newborn screen results can be found on the American College of Medical Genetics and Genomics Web site (https://www.acmg.net).

ACUTE MANAGEMENT

At-home Care

Many children with MCADD have a metabolic specialist primarily responsible for the care of their condition. Parents are instructed to monitor the child carefully, especially during periods of illness. Symptoms that should prompt concern include decreased oral intake, increased sleepiness, decreased activity, and vomiting. Some metabolic specialists institute a home glucose monitoring plan that includes checking glucose concentrations during periods of illness and whenever hypoglycemic symptoms are suspected. Other specialists prefer that patients present for evaluation when there are illnesses or circumstances that may prompt hypoglycemia. At-home care for a patient with MCADD may be possible as long as the child can tolerate adequate oral intake to prevent hypoglycemia, but caregivers should only attempt to do so in consultation with the patient's metabolic specialist. Rehydration solutions intended to replace fluid and electrolytes during periods of diarrhea and vomiting do not contain enough sugar to maintain blood glucose concentrations in a patient with MCADD; better choices for children no longer consuming infant formula or human milk are drinks that contain higher concentrations of sugar, such as juice or sports drinks.

For some patients, the metabolic specialist will prescribe bedtime doses of raw cornstarch, a complex carbohydrate that breaks down slowly, releasing glucose for an extended period of time. However, in the face of an illness that increases metabolic demand, cornstarch alone may not be sufficient to prevent overnight hypoglycemia. Pediatric health care providers and parents should be cautious and conservative when assessing a patient with MCADD. The pediatric health care provider should pay particular attention to the parent or caregiver's assessment of mental status in a child of any age. A mild decrease in activity level or attentiveness or a behavior unusual to the caregiver may be an early signal of an MCADD exacerbation, which can progress rapidly to seizures, coma, or death.

Emergency Care

It is recommended that a child with a known diagnosis of MCADD be brought to the emergency department (ED) for supplemental glucose administration early in the course of an illness to prevent development or progression of an MCADD exacerbation. This is particularly important when regular oral intake cannot be guaranteed or when parents or caregivers are unsure of the severity of symptoms. Patients and their families are typically given a sick letter or emergency letter written by the child's metabolic specialist to present at the time of arrival in the ED. Patients may also wear a medical alert bracelet or necklace to notify medical personnel of their condition. Patients and parents or caregivers are advised to carry a copy of the emergency letter with them for unexpected illnesses while away from home and are also advised to share it with the child's primary care provider. This letter usually also contains useful information for any health care provider who is planning an elective procedure. At a minimum, this letter provides direct care instructions for the ED and contact information for the metabolic specialist or provider. The metabolic specialist should be notified promptly about a patient's visit to the ED, even if the result of the ED evaluation is negative and the patient appears well and suitable for discharge from the hospital.

It cannot be stressed enough that at the time of arrival to the ED, patients with MCADD require immediate triage and medical attention. If required to wait their turn, the illness may progress to life-threatening stages in the interim, even with a brief wait. The patient should be evaluated rapidly for signs and

symptoms of hypoglycemia, including mental status changes. Patients with hypoglycemia on presentation should be treated on the basis of the severity of hypoglycemia. The most critical aspect of management of patients with MCADD is the provision of glucose, either orally or intravenously, as soon as possible, especially if there are any concerns about mental status changes. If the glucose concentrations are at or just above the normal range, the patient is not symptomatic, and the patient can tolerate sustained oral intake, then the provision of simple carbohydrates by mouth may be enough to maintain a normal blood glucose concentration. If the determination is made to discharge such a patient from the hospital rather than admit, the health care provider needs to educate the patient and/or caregivers of the signs or symptoms that should prompt a return visit to the ED. These signs include decreased mental status, decreased oral intake due to refusal or emesis, dehydration, prolonged illness, signs or symptoms of hypoglycemia, and increased caregiver concern. Follow-up arrangements with the patient's primary metabolic specialist should be made before discharge from the ED.

Many providers recommend placement of an intravenous (IV) catheter for administration of dextrose fluids at presentation to the ED, even before the examination or laboratory evaluation. If a patient with MCADD presents with a blood glucose concentration below normal range or has symptoms of hypoglycemia, then it is critical than an IV catheter be placed immediately for the administration of dextrose-containing fluids, regardless of the patient's tolerance for oral intake. A symptomatic patient with MCADD should have acute hypoglycemia treated with a bolus of 0.25 mg/kg dextrose, up to 25 g. Once euglycemia is restored, then continuous infusion of fluids containing glucose should be established. Dextrose 10% in water without any added salts is too hypotonic for continuous infusion. For children who are younger than 12 months, dextrose 10% in one-quarter–normal saline is recommended. For children who are older, dextrose 10% in half-normal saline may be administered. The rate of delivery should be at least 1.5 times that of maintenance fluids, as calculated by weight or body surface area, to accomplish a glucose infusion rate (GIR) of 10 mg/kg per minute, which is achieved by delivering dextrose 10% at this rate.[11] If the patient is experiencing rhabdomyolysis, then IV fluids with at least a 10% dextrose solution should be administered at 2 times the maintenance rate. Dextrose 5% fluids should not be used routinely in patients with MCADD, but if IV fluids with at least a 10% dextrose solution are not immediately available, dextrose 5% in half-normal saline, infused at 2 times the maintenance rate, can be used to bridge for a brief period of time until the appropriate IV fluids with a higher dextrose solution are available from the pharmacy. Once available, the patient should immediately be changed to the higher dextrose concentration to provide the desired GIR.

A thorough physical examination and clinical evaluation should be conducted to identify the source of the precipitating illness. Uncomplicated infections typical of childhood, such as otitis media, pharyngitis, or gastroenteritis, may trigger a metabolic exacerbation. If an etiology is identified, it should be appropriately treated to decrease the intensity or duration of the underlying illness. In addition to an immediate bedside glucose check, patients with MCADD may need additional laboratory evaluation in the ED. Severity of MCADD exacerbation can be assessed with a blood glucose and blood gas analysis. Additional laboratory assessments that may elucidate the triggering illness include a complete blood cell count with differential, serum chemistries, liver enzyme tests, blood cultures, and a urinalysis. Alcohol consumption may be a factor in adolescents because alcohol intoxication, particularly binge drinking, has been reported to trigger metabolic exacerbations in patients with MCADD.[12]

While the patient is maintained on IV fluids with at least a 10% dextrose solution and a GIR of at least 10 mg/kg per minute,[11] bedside glucose checks are unnecessary because this level of dextrose infusion is sufficient to prevent hypoglycemia in the absence of additional risk factors or interrupted administration. Patients who are prescribed uncooked cornstarch therapy at bedtime on a routine basis do not need cornstarch administration continued while receiving fluids with a GIR of at least 10 mg/kg per minute. A continuous infusion at this GIR will prevent overnight hypoglycemia. New treatment with uncooked cornstarch should be initiated by a metabolic health care provider and dietitian.

If a patient with MCADD also has signs and symptoms of dehydration at presentation, the delivery of dextrose-containing fluids should not be delayed to administer a normal saline bolus. If the IV catheter is of sufficient caliber, the fluid bolus can either be administered concurrently in the same IV line as the dextrose-containing fluids or through a separate IV line. If IV access cannot be initiated promptly and the child has appropriate mental status for enteral intake, then oral intake can be encouraged with carbohydrate-containing beverages, such as sports drinks, fruit juice, or nondiet sodas for older children and formula or human milk for infants. Antiemetics should be considered for those with persistent emesis to allow for increased enteral intake. It should be noted that children with MCADD should never be given formulas

enriched with medium-chain triglyceride oil, such as those often used in patients with abnormal bile secretion, pancreatic failure, or prematurity, because of their inability to process these fatty acids. If the child refuses oral intake or has recurrent emesis and IV access still cannot be established, then placement of a nasogastric or nasojejunal tube can be considered for continuous infusion of carbohydrate-rich fluids.

During the acute phase of an MCADD exacerbation, reliable parenteral access is indicated. If a patient with MCADD who has been receiving IV fluids with at least a 10% dextrose solution loses IV access, the IV should be replaced, unless the patient is ready for discharge. The approach of decreasing the IV infusion rate and monitoring for adequate intake should be avoided unless the child has already demonstrated substantial improvement. Likewise, avoid reducing the GIR by reducing the rate of fluid infusion in an attempt to encourage oral intake, especially in young children who do not understand the intent or the consequences if adequate oral intake does not follow. When a child has reached approximately three-quarters of their typical home intake without recurrent emesis, then the rate of the IV infusion can be decreased.

The use of L-carnitine therapy during acute and chronic management of MCADD remains controversial. The logic behind the use of L-carnitine supplementation is that excess acylcarnitines generated as a result of MCADD may bind free carnitine and be excreted by kidneys, leading to secondary carnitine deficiency. Given carnitine's role in the transfer of long-chain fatty acids across the inner mitochondrial membrane for subsequent β-oxidation, a deficiency in carnitine could lead to abnormalities in fatty acid oxidation.[13,14] Some authors recommend oral supplementation with 100 mg/kg per day of carnitine to correct the potential of secondary carnitine deficiency and to enhance the elimination of toxic metabolites.[15] Others recommend monitoring carnitine levels and only supplementing when they are low. Studies evaluating exercise intolerance and response to fasting challenges have been contradictory.[16–18] Importantly, carnitine supplementation is associated with significant long-term cost and mild side effects (nausea, diarrhea, abdominal pain, and a fishy odor).[17] If patients with MCADD present for care of an acute episode, the guidance provided in their sick letter or emergency letter should be followed (ie, if patients are on a long-term carnitine regimen, then they should continue on carnitine in the ED). If a letter is not available, the pediatrician should ask the parents if their child is on routine carnitine supplementation. If possible, the child's metabolic specialist should also be contacted for further instruction regarding L-carnitine therapy during the acute MCADD exacerbation.

Perioperative Management of a Patient With MCADD

Patients with MCADD are at risk for hypoglycemia if oral intake is withheld for a prolonged period before or after surgery. For elective surgical procedures, patients should be able to tolerate oral intake of clear glucose-containing fluids up to 4 hours before surgery. In a patient with MCADD, IV administration of fluids with at least a 10% dextrose solution should be started when oral intake is discontinued. Similar to an episode of acute metabolic exacerbation, IV fluids with at least a 10% dextrose solution should be infused at a rate at least 1.5 times that of maintenance to provide a GIR of 10 mg/kg per minute. Metabolic support with IV fluids with at least a 10% dextrose solution should continue through the surgery and during the recovery phase until the patient can consume an adequate oral intake. For otherwise routine procedures, such as a tonsillectomy and adenoidectomy, this may require an overnight admission if the child is unable or unwilling to eat and drink because of postoperative pain.

Trauma Management of a Patient With MCADD

A patient with MCADD with injury requires careful management to prevent acute metabolic decompensation. Injury can increase metabolic demands while also resulting in decreased oral intake because of altered mental status or pain. IV fluids with at least a 10% dextrose solution should be started if there are any signs or symptoms of hypoglycemia. Additionally, if the patient cannot immediately resume a regular diet because of mental status, assessments, or procedures, then IV fluids with at least a 10% dextrose solution will be required at 1.5 times the maintenance rate until typical oral intake is resumed.

CONCLUSIONS

Patients with MCADD who have not suffered any sequelae from their disease may present with acute illnesses or injuries similar to other patients. However, because of their interrupted metabolic pathway, they are at risk for acute metabolic decompensation during times of increased metabolic demand or decreased caloric intake. Supporting these patients with IV fluids with at least a 10% dextrose solution at 1.5 times the maintenance rate can avert the risk of hypoglycemia and prevent catastrophic outcomes.

LEAD AUTHORS

Tracy L. McGregor, MD
Susan A. Berry, MD, FAAP
Katrina M. Dipple, MD, PhD, FAAP
Rizwan Hamid, MD, PhD, FAAP

COUNCIL ON GENETICS EXECUTIVE COMMITTEE, 2018–2019

Emily Chen, MD, PhD, FAAP, Co-Chairperson
Tracy L. Trotter, MD, FAAP, Co-Chairperson

ABBREVIATIONS

ED: emergency department
GIR: glucose infusion rate
IV: intravenous
MCADD: medium-chain acyl-coenzyme A dehydrogenase deficiency

DOI: https://doi.org/10.1542/peds.2020-040303

Address correpsondence to Rizwan Hamid, MD. E-mail: rizwan.hamid@vumc.org

PEDIATRICS (ISSN Numbers: Print, 0031-4005; Online, 1098-4275).

FINANCIAL DISCLOSURE: The authors have indicated they have no financial relationships relevant to this article to disclose.

FUNDING: No external funding.

POTENTIAL CONFLICT OF INTEREST: The authors have indicated they have no potential conflicts of interest to disclose.

REFERENCES

1. Matsubara Y, Kraus JP, Yang-Feng TL, Francke U, Rosenberg LE, Tanaka K. Molecular cloning of cDNAs encoding rat and human medium-chain acyl-CoA dehydrogenase and assignment of the gene to human chromosome 1. *Proc Natl Acad Sci U S A*. 1986;83(17):6543–6547
2. Roe CR, Millington DS, Maltby DA, Kinnebrew P. Recognition of medium-chain acyl-CoA dehydrogenase deficiency in asymptomatic siblings of children dying of sudden infant death or Reye-like syndromes. *J Pediatr*. 1986;108(1):13–18
3. Matsubara Y, Narisawa K, Miyabayashi S, et al. Identification of a common mutation in patients with medium-chain acyl-CoA dehydrogenase deficiency. *Biochem Biophys Res Commun*. 1990;171(1):498–505
4. Feuchtbaum L, Carter J, Dowray S, Currier RJ, Lorey F. Birth prevalence of disorders detectable through newborn screening by race/ethnicity. *Genet Med*. 2012;14(11):937–945
5. Frazier DM, Millington DS, McCandless SE, et al. The tandem mass spectrometry newborn screening experience in North Carolina: 1997-2005. *J Inherit Metab Dis*. 2006;29(1):76–85
6. Lindner M, Hoffmann GF, Matern D. Newborn screening for disorders of fatty-acid oxidation: experience and recommendations from an expert meeting. *J Inherit Metab Dis*. 2010;33(5):521–526
7. Duran M, Hofkamp M, Rhead WJ, Saudubray JM, Wadman SK. Sudden child death and 'healthy' affected family members with medium-chain acyl-coenzyme A dehydrogenase deficiency. *Pediatrics*. 1986;78(6):1052–1057
8. Raymond K, Bale AE, Barnes CA, Rinaldo P. Medium-chain acyl-CoA dehydrogenase deficiency: sudden and unexpected death of a 45 year old woman. *Genet Med*. 1999;1(6):293–294
9. Bentler K, Zhai S, Elsbecker SA, et al.; Inborn Errors of Metabolism Collaborative. 221 newborn-screened neonates with medium-chain acyl-coenzyme A dehydrogenase deficiency: findings from the Inborn Errors of Metabolism Collaborative. *Mol Genet Metab*. 2016;119(1–2):75–82
10. Iafolla AK, Thompson RJ Jr., Roe CR. Medium-chain acyl-coenzyme A dehydrogenase deficiency: clinical course in 120 affected children. *J Pediatr*. 1994;124(3):409–415
11. Saudubray JM, Martin D, de Lonlay P, et al. Recognition and management of fatty acid oxidation defects: a series of 107 patients. *J Inherit Metab Dis*. 1999;22(4):488–502
12. Lang TF. Adult presentations of medium-chain acyl-CoA dehydrogenase deficiency (MCADD). *J Inherit Metab Dis*. 2009;32(6):675–683
13. Longo N, Frigeni M, Pasquali M. Carnitine transport and fatty acid oxidation. *Biochim Biophys Acta*. 2016;1863(10):2422–2435
14. Knottnerus SJG, Bleeker JC, Wüst RCI, et al. Disorders of mitochondrial long-chain fatty acid oxidation and the carnitine shuttle. *Rev Endocr Metab Disord*. 2018;19(1):93–106
15. Roe CR, Ding J. Mitochondrial Fatty Acid Oxidation Disorders. In: Scriver CR, Beaudet AL, Sly WS, Valle D, eds., et al. *The Metabolic and Molecular Bases of Inherited Disease*, 8th ed. Columbus, OH: McGraw-Hill; 2001:2297–2326

16. Lee PJ, Harrison EL, Jones MG, Jones S, Leonard JV, Chalmers RA. L-carnitine and exercise tolerance in medium-chain acyl-coenzyme A dehydrogenase (MCAD) deficiency: a pilot study. *J Inherit Metab Dis*. 2005;28(2): 141–152

17. Madsen KL, Preisler N, Orngreen MC, et al. Patients with medium-chain acyl-coenzyme a dehydrogenase deficiency have impaired oxidation of fat during exercise but no effect of L-carnitine supplementation. *J Clin Endocrinol Metab*. 2013;98(4):1667–1675

18. Treem WR, Stanley CA, Goodman SI. Medium-chain acyl-CoA dehydrogenase deficiency: metabolic effects and therapeutic efficacy of long-term L-carnitine supplementation. *J Inherit Metab Dis*. 1989;12(2): 112–119

Preventing Childhood Toxic Stress: Partnering With Families and Communities to Promote Relational Health

- *Policy Statement*

POLICY STATEMENT Organizational Principles to Guide and Define the Child Health Care System and/or Improve the Health of all Children

American Academy of Pediatrics
DEDICATED TO THE HEALTH OF ALL CHILDREN™

Preventing Childhood Toxic Stress: Partnering With Families and Communities to Promote Relational Health

Andrew Garner, MD, PhD, FAAP,[a,b] Michael Yogman, MD, FAAP[c,d]
COMMITTEE ON PSYCHOSOCIAL ASPECTS OF CHILD AND FAMILY HEALTH, SECTION ON DEVELOPMENTAL AND BEHAVIORAL PEDIATRICS, COUNCIL ON EARLY CHILDHOOD

By focusing on the safe, stable, and nurturing relationships (SSNRs) that buffer adversity and build resilience, pediatric care is on the cusp of a paradigm shift that could reprioritize clinical activities, rewrite research agendas, and realign our collective advocacy. Driving this transformation are advances in developmental sciences as they inform a deeper understanding of how early life experiences, both nurturing and adverse, are biologically embedded and influence outcomes in health, education, and economic stability across the life span. This revised policy statement on childhood toxic stress acknowledges a spectrum of potential adversities and reaffirms the benefits of an ecobiodevelopmental model for understanding the childhood origins of adult-manifested disease and wellness. It also endorses a paradigm shift toward relational health because SSNRs not only buffer childhood adversity when it occurs but also promote the capacities needed to be resilient in the future. To translate this relational health framework into clinical practice, generative research, and public policy, the entire pediatric community needs to adopt a public health approach that builds relational health by partnering with families and communities. This public health approach to relational health needs to be integrated both vertically (by including primary, secondary, and tertiary preventions) and horizontally (by including public service sectors beyond health care). The American Academy of Pediatrics asserts that SSNRs are biological necessities for all children because they mitigate childhood toxic stress responses and proactively build resilience by fostering the adaptive skills needed to cope with future adversity in a healthy manner.

abstract

[a]Partners in Pediatrics, Westlake, Ohio; [b]School of Medicine, Case Western Reserve University, Cleveland, Ohio; [c]Cambridge Hospital, Cambridge, Massachusetts; and [d]Harvard Medical School, Harvard University, Boston, Massachusetts

Dr Garner collaborated in conceptualizing and drafting this document, took the lead in reconciling the numerous edits, comments, and suggestions made by many expert reviewers, and made significant contributions to the manuscript; Dr Yogman collaborated in conceptualizing and drafting this document and made significant contributions to the manuscript; and all authors approved the final manuscript as submitted.

To cite: Garner A, Yogman M, COMMITTEE ON PSYCHOSOCIAL ASPECTS OF CHILD AND FAMILY HEALTH, SECTION ON DEVELOPMENTAL AND BEHAVIORAL PEDIATRICS, COUNCIL ON EARLY CHILDHOOD. Preventing Childhood Toxic Stress: Partnering With Families and Communities to Promote Relational Health. *Pediatrics*. 2021;148(2):e2021052582

In order to develop normally, a child requires progressively more complex joint activity with one or more adults who have an irrational emotional relationship with the child. Someone's got to be crazy about that kid. That's number one. First, last and always.

Urie Bronfenbrenner[1]

INTRODUCTION

The term "toxic stress" refers to a wide array of biological changes that occur at the molecular, cellular, and behavioral levels when there is prolonged or significant adversity in the absence of mitigating social-emotional buffers.[2] Whether those adversity-induced changes are considered adaptive and health-promoting or maladaptive and "toxic" depends on the context. For example, in an abusive context, biological changes, such as the methylation of the glucocorticoid receptor gene,[3–5] an increase in the size or activity of the amygdala,[6–8] and a hypersensitivity to potentially threatening cues[9] could be considered adaptive, at least initially, because those changes might promote survival in a threatening environment. But those same biological changes could prove to be maladaptive, toxic, and health harming over time.[10,11]

This toxic stress framework is powerful, because it taps into a rich and increasingly sophisticated literature describing how early childhood experiences are biologically embedded and influence developmental outcomes across the life course.[12–14] This was the focus of the original technical report on toxic stress from the American Academy of Pediatrics (AAP) in 2012.[2] Current threats to child well-being and long-term health, such as widening economic inequities, deeply embedded structural racism, the separation of immigrant children from their parents, and a socially isolating global pandemic, make the toxic stress framework as relevant as ever.

That said, the toxic stress framework is a problem-focused model because it is focused on what happens biologically in the absence of mitigating social and emotional buffers. Conversely, a solution-focused approach would focus on relational health[15] (see the Appendix for a glossary of terms, concepts, and abbreviations) by promoting the safe, stable, and nurturing relationships (SSNRs) that turn off the body's stress machinery in a timely manner.[1,16,17] Even more importantly, a strengths-based, relational health framework leverages those SSNRs to proactively promote the skills needed to respond to future adversity in a healthy, adaptive manner.[16,18,19] The power of relational health is that it not only buffers adversity when it occurs but also proactively promotes future resilience. The toxic stress framework may help to define many of our most intractable problems at a biological level, but a relational health framework helps to define the much-needed solutions at the individual, familial, and community levels (see Table 1).

This revised policy statement on childhood toxic stress builds on the 2012 policy statement[12] and technical report[2] by:

- Acknowledging that a spectrum of adversity exists, from discrete, threatening events (such as abuse, bullying, or disasters) to ongoing, chronic hardships (such as poverty, racism, social isolation, or neglect). These varied adversities share the potential to trigger toxic stress responses and inhibit the formation of SSNRs.
- Reaffirming an ecobiodevelopmental framework[2] because early childhood experiences, both adverse and nurturing, are biologically embedded and influence the development of both disease and wellness later in life.
- Asserting that adults with core life skills are essential, not only to form and maintain SSNRs with children but also to scaffold and develop the basic social and emotional skills that enable children to be resilient and flourish despite adversity. A multigenerational perspective is fundamental.
- Promoting a public health approach that not only prevents, mitigates, and treats toxic stress but, more importantly, proactively promotes, reduces barriers to, and repairs relational health (the capacity to develop and maintain SSNRs with others).
- Emphasizing that the vertical integration of this public health approach or the layering of primary, secondary, and tertiary preventions and/or interventions is necessary because the heterogeneity of responses to adversity seen at the population level will need to be addressed through a menu of programs that are layered and matched to specific levels of individual need (universal preventions, plus targeted interventions for those at risk, plus indicated therapies for those with symptoms or diagnoses).
- Proposing that the public health approach also be integrated horizontally across multiple public service sectors (eg, health care, behavioral health, education, social services, justice, and faith communities) because SSNRs are promoted in safe, stable, and nurturing families that have access to safe, stable, and nurturing communities with a wide range of resources and services.

This policy statement asserts that to move forward (to proactively build

TABLE 1 A Comparison of the Toxic Stress and Relational Health Frameworks

	Toxic Stress	Relational Health
Definition	Toxic stress refers to the biological processes that occur after the extreme or prolonged activation of the body's stress response systems in the absence of SSNRs.	Relational health refers to the capacity to develop and sustain SSNRs, which in turn prevent the extreme or prolonged activation of the body's stress response systems.
Contribution	Toxic stress explains how a wide range of ACEs become biologically embedded and alter life-course trajectories in a negative manner.	Relational health explains how SSNRs buffer adversity and promote the skills needed to be resilient in the future.
Approach to clinical care	Toxic stress is a deficits-based approach because it is focused on the problem: those biological processes triggered by significant adversity in the absence of SSNRs.	Relational health is a strengths-based approach because it is focused on solutions: those individual, family, and community capacities that promote SSNRs, buffer adversity, and build resilience.
Primary preventions in the framework	Primary preventions in the toxic stress framework are focused on how to prevent the wide array of adversities that might precipitate a toxic stress response.	Primary preventions in the relational health framework are focused on how to universally promote the development and maintenance of SSNRs.
Secondary preventions in the framework	Secondary preventions in the toxic stress framework are focused on identifying individuals at high risk for poor outcomes resulting from toxic stress responses by using population-based risk factors (eg, ACE scores) or emerging biomarkers (eg, methylation patterns).	Secondary preventions in the relational health framework are focused on identifying the potential individual, family, and community barriers to SSNRs by developing respectful and caring therapeutic relationships with patients, families, and communities.
Tertiary preventions in the framework	Tertiary preventions in the toxic stress framework are focused on the evidence-based practices that treat toxic stress-related morbidities such as anxiety, depression, oppositional defiant disorder, posttraumatic stress disorder, and substance abuse disorder.	Tertiary preventions in the relational health framework are focused on the evidence-based practices such as ABC, CPP, or PCIT that repair strained relationships and assist them in becoming more safe, stable, and nurturing.
Summary	Toxic stress defines the problem. Toxic stress explains how many of our society's most intractable problems (disparities in health, education, and economic stability) are rooted in our shared biology but divergent experiences and opportunities.	Relational health defines the solution. Relational health explains how the individual, family, and community capacities that support the development and maintenance of SSNRs also buffer adversity and build resilience across the life course.

not only the healthy, happy children of today but also the well-regulated parents and productive citizens of the future) family-centered pediatric medical homes (FCPMHs) (see the Appendix for a detailed description) need to universally promote relational health. SSNRs not only buffer adversity when it occurs but also proactively build the foundational social and emotional skills that lead to resilience in the face of future adversity. Although pediatric and early childhood professionals have long recognized the parent-child relationship as foundational,[20–22] the elemental nature of relational health is not reflected in much of our current training, research, practice, and advocacy. To prevent childhood toxic stress responses and support optimal development across the life span, the promotion of relational health needs to become an integral component of pediatric care and a primary objective for pediatric research and advocacy.

A SPECTRUM OF ADVERSITY

The previous policy statement[12] and technical report[2] on childhood toxic stress noted the 10 adverse childhood experiences (ACEs) studied in the landmark ACEs Study that began in the 1990s: physical, emotional, or sexual abuse; physical or emotional neglect; problematic parental substance misuse; parental mental illness; parental separation or divorce; intimate partner violence; and an incarcerated house member.[23] These adversities are associated with a wide array of negative outcomes in a dose-dependent manner, such that the higher the ACE score (1 point for each category experienced before the age of 18 years), the higher the risk for unhealthy behaviors such as tobacco, alcohol, and other substance use; risky sexual behaviors; and obesity.[23,24] Dose-dependent relationships have also

been found between ACE scores and several of the leading causes of adult morbidity and mortality,[23,24] including cardiovascular disease,[25] lung disease,[26] liver disease,[27] mental illness,[28] and cancer.[29]

These well-established associations between ACEs and poor health outcomes decades later highlight the importance of understanding the biological mechanisms that allow adversity in childhood to "get under the skin" and to negatively impact life-course trajectories.[30–36] As discussed in the 2012 AAP technical report,[2] toxic stress responses, in which the physiologic stress response to adversity is large, chronic, and unmitigated by social-emotional buffers, are one such mechanism. Toxic stress responses are known to alter multiple systems that interact in a reciprocal and dynamic manner: genomic function, brain structure and connectivity, metabolism, neuroendocrine-immune function, the inflammatory cascade, and the microbiome.[13,14] Toxic stress-induced alterations also influence the adoption of maladaptive coping behaviors decades later.[37–40]

Several researchers have noted that many other experiences in childhood are also associated with poor outcomes later in life, and these include being raised in poverty,[41] left homeless,[42–44] exposed to neighborhood violence,[45–47] subjected to racism,[48–50] bullied,[51,52] or punished harshly.[53] This finding suggests that there is a wide spectrum of adversity that runs from discrete, threatening events (such as being abused, bullied, or exposed to disasters or other forms of violence) to ongoing, chronic life conditions (such as exposure to parental mental illness, racism, poverty, neglect, family separation or a placement in foster care, and environmental toxins or air pollution; unrelenting anxiety about a global pandemic, climate change, or deportation; or social rejection because of one's sexual orientation or gender identity). Although children experiencing discrete catastrophic events such as abuse are at a high risk for toxic stress responses, epidemiology suggests that the largest number of children at risk for toxic stress responses are those affected by ongoing chronic life conditions such as neglect.[54,55] This finding suggests that although interventions targeting children with acute threats are needed urgently (eg, efforts preventing physical abuse, child trafficking, and gun violence), those interventions alone will almost certainly miss large segments of the population (eg, those experiencing the threats of parental mental illness, racism, poverty, social isolation) who may also develop toxic stress responses and their associated poor outcomes. To minimize the burden of toxic stress responses at the population level, the entire pediatric community needs to identify and address not only the acute threats to child wellness such as abuse and physical violence but also the ongoing, chronic life conditions such as racism, poverty, and isolation that are rooted in deep-seated social constructs, societal inequities (including those within the health care system), and public policies that inhibit social cohesion, equity, and relational health. Acute threats to childhood wellness such as abuse need to be taken seriously; similar attention should be given to the social inequities and ongoing, chronic life conditions that similarly imperil a child's biological wellness and life-course trajectory.

This wide spectrum of adversity underscores the fact that ACE scores and other epidemiologically derived risk factors at the population level are not valid or reliable predictors of outcomes at the individual level.[56] Toxic stress, by contrast, refers to an individual's physiologic response to these adversities, and biomarkers of this physiologic response have the potential to be more sensitive and specific measures of experienced adversity at the individual level.[37] Validated biomarkers also offer transformational potential as measures of responsiveness to specific interventions.[37,57] With these applications in mind, the pediatric research community is hoping to develop clinic-friendly, noninvasive biomarkers for different forms and degrees of adversity.

Finally, the diverse conditions included in a broader spectrum of adversity make the formation of SSNRs more difficult. Consequently, the challenge is not only to prevent a broad spectrum of adversities from occurring but also to prevent them from becoming barriers to the SSNRs that allow individuals from across the spectrum of adversity to be resilient and flourish despite the adversity.[17,58,59]

An important consideration across many harmed and exploited communities (such as American Indian or Alaska Native populations) is the accumulation of toxic stress responses across generations, sometimes referred to as historical trauma.[60] Although higher levels of historical trauma are associated with poorer health outcomes, the science underlying these associations is only now being studied rigorously.[61] A detailed discussion of historical trauma and the special needs of these communities is beyond the scope of this policy statement, but the layered, integrated public health approaches presented here to prevent childhood toxic stress and promote relational health might inform efforts to address historical trauma as well.

THE ECOBIODEVELOPMENTAL MODEL OF DISEASE AND WELLNESS

Fortunately, adversity in childhood is only half the story, as positive experiences in childhood are associated with improved outcomes later in life. For example, positive relational experiences, such as engaged, responsive caregivers,[59,62–65] shared children's book reading,[66–68] access to quality early childhood education,[69–71] and opportunities for developmentally appropriate play with others[66,72–74] are associated with positive impacts on learning, behavior, and health. Early childhood experiences, both adverse and positive, appear to be biologically embedded and influence both disease and wellness across the life course.[30] The ecobiodevelopmental model of disease and wellness explains how the ongoing but cumulative and reciprocal dance between ecology and biology leads to changes at the molecular (eg, methylation patterns), cellular (eg, brain connectivity patterns), and behavioral levels (eg, tobacco, alcohol, or other substance use).[2,17] These changes are either adaptive or maladaptive depending on the context, and they are either benefits or risks to future health, academic success, and economic productivity.[75]

For example, significant adversity in the last trimester of pregnancy is associated with methylation of the child's glucocorticoid receptor gene.[76] In adults, the methylation of this gene is associated with the expression of fewer glucocorticoid receptors in the brain.[5] Because cortisol downregulates its own production via negative feedback loops in the brain that use glucocorticoid receptors, children with fewer glucocorticoid receptors would be expected to have higher cortisol levels and be more irritable and harder to console.[77] These changes could be considered adaptive and beneficial in the short-term because they might prepare the newborn infant for a stressful world in which the infant may need to be more vocal to have his or her needs met. But these same changes could be considered maladaptive over time because the higher cortisol levels could impair learning, and the infant's irritability could impair the formation of a strong parental bond with the infant. Conversely, early supports that allow new mothers more opportunities to bond with, breastfeed, and simply stroke their children are associated with decreases in the methylation of the glucocorticoid receptor gene, perhaps allowing infants to downregulate their stress responses more effectively.[78,79] This finding is one of the most significant predictions of the ecobiodevelopmental model: the biological mechanisms that underlie the embedding of significant childhood adversity may also underlie the embedding of positive relational experiences in childhood. The challenge, then, is not only to prevent adversity but also (for mothers, fathers, and other engaged adults) to actively promote positive relational experiences throughout infancy and childhood.

COMPONENTS OF A PUBLIC HEALTH APPROACH TO TOXIC STRESS

The ecobiodevelopmental model suggests that, to improve the likelihood of positive developmental outcomes across the life span, efforts should be made to improve the salient features of the child's environment. Changing all of the potentially salient features of a child's environment cannot be reduced to a single intervention or program, so there will be no singular panacea when it comes to addressing childhood toxic stress responses. Rather, an integrated public health approach (see Fig 1) is needed to support all children, including those with delays in development and special health care needs.[80–82] The foundation for any public health approach is universal primary prevention. In the case of toxic stress responses, universal primary prevention means trying to prevent the precipitants of toxic stress responses (eg, advocating to address the spectrum of adversities discussed above) as well as promote healthy, adaptive responses to adversity through the provision of social supports that nurture the development of foundational resilience skills (such as task persistence, curiosity, and self-regulation).[16,19,59,83]

For children at higher risk for toxic stress responses, targeted secondary interventions with tiered services (eg, HealthySteps[84,85]) may be needed. Children with known adversity but no overt symptoms,[18] children with parents who experienced significant adversity as a child,[86] and families struggling with the social determinants of health (SDoHs) (eg, poverty leading to food or housing insecurity,[87,88] language barriers, or acculturation leading to conflicts within immigrant families[89]) may benefit from an array of interventions that mitigate specific risk factors. For example, the AAP currently recommends screening parents for postpartum depression[90] and food insecurity.[87,88] Similarly, when clinical markers for an individual child's biological sensitivity to context[91–94] (see the Appendix for a glossary of terms, concepts, and abbreviations) are available, children of high (versus low) sensitivity may also benefit from different types of interventions.[95] In concordance with a layered public health approach, these various targeted interventions will

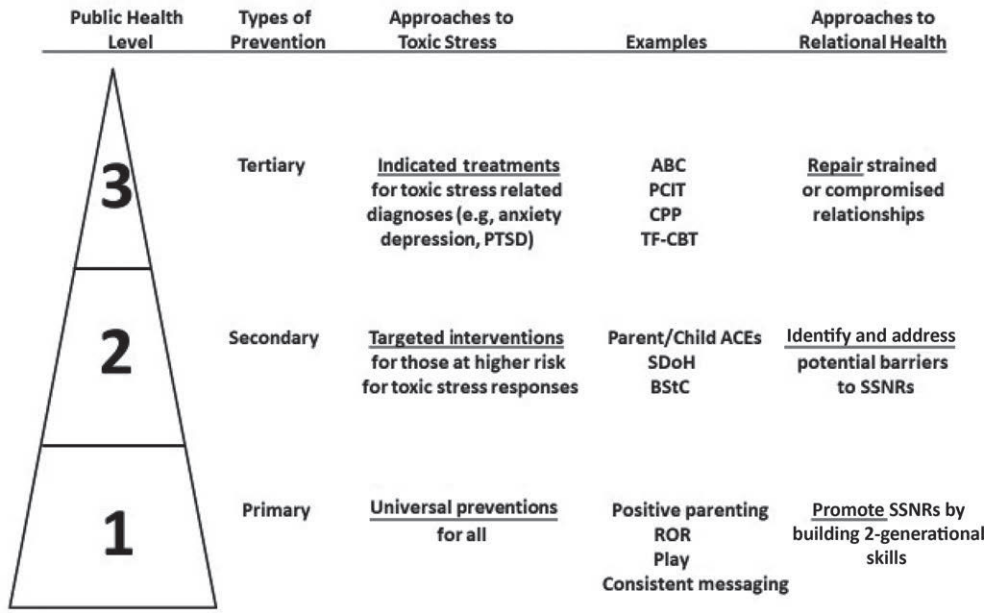


FIGURE 1 A public health approach to prevent childhood toxic stress is a public health approach to promote relational health. Many of the components of a public health approach to prevent, mitigate, and treat toxic stress responses (see examples) are also components of a public health approach to promote, identify barriers to, and repair SSNRs. The examples provided are illustrative and not intended to be comprehensive or exhaustive. See the Appendix for full descriptions of the abbreviations. BStC, biological sensitivity to context; PTSD, posttraumatic stress disorder. Adapted with permission from Garner AS, Saul RA. Thinking Developmentally: Nurturing Wellness in Childhood to Promote Lifelong Health. Itasca, IL: American Academy of Pediatrics; 2018

supplement but not replace the universal primary preventions.

For children who are symptomatic or meet criteria for toxic stress-related diagnoses (eg, anxiety, oppositional defiant disorder, or posttraumatic stress), indicated, evidence-based therapies are needed. For younger children, these therapies may include attachment and biobehavioral catch-up (ABC),[96–98] parent-child interaction therapy (PCIT),[99–102] and child-parent psychotherapy (CPP).[103–105] For older children, trauma-focused cognitive-behavioral therapy (TF-CBT) may be beneficial.[106,107] The effectiveness of these evidence-based therapies may be reduced if targeted interventions are not used to address emerging areas of risk or if universal primary preventions are not applied as well.[59,108] A layered public health approach mirrors the concept of proportionate universalism (see the Appendix for a glossary of terms, concepts, and abbreviations), in which the delivery of universal services is at a scale and intensity that is proportionate to the degree of need.[109–112] For example, if access to healthy foods is a universal objective, a proportionate response would recognize that some families may only need education about which foods are healthy, whereas some may need education about healthy foods and additional financial resources to purchase those healthy foods, and still others may require education about healthy foods, additional financial resources, and access and/or transportation to stores that sell healthy foods.

THE EMERGING SCIENCE OF RELATIONAL HEALTH

The concept of childhood toxic stress taps into a rich literature on the biology of adversity and explains the danger in overlooking significant adversity in childhood. To move forward (to proactively build healthy, resilient children), the pediatric community needs to embrace the concept of relational health.[15] Relational health refers to the ability to form and maintain SSNRs, as these are potent antidotes for childhood adversity and toxic stress responses.[57,113] Not only do SSNRs buffer adversity and turn potentially toxic stress responses into tolerable or positive responses, but they are also the primary vehicle for building the foundational resilience skills that allow children to cope with future adversity in an adaptive, healthy manner.[16,17] These findings highlight the need for multigenerational approaches that support parents and adults as they, in turn, provide the SSNRs that all children need to flourish.

Developmental science is only beginning to understand the way relational health buffers adversity and builds resilience, but emerging data suggest that responsive interactions between children and engaged, attuned adults are

paramount.[1,16,114,115] Not only are infants programmed to connect socially and emotionally with adult caregivers,[116] but the brains of parents of newborn infants appear to be reprogrammed to connect with their infants.[117] Imaging studies of new parents demonstrate changes in several major brain circuits, including a reward circuit, social information circuit, and emotional regulation circuit.[117,118] The reward circuit includes the striatum, ventral tegmental area, anterior cingulated cortex, and prefrontal cortex, where dopamine and rising levels of oxytocin interact to make social interactions more rewarding, thereby encouraging more parental engagement in infant care.[118,119] The social information circuit includes structures such as the anterior insula, inferior frontal gyrus, superior temporal gyrus, and supplemental motor area, which support internal representations of what others may be experiencing and more empathic responses to infant behaviors.[118,119] Finally, the emotional regulation circuit includes the amygdala, superior temporal sulcus, temporoparietal junction, and prefrontal cortex, which promote social cognition and a downregulation of the stress response.[118,119] The convergent conclusion from these preliminary imaging studies of the parental brain is clear: much like the infant brain, the parental brain is programmed to connect.

Recent research suggests that this dyadic need to connect promotes the development of biobehavioral synchrony between parents and infants.[119,120] Feldman[119] states, "Such coordination is observed across four systems: the matching of nonverbal behavior; the coupling of heart rhythms and autonomic function; the coordination of hormone release [eg, oxytocin following contact with both mothers and fathers]; and brain to brain synchrony [eg, coordinated brain oscillation in alpha and gamma rhythms]." Because the human brain is so immature at birth, the infant is dependent on this biobehavioral synchrony not only for survival but also for laying the foundation for future self-regulation and social-emotional skills. One expert has written that "this synchronous biobehavioral matrix builds the child's lifelong capacity for intimacy, socio-affective skills, adaptation to the social group, and the ability to use social relationships to manage stress."[117] Early relational experiences with engaged and attuned adults have a profound influence on early brain and child development.

LINKS BETWEEN RELATIONAL HEALTH AND RESILIENCE

The importance of engaged and attuned adults does not end in the newborn period. In fact, there is increasing evidence that strong social-emotional supports, such as high family resilience and connection and the provision of positive childhood relational experiences, are associated with children who are resilient and flourish despite their level of adversity.[59,121] This finding has renewed interest in defining the critical elements that children, families, and communities need to thrive despite adversity.[18,19,65,122–124] Resilience, for example, is now understood to be the manifestation of capacities, resources, or skills that allow some children, families, and communities to respond to adversity in a healthy, adaptive manner.[16,83,124] At the child level, foundational capabilities (such as social skills, emotional regulation, language, and executive functions like impulse inhibition, working memory, cognitive flexibility, abstract thought, planning, and problem solving) are the building blocks of resilience and need to be modeled, taught, learned, practiced, reinforced, and celebrated.[16] A recent literature review identified 5 modifiable resilience factors relevant to clinical pediatric care: (1) "addressing maternal mental health problems"; (2) "encouraging responsive, nurturing parenting"; (3) "building positive appraisal styles and executive function skills"; (4) "teaching children self-care skills and routines"; and (5) "using trauma-focused interventions and educating families about trauma."[83] The emphasis on building new skills underscores the AAP's concern that excessive screen time might limit opportunities to develop more adaptive and generalizable skills.[125]

Flourishing despite adversity is another construct that has been studied. Three indicators of flourishing are amenable to parental report and are rough markers of executive function: (1) "the child shows interest and curiosity in learning new things," (2) "the child works to finish tasks he or she starts," and (3) "the child stays calm and in control when faced with a challenge."[59] In analyses of data from the 2016–2017 National Survey of Children's Health, "the prevalence of flourishing children increased in a graded fashion with increasing levels of family resilience and connection."[59] In fact, a higher percentage of children with high adversity (ACE scores 4–9) but high family connection and resilience were flourishing (30.5%) than children with low adversity (ACE score of 0) but low family resilience and connection (26.8%).[59] Approaches to minimizing toxic stress that only look at measures of adversity (such as ACE scores or biomarkers) will miss out on opportunities to support the relational health that promotes

flourishing despite adversity. Measures of both resilience and "flourishing despite adversity" suggest that much more can be done to build the SSNRs and overall relational health that buffers adversity and builds both the skills and contexts necessary for children to thrive. The Healthy Outcomes From Positive Experiences framework promotes relational health through positive childhood experiences, such as "being in nurturing, supportive relationships; living, developing, playing, and learning in safe, stable, protective, and equitable environments; having opportunities for constructive social engagement and connectedness; and learning social and emotional competencies."[126,127]

A PUBLIC HEALTH APPROACH TO BUILD RELATIONAL HEALTH

Applying a public health approach to the promotion of relational health (see Fig 1) reveals that many of the universal primary preventions for toxic stress are also effective means of promoting the development of SSNRs (eg, positive parenting styles, developmentally appropriate play with others,[66,73,74,128] and shared reading[129,130]). Similarly, many of the risk factors for toxic stress responses that are the targets of secondary interventions are also potential barriers to the development of SSNRs that need to be identified and addressed (eg, child ACE scores, parent ACE scores, SDoHs, or even a strong biological sensitivity to context). Finally, many of the indicated treatments for children who are symptomatic as a result of toxic stress are programs that focus on repairing strained or compromised relationships (eg, ABC, PCIT, CPP, and TF-CBT). In short, a public health approach to prevent childhood toxic stress is a public health approach to promote relational health.

Vertical Integration to Match Levels of Need With Specific Interventions

Emerging data supporting a biological sensitivity to context (see the Appendix for a glossary of terms, concepts, and abbreviations) begin to explain heterogeneous responses to both adversity and interventions at the population level.[92,131–136] Consequently, there is an urgent need for a battery of biological, behavioral, and contextual markers that might better stratify both the risks and predicted responsiveness to interventions at the individual level.[37] FCPMHs (see the Appendix for a detailed description) are well placed to begin matching levels of need with specific types of interventions, a process known as vertical integration.[82]

Public health approaches are vertically integrated when they are founded on universal primary preventions (eg, promoting family resilience and connection and positive childhood experiences), with tiered, targeted interventions (eg, addressing SDoHs) and indicated treatments (eg, PCIT) being layered on this foundation, depending on the specific needs of the particular child, family, or community. This emphasis on universal primary preventions is congruent with the fact that more children are mentally and socially well and flourish as adults, regardless of their level of childhood adversity, if they also are afforded positive relational experiences and high family resilience and connection during childhood.[59,121] Relational health includes more than "nurturing" in its traditional, spoken sense (eg, verbal warmth or responsivity); it also includes the activities that support the relationship more broadly (eg, reading aloud and a prescription to play), and research has documented that nurturing words and actions are inextricably linked.[137] Although there are both practice-based (eg, Reach Out and Read [ROR],[129,138,139] the Video Interaction Project [VIP],[66,72] HealthySteps[84,85]) and community-based programs (eg, positive parenting programs,[140,141] home visiting programs,[142,143] quality early child care settings[69,71]) that promote these early positive relational experiences, they are not funded at levels that would make them universally accessible. More importantly, they are rarely integrated vertically with other programs that layer on additional efforts to address barriers to relational health (eg, SDoHs) or already strained or compromised relationships (eg, PCIT) when needed. A vertically integrated public health approach acknowledges that universal primary preventions are absolutely necessary yet insufficient to promote relational health.

For children deemed to be at high risk for toxic stress responses, potential barriers to relational health need to be identified and addressed through team-based care[144] and collaborative community partnerships (eg, food banks,[145,146] medical-legal partnerships[147]). These additional interventions are supplemental to and do not replace universal primary preventions. Similarly, symptomatic children need to be referred to evidence-based treatment programs (eg, ABC, PCIT, CPP, TF-CBT), but these are supplemental to and do not replace either targeted interventions for potential barriers to SSNRs or the aforementioned universal primary preventions. Efforts to repair strained or compromised relationships are likely to be more effective if other potential barriers to SSNRs are being addressed (eg, parental mental illness and basic needs) and additional efforts are being made to actively promote

SSNRs (eg, the provision of developmentally appropriate play).

Horizontal Integration Across Sectors at the Community Level

A public health approach to promoting relational health should also be integrated horizontally (or across sectors) at the local level.[81,82,148] SSNRs are easier to form when safe, stable, and nurturing families are able to live in safe, stable, and nurturing communities.[124,149,150] The FCPMH is ideally placed to educate families about what a safe, stable, and nurturing family environment looks like for a child, but doing so will require changes at the provider and practice levels (see Table 2). However, FCPMHs are also called to advocate for policies at the federal, state, and local levels that promote safe, stable, and nurturing communities. In doing so, FCPMHs become the anchor for "medical neighborhoods,"[149] in which community resources across multiple sectors (eg, health, education, justice, social services, faith communities, and businesses) collaborate not only to address barriers to SSNRs (such as home visiting programs,[142] HealthySteps,[150,151] medical-legal partnerships,[147] coordinated responses to disasters,[152,153] and efforts to promote access to healthy foods, safe housing, potable water, and clean air) but also to advocate for public policies (such as paid parental leave,[154,155] income support,[87,88] restorative justice,[156–158] and implementation of the Family First Prevention Services Act) that intentionally and actively foster SSNRs (Table 2).[149,159–161]

THE CENTRALITY OF RELATIONSHIPS IN PEDIATRIC CARE

A public health approach to relational health is built on the SSNRs that buffer adversity and build resilience. Such an approach will require pediatricians, other pediatric health care professionals, and FCPMHs in general to partner with families and communities in practical and innovative ways to universally promote SSNRs, address potential barriers to SSNRs in a targeted manner, and afford indicated treatments that repair relationships that have been strained or compromised (see Table 2). But underlying this approach are 2 fundamental assumptions. The first is that pediatric providers will have the financial supports needed to expand their capacity for developing respectful, continuous, trusted, and nurturing relationships with both the patients and caregivers of the patients who they serve. Without strong therapeutic alliances with patients, caregivers, and families, few of the recommended universal primary preventions will be implemented, few of the targeted interventions will be used, and few of the indicated treatments will be sought. To promote SSNRs at the practice level, both financial incentives (eg, payment reforms) and enhanced training needs to be provided.[162,163] Pediatric providers should be afforded the following: (1) sufficient time with patients and families, (2) the benefit of long-term continuity with patients and families, and (3) opportunities to learn about and practice the interpersonal and communication skills needed to form respectful, trusted, and collaborative therapeutic relationships.[162] For parents to trust, pediatric providers need to listen and understand parental concerns and beliefs before making recommendations. Communication could be further enhanced by cultural humility,[164,165] implicit bias training,[166–171] a more diverse health care team (eg, providing families and patients the opportunity to seeing themselves reflected in the sex, ethnicity, and cultural backgrounds of the team members), and access to professional interpreters. In the end, the ability of the FCPMH to leverage change within the family context is entirely dependent on the capacity of the pediatric providers to form strong therapeutic relationships with the patients, caregivers, and families.

The second assumption is that the FCPMH will have the capacity to form working relationships with a wide array of community partners. The FCPMH alone cannot leverage significant change within the community context. Changing community contexts will require healthy, trusting, and robust partnerships with a wide array of local community partners from multiple sectors (education, social services, and businesses), not only to facilitate family access to the requisite community interventions but also to coordinate effective advocacy campaigns to secure both those interventions and family-friendly public policies. Simply put, successfully implementing a public health approach that prevents childhood toxic stress and promotes SSNRs will require FCPMHs to put relational health at the center of everything they do.[172]

ACKNOWLEDGING THE ROLE AND TOLL OF SOCIAL ISOLATION

There is an emerging evidence base that social isolation is on the rise and detrimental to both individual[173] and community health.[174] Social scientists have documented the fragmentation of society at the community level[175] as well as its negative impact on how communities view their collective stewardship of their most treasured resource: their children.[176] Psychologists have decried a "crisis of connection" and point to a culture that values the self over relationships and individual

TABLE 2 Implementing a Public Health Approach to Relational Health Will Require Changes at the Provider, Practice, and Community Levels, as Well as Horizontal Integration Across Sectors

Types of Prevention	Approaches to Relational Health	Examples at the Provider Level	Examples at the Practice Level	Examples at the Community Level
Tertiary	Repair strained or compromised relationships	Build the therapeutic alliance; employ a common-factors approach; explain behavioral responses to stress; endorse referral resources.	Colocate counseling services (warm handoffs); facilitate, track, and follow-up on referrals offered.	Embrace restorative justice and social inclusion (over punitive measures and exclusion).
Secondary	Identify and address potential barriers to SSNRs	Build the therapeutic alliance; surveil for possible barriers to SSNRs; champion screening at practice level; endorse referral resources.	Universal screening for prevalent barriers seen in that practice; facilitate, track, and follow-up on referrals offered.	Identify and address sources of inequity, isolation, and social discord (poverty and racism).
Primary	Promote SSNRs by building 2-generational relational skills	Build the therapeutic alliance; promote positive parenting; encourage developmentally appropriate play.	Provide or support positive parenting classes; participate in ROR, VIP, and other programs that support the dyad.	Implement home visiting; support extended family medical leave.

See the Appendix for full descriptions of the abbreviations.

successes over the general welfare, leading to declining levels of empathy and trust.[177] Epidemiologists have demonstrated that an individual's degree of social isolation is a powerful predictor of mortality, much like traditional clinical risk factors (eg, obesity or hypertension) or ACE scores.[178] Both epidemiologists and economists have pointed to increasing levels of inequity as correlating with poorer levels of overall health for both the impoverished and the wealthy.[174] Finally, physiologists have long known that social deprivation in childhood alters the programming of the body's stress response.[179,180]

Taken together, these diverse lines of inquiry suggest that it may not actually be the wide spectrum of childhood adversity that drives poor outcomes but the degree to which that adversity drives shame, guilt, anger, alienation, disenfranchisement, and degree of social isolation.[181,182] If so, the proposed public health approach toward the promotion of SSNRs is needed, not only to buffer adversity and promote resilience but also to begin bridging political, religious, economic, geographic, identity-based, and ideological divides that increase social isolation, encourage tribalism, diminish empathy, and, ultimately, drive poor outcomes in the medical, educational, social service, and justice systems.

For many resource-poor families and older children, overall relational health is dependent not only on dyadic serve and return interactions with family members but also on trusted, SSNRs with others in the community through interactions at the medical clinic, school, recreation leagues, faith-based and civic organizations, community improvement efforts, and employment opportunities. Along

these lines, the Aspen Institute has created the Social Fabric Project to incentivize local projects that prioritize the building of relationships and community connections over a focus on self-absorption and hyperindividualism.[183] Similarly, more attention could be given to the built environment and need for public green spaces, such as parks, to promote social cohesion and a sense of community belonging.[184,185]

Finally, it should be noted that public health mandates to maintain "social distancing" during the coronavirus pandemic actually refer to physical distancing and are not intended to further isolate, alienate, or disenfranchise already vulnerable populations. If nothing else, pandemic-mandated stay-at-home orders should increase our collective awareness of the distress associated with being socially isolated or vulnerable. The coronavirus pandemic has highlighted the urgent need to provide all children with the SSNRs that buffer unexpected adversities and build the skills necessary to be resilient.

A RENEWED COMMITMENT TO SCIENCE-BASED POLICY FORMATION

In the decade since the first AAP policy statement and technical report on childhood toxic stress were published, even more evidence has accumulated that:

1. "What happens in childhood does not stay in childhood."[186,187] Adverse experiences in childhood are not destiny, but for many children, significant adversity bends life-course trajectories for the worse.
2. In the absence of SSNRs, many different forms of childhood adversity (from catastrophic episodes of abuse or violence to chronic conditions, such as exposure to racism, poverty, and/or neglect) can lead to toxic stress responses that result in changes at the molecular, cellular, and behavioral levels and negatively impact outcomes in health, education, and economic productivity.
3. Individual variation in biological sensitivity to context (see the Appendix for a glossary of terms, concepts, and abbreviations) contributes to heterogeneity in both responses to adversity and responses to interventions. This has important implications for how we nurture and fulfill the potential of all children, not just those who are relatively less sensitive to their contexts and appear to be relatively more resilient despite adversity.
4. In the presence of SSNRs, a limited degree of childhood adversity (eg, normative childhood frustrations and setbacks) can lead to the positive stress responses that build the rudiments of resilience: a set of social and emotional skills that allow children to adapt to future adversity in a healthy manner.
5. Relational health, in the form of at least one SSNR, is a universal, biological imperative for children to fulfill their potential; to be healthy and resilient; to be successful academically, economically, and socially; and, perhaps most importantly, to be the caregivers that value and build SSNRs with subsequent generations.

Society is currently trending toward division, marginalization, alienation, and social isolation.[177] In opposing this trend and calling for a public health approach that builds SSNRs, the AAP is working to translate the latest developmental science into practices and public policies (see Table 2) that build healthy, resilient children. With almost a century of service to children, families, and communities, the field of pediatrics has made critical contributions at the interface of science and public policy. Be it child labor laws, federal grants to states to promote maternal-child health, support for paid parental leave after childbirth, required immunizations to attend school, the use of car safety seats, the adoption of children by same-sex parents, the harms of corporal punishment, the safe storage of firearms, the care of immigrant children in federal custody, the negative effect of toxins and global warming on child health, or the importance of nutrition and income support for healthy families, pediatric professionals have been a powerful force for bringing a scientifically grounded, evidence-based perspective to public debates. The AAP remains committed to respond when empirical evidence and the latest developmental science shine new light on the issues and trends of the day. Simply put, public policies, social constructs, and societal norms that divide, marginalize, alienate, and isolate are clear threats to the well-being of all children. The commitment of the AAP to the well-being of all children requires that it not only address a wide spectrum of adversities but, also, that it speak against public policies, social constructs, and societal norms that perpetuate the ongoing, chronic precipitants of toxic stress responses such as poverty[87,88] and racism[166] and for public policies that promote relational health, inclusion, and equity.[111,188–191]

APPLICATION OF SCIENCE-BASED PRINCIPLES TO STRENGTHEN PEDIATRIC PRACTICE

Drawing on a framework produced by the Center on the Developing Child at Harvard University,[192] this policy statement highlights the following 3 science-informed principles to prevent toxic stress

responses and to build healthy, resilient children.

Support Nurturing Relationships

Of the 3 principles, this is the one that aligns most clearly with the core functions of the FCPMH and is, therefore, the primary focus of this policy statement. The use of trusted, supportive relationships within the FCPMH to promote the relational health of families is an emerging focal point for pediatric clinical research, and pediatric primary care is increasingly seen as a venue for fostering social-emotional health.[193,194] These universal primary prevention strategies form the base of the public health pyramid (Fig 1 and Table 2), but additional, layered interventions that recognize and address child-level (eg, delays in development and a biological sensitivity to context), family-level (eg, poverty and parent mental illness), and community-level (eg, racism and violence) barriers to SSNRs may also be required for some families, whereas others will need even more intensive, evidence-based treatments (eg, ABC, PCIT, CPP, TF-CBT) to repair relationships that are already strained or compromised. The buffering and skill-building roles of responsive relationships are biologically embedded, and they are essential promoters of healthy development.[59] Existing AAP reports on managing perinatal depression,[90] supporting grieving children,[195] fostering male caregiver engagement,[196] partnering with home visiting programs,[142] encouraging developmentally appropriate play,[74,197] discouraging screen time,[125] and promoting shared-book reading[67,68] include additional recommendations on ways primary care pediatricians might promote SSNRs.

Reduce External Sources of Stress on Families

This principle points to the potential benefits of addressing stressors from across the spectrum of adversity, including those that might have been considered well beyond the scope of traditional pediatric practice in the past. Poverty, food insecurity, housing insecurity, racism, community violence, discrimination, alienation, disenfranchisement, and social isolation are examples that impose significant hardships on families and become potential barriers to developing SSNRs. FCPMHs could work to reduce these barriers by partnering with their AAP chapter, local organizations (such as schools, businesses, and faith-based organizations), and other community assets (including parents, extended family, child care providers, community health workers, and patients) to form medical neighborhoods[149,159,161] that work collaboratively to address the SDoHs while also advocating for policies that support safe, stable, and nurturing families and communities. For example, expanding family leave policies[154] could reduce family stress and promote positive childhood experiences. Similarly, advocating for a Health in All Policies approach could advance health equity and minimize family and community distress by addressing the underlying economic inequities.[198–200] The commitment of the AAP to decreasing family stress is manifest in many of its official statements, including poverty,[87,88] racism,[166] maternal depression,[90] disasters,[152,153] father engagement,[196] home visiting,[142] and the importance of play.[74,197]

Strengthening Core Life Skills

The strengthening of core life skills (eg, executive function and self-regulation) is needed for families and communities to provide well-regulated, nurturing environments. Although intensive, capacity-building efforts for parents and other caregivers with limited executive function skills is beyond the scope of most pediatric settings, providing information and support around basic child-rearing practices and establishing daily routines is a cornerstone of traditional primary care. Caregivers with core life skills are essential for the development of executive function and self-regulation skills in their children. The guidelines on parent education and support in *Bright Futures: Guidelines for Health Supervision of Infants, Children, and Adolescents* (4th edition) is a starting point for all families,[201] but there is a need to provide more effective, individualized, evidence-based parenting supports (eg, ROR, HealthySteps, VIP) beyond simply providing information about child development. Integrated behavioral health services as part of the FCPMH team might be the next layer for parents who need additional assistance (eg, parental depression), and the need for more intensive skill building (eg, PCIT) for some parents becomes yet another focus for collaboration with key services within the community (eg, ABC, PCIT, CPP, and TF-CBT). Understanding, practicing, and reinforcing executive functions and self-regulation skills (eg, managing strong emotions, ensuring adequate sleep, and getting regular exercise) is essential because all caregivers need these skills to create the kinds of environments in which children thrive.[16,37,59] Whether an adult coaching or skill-building component is incorporated within a FCPMH or connected to it in a collaborative manner, the essential role that these programs play in promoting the healthy development of children is clear, especially for those who are the most disadvantaged.[1,16]

Realizing the full impact of these principles within primary care practice, however, will also require fundamental changes in medical education and payment models. To usher in these fundamental reforms, more pediatricians will need to assume leadership positions outside the realm of clinical care.[202,203] In addition, pediatric training programs will need to educate residents about the ecobiodevelopmental model, train them on how to develop strong therapeutic relationships with parents and caregivers, teach them how to model nurturing and affirming interactions with children of all ages, train them how to encourage caregivers to have positive relational experiences with children of all ages, prepare them to work as part of interdisciplinary teams[144,150] (eg, integrated with behavioral health and social service professionals), educate them on how to develop collaborative partnerships with community referral resources, and encourage them to become vocal advocates for public policies that promote safe, stable, and nurturing families and communities.

Foremost on the advocacy agenda will be the need for serious payment reforms that consider the complexity of care attributable to adverse family and community contexts and include financial supports that incentivize families to engage with an FCPMH.[204] Payment reforms need to be sufficient to allow FCPMHs to spend more time with families, function as interdisciplinary teams, integrate into their community's initiatives and services to support children and families (horizontal integration), and anchor medical neighborhoods that not only foster wellness in childhood but promote positive outcomes across the life span.

SUMMARY AND RECOMMENDATIONS

Preventing childhood toxic stress responses, promoting resilience, and optimizing development will require that all children be afforded the SSNRs that buffer a wide range of adversities and build the foundational skills needed to cope with future adversity in an adaptive, health-promoting manner. The 3 principles described above, each of which is grounded in the research literature, provide a science-based framework for developing innovative strategies to promote SSNRs at the dyadic level, family level, and community level. Translating these principles into pediatric practice will require FCPMHs to:

1. Understand the toxic stress framework, which explains how many of our society's most intractable problems, such as disparities in health, education, and economic stability, are rooted in our shared biology but divergent experiences and opportunities (see Table 1).
2. Understand the relational health framework, which explains how the individual, family, and community capacities that support the development and maintenance of SSNRs also buffer adversity and build resilience across the life course (see Table 1).
3. Foster strong, trusted, respectful, and supportive relationships with patients and their families to encourage the acceptance of individualized prevention, intervention, and treatment strategies. Doing so will require all health professionals to address their implicit biases, develop cultural humility, and provide culturally competent recommendations.
4. Foster strong, trusted, respectful, and effective collaborations with the community partners who are well-positioned to provide the individualized prevention, intervention, and treatment strategies.
5. Acknowledge that a wide range of adversities, from discrete, threatening events to ongoing, chronic life conditions, share the potential to trigger toxic stress responses and inhibit the formation of SSNRs.
6. Embrace an ecobiodevelopmental model for understanding how both adverse and positive relational experiences in childhood become biologically embedded and impact both negative and positive outcomes across the life course.
7. Move beyond singular, panacea programs toward a layering of interventions that are integrated, both vertically and horizontally, into the local public health efforts to promote safe, stable, and nurturing communities, families, and relationships.
8. Employ a vertically integrated public health approach to promote relational health that is founded on universal primary preventions (such as positive parenting programs, ROR, and developmentally appropriate play) but also offers more precise screening for relational health barriers (such as maternal depression, food insecurity, or exposure to racism) as well as indicated treatments to repair strained or compromised relationships (such as ABC, CPP, PCIT, and TF-CBT).
9. Become hubs for medical neighborhoods, horizontally integrating a wide array of local efforts and early childhood initiatives that not only support families with resources and programs but also advocate for

the public policies that promote safe, stable, and nurturing families and communities.

10. Advocate that health systems, payers, and policy makers at all levels of government align incentives and provide funding to promote the universal primary prevention work discussed in this policy statement. FCPMHs are well-suited and even inclined to support the formation and maintenance of SSNRs as outlined in this policy statement, but they are not currently funded to do so.[205]

Finally, to develop the physician leadership for the FCPMHs of the future, pediatric training programs will need to:

1. Educate residents about the ecobiodevelopmental model and the implications for not only health care but education, juvenile justice, and public policy.
2. Provide longitudinal experiences that train residents on how to develop strong, trusted, respectful, and supportive relationships with parents and caregivers. Doing so will require all trainees to address their implicit biases, develop cultural humility, and provide culturally competent recommendations.
3. Teach residents how to identify and develop collaborative relationships with the local referral resources and early childhood initiatives in their communities.
4. Prepare residents to work as part of the interdisciplinary teams[144] that transform FCPMHs into hubs for medical neighborhoods.[161]
5. Educate residents about the many different facets of a fractured early childhood system of care (eg, Medicaid, Individuals with Disabilities Education Act Parts C and B, Child Care and Development Block Grants, Head Start, etc), as there is little collaboration or communication between the systems, funders, and programs that address child health, out-of-home child care, education, special education, protective services, or public health. Trainees need to understand all of these many facets so they are prepared to be effective advocates for their patients and families.
6. Encourage them to become leaders in interdisciplinary early childhood systems work and vocal advocates for public policies that promote positive relational experiences in safe, stable, and nurturing families and communities.

APPENDIX

Glossary of Terms, Concepts, and Abbreviations

ABC

Acronym for Attachment and Biobehavioral Catch-up; ABC is an evidence-based program of interventions to assist foster parents in nurturing children who have experienced disruptions in care.

ACEs

Acronym for adverse childhood experiences. In the original ACE Study, 10 categories of adversity were examined: emotional, physical, and sexual abuse; 5 measures of household dysfunction, including the mother being treated violently (intimate partner violence), household substance abuse, household mental illness, parental separation or divorce, and incarcerated household member; and emotional or physical neglect. Other investigators have applied the term ACEs to additional adversities known to affect child health, such as poverty, neighborhood violence, and exposure to racism. Although this term is frequently used to refer to the child's experiences (child ACEs), it has also been applied to the adversities that parents experienced during their own childhoods (parental ACEs).

ACE Score

The ACE score is the sum of the 10 original categories of ACEs experienced before the 18th birthday. To determine an individual's ACE score, see http://acestoohigh.com/got-your-ace-score.

Biobehavioral Synchrony

Biobehavioral synchrony refers to the matching of nonverbal behaviors (eg, eye contact), coupling autonomic functions (eg, heart rate), coordination of hormone release (eg, oxytocin), and alignment of brainwaves between a parent and an infant.

Biological Sensitivity to Context

Biological sensitivity to context is a theory with emerging evidence "that children differ in their susceptibility to environmental influence in a 'for better and for worse' manner, depending on their psychobiologic reactivity to stress." As a consequence, "the very characteristics that are often thought of as children's frailties (eg, high stress reactivity) can also be their strengths, given the right context."*,[91,131,134,206]

Common-Factors Approach

The common factors are communication skills that help to build a therapeutic alliance (the bond felt between the clinician and

**The quoted material in this entry is from Ellis BJ. Biological Sensitivity to Context/Adaptive Calibration Model. University of Utah, Department of Psychology, College of Social & Behavioral Science. Available at: https://psych.utah.edu/research/labs/biological-sensitivity.php.*

patient and/or family, a powerful factor in facilitating emotional and psychological healing), which, in turn, increases the patient and/or family's optimism, feelings of well-being, and willingness to work toward improved health. Other common-factors techniques target feelings of anger, ambivalence, and hopelessness, family conflicts, and barriers to behavior change and help seeking. Still other techniques keep the discussion focused, practical, and organized. These techniques come from family therapy, cognitive therapy, motivational interviewing, family engagement, family-focused pediatrics, and solution-focused therapy. They have been proven useful and effective in addressing mental health symptoms in pediatrics across the age spectrum (as per the AAP policy statement on mental health competencies in pediatric care).

CPP

Acronym for child-parent psychotherapy; CPP is an evidence-based, psychoanalytic approach for treating dysfunctional parent-child relationships based on the theory that the parent has unresolved conflicts with previous relationships.

Ecobiodevelopmental

The ecobiodevelopmental framework asserts that the ecology becomes biologically embedded, and there is an ongoing but cumulative dance between the ecology and the biology that drives development over the life span.

Executive Functions

Executive functions are the cognitive skills needed to control behavior and attain goals. Executive functions are core life skills, and they include capacities like impulse inhibition, working memory, cognitive flexibility, abstract thought, planning, and problem solving.

FCPMH

Acronym for the family-centered pediatric medical home; in an FCPMH, the pediatrician leads an interdisciplinary team of professionals providing care that is:

- family-centered: the family is recognized and acknowledged as the primary caregiver and support for the child, ensuring that all medical decisions are made in true partnership with the family;
- accessible: care is easy for the child and family to obtain, including geographic access and insurance accommodation;
- continuous: the same primary care clinician cares for the child from infancy through young adulthood, providing assistance and support to transition to adult care;
- comprehensive: preventive, primary, and specialty care are provided to the child and family;
- coordinated: a care plan is created in partnership with the family and communicated with all health care clinicians and necessary community agencies and organizations;
- compassionate: genuine concern for the well-being of a child and family are emphasized and addressed; and
- culturally effective: the family and child's culture, language, beliefs, and traditions are recognized, valued, and respected.

An FCPMH is not a building or place; it extends beyond the walls of a clinical practice. A medical home builds partnerships with clinical specialists, families, and community resources. The medical home recognizes the family as a constant in a child's life and emphasizes partnership between health care professionals and families (as per the National Resource Center for the Patient/Family-Centered Medical Home at the AAP).

If properly funded, FCPHMs are well placed to implement the following functions:

- screening for behavioral and developmental risk factors and diagnoses, including mental health conditions, developmental delays, SDoHs, and family-level risk and resilience factors;
- care coordination, linking families to community-based supports to address SDoHs, parenting concerns, developmental delays, and behavioral and mental health concerns;
- integrated behavioral health and family support services through colocated, interdisciplinary teams that include case management, behavioral health services, and positive parenting programs;
- preventive and dyadic mental health services that do not requiring a psychiatric diagnosis code for payment, thereby enabling the deployment of primary and secondary prevention strategies before the emergence of behavioral or medical disorders;
- enhanced payment for prolonged medical visits, allowing for more patient-centered communication, interdisciplinary care, and development of therapeutic alliances; and
- ancillary support services (interpretation, telemedicine, transportation, etc) enabling youth with special health care needs to access the many layers of support that they frequently require.

HealthySteps

HealthySteps is an evidence-based, interdisciplinary pediatric primary care program that promotes positive parenting and healthy development for infants and toddlers, with an emphasis on families living in low-income communities. HealthySteps uses a tiered approach to match services with the level of need, and the core components include: (1) child development social-emotional, and behavioral screening, (2) screening for family needs, (3) child development support line (eg, phone,

text, e-mail, and online portal), (4) child development and behavioral consultants, (5) care coordination and systems navigation, (6) positive parenting guidance and information, (7) early learning resources, and (8) ongoing, preventive team-based well-child visits.

Horizontal Integration

A public health approach that cuts across traditional silos and funding streams; a horizontally integrated public health approach also includes the educational, civic, social service, and juvenile justice systems.

Medical Neighborhood

Extends the concept of the FCPMH into the local community; in a medical neighborhood, the FCPMH or health system anchors and supports cross-sector efforts to address family needs (eg, the SDoH), promote population level wellness, and collectively advocate for needed funding and policy changes.

PCIT

Acronym for Parent-Child Interaction Therapy; PCIT is an evidence-based intervention to change the patterns of parent-child interactions to improve the parent-child relationship.

Positive Childhood Experiences

Reciprocal experiences with engaged and attuned adults (like those that occur during developmentally appropriate play) that build SSNRs; they are warm, affirming, and inclusive, and they promote early relational health.

Relational Health

The capacity to develop and maintain SSNRs with others; relational health is an important predictor of wellness across the life span.

Resilience

The capacity to respond to adversity in a healthy, adaptive manner; resilience is the manifestation of skills (eg, social skills, emotional regulation, language, and executive functions) that can be modeled, taught, learned, practiced, and reinforced.

Restorative Justice

Refers to efforts to repair the harm that occurs with unjust behaviors, as opposed to retributive or punitive justice, which simply punishes those who have acted unjustly. Typically, restorative justice allows the victims and the offenders to mediate a restitution agreement that is satisfactory to both parties. In this way, the victims play an active role in communicating with and understanding the offenders, and the offenders have the chance to take responsibility for their actions, identify steps that might prevent offending behaviors in the future, and redeem themselves in the eyes of the victims and community (as per Garner and Saul[17])

ROR

Acronym for Reach Out and Read; ROR is a nonprofit organization and early literacy program. ROR provides age appropriate books and encourages parents to regularly read to and interact with their children to support school readiness and healthy parent-child relationships.

SDoHs

Acronym for the social determinants of health; SDoHs refer to conditions where people live, learn, work, and play (like socioeconomic status, social capital, or exposure to discrimination or community violence) that are known to affect health outcomes across the life span.

SSNRs

Acronym for safe, stable, and nurturing relationships; these allow the child to feel protected, connected, and competent.

TF-CBT

Acronym for Trauma-Focused Cognitive Behavioral Therapy; TF-CBT is an evidence-based, manualized, skills-based therapy that allows parents and children to better process emotions and thoughts related to traumatic experiences.

Toxic Stress

The biological response to frequent, prolonged, or severe adversities in the absence of at least one safe stable and nurturing relationship; these biological responses might be beneficial or adaptive initially, but they often become health harming or maladaptive or "toxic" over time or in different contexts.

Vertical Integration

A public health approach that includes primary universal preventions to promote wellness (like promoting positive parenting practices), secondary targeted interventions for those deemed to be at risk for poor outcomes (like using biomarkers both to identify those at higher risk and to monitor the effectiveness of various interventions), and tertiary evidence-based treatments for the symptomatic (like referring to providers trained in TF-CBT).

VIP

Acronym for the Video Interaction Project; VIP uses video-taped interactions of parent-child dyads to teach parents how to be more engaged, attuned, and responsive to their child's developing behaviors.

ACKNOWLEDGMENTS

Drs Garner and Yogman gratefully acknowledge the contributions of Dr Shonkoff to early drafts of this article.

LEAD AUTHORS

Andrew Garner, MD, PhD, FAAP
Michael Yogman, MD, FAAP

ABBREVIATIONS

AAP: American Academy of Pediatrics
ABC: attachment and biobehavioral catch-up
ACE: adverse childhood experience
CPP: child–parent psychotherapy
FCPMH: family-centered pediatric medical home
PCIT: parent–child interaction therapy
ROR: Reach Out and Read
SDoH: social determinants of health
SSNR: safe, stable, and nurturing relationship
TF-CBT: trauma-focused cognitive-behavioral therapy
VIP: Video Interaction Project

All policy statements from the American Academy of Pediatrics automatically expire 5 years after publication unless reaffirmed, revised, or retired at or before that time.

DOI: https://doi.org/10.1542/peds.2021-052582

Address correspondence to xxx. E-mail: xxx

PEDIATRICS (ISSN Numbers: Print, 0031-4005; Online, 1098-4275).

FINANCIAL DISCLOSURE: The authors have indicated they have no financial relationships relevant to this article to disclose.

FUNDING: No external funding.

POTENTIAL CONFLICT OF INTEREST: The authors have indicated they have no potential conflicts of interest to disclose.

REFERENCES

1. National Scientific Council on the Developing Child. *Young Children Develop in an Environment of Relationships: Working Paper No. 1*. Cambridge, MA: Center on the Developing Child at Harvard University; 2004. Available at: https://developingchild.harvard.edu/resources/wp1/. Accessed June 28, 2021
2. Shonkoff JP, Garner AS; Committee on Psychosocial Aspects of Child and Family Health; Committee on Early Childhood, Adoption, and Dependent Care; Section on Developmental and Behavioral Pediatrics. The lifelong effects of early childhood adversity and toxic stress. *Pediatrics*. 2012;129(1):e232–e246
3. Romens SE, McDonald J, Svaren J, Pollak SD. Associations between early life stress and gene methylation in children. *Child Dev*. 2015;86(1):303–309
4. Labonte B, Yerko V, Gross J, et al. Differential glucocorticoid receptor exon 1(B), 1(C), and 1(H) expression and methylation in suicide completers with a history of childhood abuse. *Biol Psychiatry*. 2012;72(1):41–48
5. McGowan PO, Sasaki A, D'Alessio AC, et al. Epigenetic regulation of the glucocorticoid receptor in human brain associates with childhood abuse. *Nat Neurosci*. 2009;12(3):342–348
6. McCrory EJ, Gerin MI, Viding E. Annual research review: childhood maltreatment, latent vulnerability and the shift to preventative psychiatry - the contribution of functional brain imaging. *J Child Psychol Psychiatry*. 2017;58(4):338–357
7. Marusak HA, Martin KR, Etkin A, Thomason ME. Childhood trauma exposure disrupts the automatic regulation of emotional processing. *Neuropsychopharmacology*. 2015;40(5):1250–1258
8. van Harmelen AL, van Tol MJ, Demenescu LR, et al. Enhanced amygdala reactivity to emotional faces in adults reporting childhood emotional maltreatment. *Soc Cogn Affect Neurosci*. 2013;8(4):362–369
9. Sandre A, Ethridge P, Kim I, Weinberg A. Childhood maltreatment is associated with increased neural response to ambiguous threatening facial expressions in adulthood: evidence from the late positive potential. *Cogn Affect Behav Neurosci*. 2018;18(1):143–154
10. Danese A, McEwen BS. Adverse childhood experiences, allostasis, allostatic load, and age-related disease. *Physiol Behav*. 2012;106(1):29–39
11. Rogosch FA, Dackis MN, Cicchetti D. Child maltreatment and allostatic load: consequences for physical and mental health in children from low-income families. *Dev Psychopathol*. 2011;23(4):1107–1124
12. Garner AS, Shonkoff JP; Committee on Psychosocial Aspects of Child and Family Health; Committee on Early Childhood, Adoption, and Dependent Care; Section on Developmental and Behavioral Pediatrics. Early childhood adversity, toxic stress, and the role of the pediatrician: translating developmental science into lifelong health. *Pediatrics*. 2012;129(1):e224–e231
13. Boyce WT, Levitt P, Martinez FD, McEwen BS, Shonkoff JP. Genes, environments, and time: the biology of adversity and resilience. *Pediatrics*. 2021;147(2):e20201651
14. Shonkoff JP, Boyce WT, Levitt P, Martinez F, McEwen B. Leveraging the biology of adversity and resilience to transform pediatric practice. *Pediatrics*. 2021;147(2):e20193845
15. Frameworks Institute. *Building Relationships: Framing Early Relational Health*. Washington, DC: Frameworks Institute; 2020
16. National Scientific Council on the Developing Child. *Supportive Relationships and Active Skill-Building Strengthen the Foundations of Resilience*: Working Paper No. 13 Cambridge, MA: National Scientific Council on the Developing Child; 2015. Available at: https://developingchild.harvard.edu/resources/supportive-relationships-and-active-skill-building-strengthen-the-foundations-of-resilience/. Accessed June 28, 2021
17. Garner A, Saul R. *Thinking Developmentally: Nurturing Wellness in Childhood to Promote Lifelong Health*. 1st ed. Itasca, IL: American Academy of Pediatrics; 2018
18. Brody GH, Yu T, Beach SR. Resilience to adversity and the early origins of disease. *Dev Psychopathol*. 2016;28(4, pt 2):1347–1365
19. Flouri E, Midouhas E, Joshi H, Tzavidis N. Emotional and behavioural resilience to multiple risk exposure in early life: the role of parenting. *Eur Child Adolesc Psychiatry*. 2015;24(7):745–755
20. Bowlby J. *A Secure Base: Parent-Child Attachment and Healthy Human Development*. New York, NY: Basic Books; 1988
21. Ainsworth MD. Object relations, dependency, and attachment: a theoretical review of the infant-mother relationship. *Child Dev*. 1969;40(4):969–1025
22. Brazelton TB. *Touchpoints: Birth to 3: Your Child's Emotional and Behavioral Development*. 2nd ed. Cambridge, MA: Da Capo Lifelong Books; 2006
23. Felitti VJ, Anda RF, Nordenberg D, et al. Relationship of childhood abuse and household dysfunction to many of the leading causes of death in adults. The Adverse Childhood Experiences (ACE) Study. *Am J Prev Med*. 1998;14(4):245–258
24. Anda RF, Felitti VJ, Bremner JD, et al. The enduring effects of abuse and related adverse experiences in childhood. A convergence of evidence from neurobiology and epidemiology. *Eur Arch Psychiatry Clin Neurosci*. 2006;256(3):174–186
25. Dong M, Giles WH, Felitti VJ, et al. Insights into causal pathways for ischemic heart disease: adverse childhood experiences study. *Circulation*. 2004;110(13):1761–1766

26. Anda RF, Brown DW, Dube SR, Bremner JD, Felitti VJ, Giles WH. Adverse childhood experiences and chronic obstructive pulmonary disease in adults. *Am J Prev Med.* 2008;34(5):396–403
27. Dong M, Dube SR, Felitti VJ, Giles WH, Anda RF. Adverse childhood experiences and self-reported liver disease: new insights into the causal pathway. *Arch Intern Med.* 2003;163(16):1949–1956
28. Anda RF, Brown DW, Felitti VJ, Bremner JD, Dube SR, Giles WH. Adverse childhood experiences and prescribed psychotropic medications in adults. *Am J Prev Med.* 2007;32(5):389–394
29. Brown DW, Anda RF, Felitti VJ, et al. Adverse childhood experiences are associated with the risk of lung cancer: a prospective cohort study. *BMC Public Health.* 2010;10:20
30. Hertzman C. Putting the concept of biological embedding in historical perspective. *Proc Natl Acad Sci USA.* 2012;109(suppl 2):17160–17167
31. Hertzman C, Boyce T. How experience gets under the skin to create gradients in developmental health. *Ann Rev Public Health.* 2010;31:329–347
32. McEwen BS. Brain on stress: how the social environment gets under the skin. *Proc Natl Acad Sci USA.* 2012;109(suppl 2):17180–17185
33. Szyf M, Bick J. DNA Methylation: A Mechanism for Embedding Early Life Experiences in the Genome. *Child Dev.* 2013;84(1):49–57
34. Chae DH, Nuru-Jeter AM, Adler NE, et al. Discrimination, racial bias, and telomere length in African-American men. *Am J Prev Med.* 2014;46(2):103–111
35. Liu SY, Kawachi I. Discrimination and telomere length among older adults in the United States. *Public Health Rep.* 2017;132(2):220–230
36. Lee DB, Kim ES, Neblett EW. The link between discrimination and telomere length in African American adults. *Health Psychol.* 2017;36(5):458–467
37. Shonkoff JP. Capitalizing on advances in science to reduce the health consequences of early childhood adversity. *JAMA Pediatr.* 2016;170(10):1003–1007
38. Shonkoff JP. Leveraging the biology of adversity to address the roots of disparities in health and development. *Proc Natl Acad Sci USA.* 2012;109(suppl 2):17302–17307
39. Shonkoff JP, Boyce WT, McEwen BS. Neuroscience, molecular biology, and the childhood roots of health disparities: building a new framework for health promotion and disease prevention. *JAMA.* 2009;301(21):2252–2259
40. National Scientific Council on the Developing Child. *Excessive Stress Disrupts the Architecture of the Developing Brain: Working Paper No. 3.* Updated Edition. Cambridge, MA: National Scientific Council on the Developing Child; 2014. Available at: https://developingchild.harvard.edu/resources/wp3/. Accessed June 28, 2021
41. Non AL, Román JC, Gross CL, et al. Early childhood social disadvantage is associated with poor health behaviours in adulthood. *Ann Hum Biol.* 2016;43(2):144–153
42. Merrick MT, Henly M, Turner HA, et al. Beyond residential mobility: A broader conceptualization of instability and its impact on victimization risk among children. *Child Abuse Negl.* 2018;79:485–494
43. Cutuli JJ, Ahumada SM, Herbers JE, Lafavor TL, Masten AS, Oberg CN. Adversity and children experiencing family homelessness: implications for health. *J Child Poverty.* 2017;23(1):41–55
44. Jetelina KK, Reingle Gonzalez JM, Cuccaro PM, et al. The association between familial homelessness, aggression, and victimization among children. *J Adolesc Health.* 2016;59(6):688–695
45. James S, Donnelly L, Brooks-Gunn J, McLanahan S. Links between childhood exposure to violent contexts and risky adolescent health behaviors. *J Adolesc Health.* 2018;63(1):94–101
46. Saxbe D, Khoddam H, Piero LD, et al. Community violence exposure in early adolescence: longitudinal associations with hippocampal and amygdala volume and resting state connectivity. *Dev Sci.* 2018;21(6):e12686
47. Ma J, Grogan-Kaylor A, Lee SJ. Associations of neighborhood disorganization and maternal spanking with children's aggression: a fixed-effects regression analysis. *Child Abuse Negl.* 2018;76:106–116
48. Thurston H, Bell JF, Induni M. Community-level adverse experiences and emotional regulation in children and adolescents. *J Pediatr Nurs.* 2018;42:25–33
49. Evans SZ, Simons LG, Simons RL. Factors that influence trajectories of delinquency throughout adolescence. *J Youth Adolesc.* 2016;45(1):156–171
50. Wade R Jr, Cronholm PF, Fein JA, et al. Household and community-level adverse childhood experiences and adult health outcomes in a diverse urban population. *Child Abuse Negl.* 2016;52:135–145
51. Takizawa R, Danese A, Maughan B, Arseneault L. Bullying victimization in childhood predicts inflammation and obesity at mid-life: a five-decade birth cohort study. *Psychol Med.* 2015;45(13):2705–2715
52. Halpern J, Jutte D, Colby J, Boyce WT. Social dominance, school bullying, and child health: what are our ethical obligations to the very young? *Pediatrics.* 2015;135(suppl 2):S24–S30
53. Zolotor AJ. Corporal punishment. *Pediatr Clin North Am.* 2014;61(5):971–978
54. Odgers CL, Jaffee SR. Routine versus catastrophic influences on the developing child. *Annu Rev Public Health.* 2013;34:29–48
55. Keeshin BR, Dubowitz H. Childhood neglect: the role of the paediatrician. *Paediatr Child Health.* 2013;18(8):e39–e43
56. Anda RF, Porter LE, Brown DW. Inside the adverse childhood experience score: strengths, limitations, and misapplications. *Am J Prev Med.* 2020;59(2):293–295
57. Slopen N, McLaughlin KA, Shonkoff JP. Interventions to improve cortisol regulation in children: a systematic review. *Pediatrics.* 2014;133(2):312–326
58. Shonkoff JP, Fisher PA. Rethinking evidence-based practice and two-generation programs to create the future of early childhood policy. *Dev Psychopathol.* 2013;25(4, pt 2):1635–1653
59. Bethell CD, Gombojav N, Whitaker RC. Family resilience and connection promote flourishing among US children,

even amid adversity. *Health Aff (Millwood).* 2019;38(5):729–737

60. Conching AKS, Thayer Z. Biological pathways for historical trauma to affect health: A conceptual model focusing on epigenetic modifications. *Soc Sci Med.* 2019;230:74–82
61. Gone JP, Hartmann WE, Pomerville A, Wendt DC, Klem SH, Burrage RL. The impact of historical trauma on health outcomes for indigenous populations in the USA and Canada: a systematic review. *Am Psychol.* 2019;74(1):20–35
62. Weisleder A, Cates CB, Dreyer BP, et al. Promotion of positive parenting and prevention of socioemotional disparities. *Pediatrics.* 2016;137(2):e20153239
63. Mendelsohn AL, Huberman HS, Berkule SB, Brockmeyer CA, Morrow LM, Dreyer BP. Primary care strategies for promoting parent-child interactions and school readiness in at-risk families: the Bellevue Project for Early Language, Literacy, and Education Success. *Arch Pediatr Adolesc Med.* 2011;165(1):33–41
64. Yousafzai AK, Rasheed MA, Rizvi A, Armstrong R, Bhutta ZA. Parenting skills and emotional availability: an RCT. *Pediatrics.* 2015;135(5):e1247–e1257
65. Hambrick EP, Brawner TW, Perry BD, Brandt K, Hofmeister C, Collins JO. Beyond the ACE score: examining relationships between timing of developmental adversity, relational health and developmental outcomes in children. *Arch Psychiatr Nurs.* 2019;33(3):238–247
66. Mendelsohn AL, Cates CB, Weisleder A, et al. Reading aloud, play, and social-emotional development. *Pediatrics.* 2018;141(5):e20173393
67. COUNCIL ON EARLY CHILDHOOD; COUNCIL ON SCHOOL HEALTH. The pediatrician's role in optimizing school readiness. *Pediatrics.* 2016;138(3):e20162293
68. High PC, Klass P; Council on Early Childhood. Literacy promotion: an essential component of primary care pediatric practice. *Pediatrics.* 2014;134(2):404–409
69. Campbell F, Conti G, Heckman JJ, et al. Early childhood investments substantially boost adult health. *Science.* 2014;343(6178):1478–1485
70. McLaughlin AE, Campbell FA, Pungello EP, Skinner M. Depressive symptoms in young adults: the influences of the early home environment and early educational child care. *Child Dev.* 2007;78(3):746–756
71. Schweinhart LH, Monte J, Xiang Z. *Lifetime Effects: the High/Scope Perry Preschool Study Through Age 40.* Ypsilanti, MI.: High/Scope Press; 2005
72. Cates CB, Weisleder A, Berkule Johnson S, et al. Enhancing parent talk, reading, and play in primary care: sustained impacts of the video interaction project. *J Pediatr.* 2018;199:49–56.e1
73. Chang SM, Grantham-McGregor SM, Powell CA, et al. Integrating a parenting intervention with routine primary health care: a cluster randomized trial. *Pediatrics.* 2015;136(2):272–280
74. Yogman M, Garner A, Hutchinson J, Hirsh-Pasek K, Golinkoff RM; COMMITTEE ON PSYCHOSOCIAL ASPECTS OF CHILD AND FAMILY HEALTH; COUNCIL ON COMMUNICATIONS AND MEDIA. The power of play: a pediatric role in enhancing development in young children. *Pediatrics.* 2018;142(3):e20182058
75. Garner AS. Thinking developmentally: the next evolution in models of health. *J Dev Behav Pediatr.* 2016;37(7):579–584
76. Palma-Gudiel H, Córdova-Palomera A, Eixarch E, Deuschle M, Fañanás L. Maternal psychosocial stress during pregnancy alters the epigenetic signature of the glucocorticoid receptor gene promoter in their offspring: a meta-analysis. *Epigenetics.* 2015;10(10):893–902
77. Oberlander TF, Weinberg J, Papsdorf M, Grunau R, Misri S, Devlin AM. Prenatal exposure to maternal depression, neonatal methylation of human glucocorticoid receptor gene (NR3C1) and infant cortisol stress responses. *Epigenetics.* 2008;3(2):97–106
78. Murgatroyd C, Quinn JP, Sharp HM, Pickles A, Hill J. Effects of prenatal and postnatal depression, and maternal stroking, at the glucocorticoid receptor gene. *Transl Psychiatry.* 2015;5:e560
79. Lester BM, Conradt E, LaGasse LL, Tronick EZ, Padbury JF, Marsit CJ. Epigenetic programming by maternal behavior in the human infant. *Pediatrics.* 2018;142(4):e20171890
80. Halfon N, Larson K, Son J, Lu M, Bethell C. income inequality and the differential effect of adverse childhood experiences in US children. *Acad Pediatr.* 2017;17(7S):S70–S78
81. Halfon N, Wise PH, Forrest CB. The changing nature of children's health development: new challenges require major policy solutions. *Health Aff (Millwood).* 2014;33(12):2116–2124
82. Halfon N, Inkelas M, Hochstein M. The health development organization: an organizational approach to achieving child health development. *Milbank Q.* 2000;78(3):447–497
83. Traub F, Boynton-Jarrett R. Modifiable resilience factors to childhood adversity for clinical pediatric practice. *Pediatrics.* 2017;139(5):e20162569
84. Minkovitz CS, Strobino D, Mistry KB, et al. Healthy Steps for Young Children: sustained results at 5.5 years. *Pediatrics.* 2007;120(3):e658–e668
85. Johnston BD, Huebner CE, Anderson ML, Tyll LT, Thompson RS. Healthy steps in an integrated delivery system: child and parent outcomes at 30 months. *Arch Pediatr Adolesc Med.* 2006;160(8):793–800
86. Schickedanz A, Halfon N, Sastry N, Chung PJ. Parents' adverse childhood experiences and their children's behavioral health problems. *Pediatrics.* 2018;142(2):e20180023
87. Pascoe JM, Wood DL, Duffee JH, Kuo A; COMMITTEE ON PSYCHOSOCIAL ASPECTS OF CHILD AND FAMILY HEALTH; COUNCIL ON COMMUNITY PEDIATRICS. Mediators and adverse effects of child poverty in the United States. *Pediatrics.* 2016;137(4):e20160340
88. COUNCIL ON COMMUNITY PEDIATRICS. Poverty and child health in the United States. *Pediatrics.* 2016;137(4):e20160339
89. Kim SY, Schwartz SJ, Perreira KM, Juang LP. Culture's influence on stressors, parental socialization, and developmental processes in the mental health of children of immigrants. *Annu Rev Clin Psychol.* 2018;14:343–370
90. Earls MF, Yogman MW, Mattson G, Rafferty J; COMMITTEE ON PSYCHOSOCIAL

ASPECTS OF CHILD AND FAMILY HEALTH. Incorporating recognition and management of perinatal depression into pediatric practice. *Pediatrics.* 2019;143(1):e20183259

91. Ellis BJ, Shirtcliff EA, Boyce WT, Deardorff J, Essex MJ. Quality of early family relationships and the timing and tempo of puberty: effects depend on biological sensitivity to context. *Dev Psychopathol.* 2011;23(1):85–99
92. Obradović J, Bush NR, Stamperdahl J, Adler NE, Boyce WT. Biological sensitivity to context: the interactive effects of stress reactivity and family adversity on socioemotional behavior and school readiness. *Child Dev.* 2010;81(1):270–289
93. Obradović J, Boyce WT. Individual differences in behavioral, physiological, and genetic sensitivities to contexts: implications for development and adaptation. *Dev Neurosci.* 2009;31(4):300–308
94. Boyce WT. *The Orchid and the Dandelion: Why Some Children Struggle and How All Can Thrive.* New York, NY: Knopf; 2019
95. Gleason MM, Goldson E, Yogman MW; COUNCIL ON EARLY CHILDHOOD; COMMITTEE ON PSYCHOSOCIAL ASPECTS OF CHILD AND FAMILY HEALTH; SECTION ON DEVELOPMENTAL AND BEHAVIORAL PEDIATRICS. Addressing early childhood emotional and behavioral problems. *Pediatrics.* 2016;138(6):e20163025
96. Dozier M, Roben CKP, Caron E, Hoye J, Bernard K. Attachment and Biobehavioral Catch-up: an evidence-based intervention for vulnerable infants and their families. *Psychother Res.* 2018;28(1):18–29
97. Dozier M, Bernard K. Attachment and biobehavioral catch-up: addressing the needs of infants and toddlers exposed to inadequate or problematic caregiving. *Curr Opin Psychol.* 2017;15:111–117
98. Bernard K, Dozier M, Bick J, Lewis-Morrarty E, Lindhiem O, Carlson E. Enhancing attachment organization among maltreated children: results of a randomized clinical trial. *Child Dev.* 2012;83(2):623–636
99. Bjørseth Å, Wichstrøm L. Effectiveness of parent-child interaction therapy (PCIT) in the treatment of young children's behavior problems. a randomized controlled study. *PLoS One.* 2016;11(9):e0159845
100. Thomas R, Herschell AD. Parent-child interaction therapy: a manualized intervention for the therapeutic child welfare sector. *Child Abuse Negl.* 2013;37(8):578–584
101. Thomas R, Zimmer-Gembeck MJ. Parent-child interaction therapy: an evidence-based treatment for child maltreatment. *Child Maltreat.* 2012;17(3):253–266
102. Thomas R, Zimmer-Gembeck MJ. Accumulating evidence for parent-child interaction therapy in the prevention of child maltreatment. *Child Dev.* 2011;82(1):177–192
103. Hagan MJ, Browne DT, Sulik M, Ippen CG, Bush N, Lieberman AF. Parent and child trauma symptoms during child-parent psychotherapy: a prospective cohort study of dyadic change. *J Trauma Stress.* 2017;30(6):690–697
104. Ghosh Ippen C, Harris WW, Van Horn P, Lieberman AF. Traumatic and stressful events in early childhood: can treatment help those at highest risk? *Child Abuse Negl.* 2011;35(7):504–513
105. Lieberman AF, Ghosh Ippen C, VAN Horn P. Child-parent psychotherapy: 6-month follow-up of a randomized controlled trial. *J Am Acad Child Adolesc Psychiatry.* 2006;45(8):913–918
106. Cohen JA, Deblinger E, Mannarino AP, Steer RA. A multisite, randomized controlled trial for children with sexual abuse-related PTSD symptoms. *J Am Acad Child Adolesc Psychiatry.* 2004;43(4):393–402
107. Cisler JM, Sigel BA, Kramer TL, et al. Amygdala response predicts trajectory of symptom reduction during trauma-focused cognitive-behavioral therapy among adolescent girls with PTSD. *J Psychiatr Res.* 2015;71:33–40
108. Merrick MT, Ford DC, Ports KA, Guinn AS. Prevalence of adverse childhood experiences from the 2011-2014 Behavioral Risk Factor Surveillance System in 23 States. *JAMA Pediatr.* 2018;172(11):1038–1044
109. Bywater T, Berry V, Blower SL, et al. Enhancing social-emotional health and wellbeing in the early years (E-SEE): a study protocol of a community-based randomised controlled trial with process and economic evaluations of the incredible years infant and toddler parenting programmes, delivered in a proportionate universal model. *BMJ Open.* 2018;8(12):e026906
110. Egan M, Kearns A, Katikireddi SV, Curl A, Lawson K, Tannahill C. Proportionate universalism in practice? A quasi-experimental study (GoWell) of a UK neighbourhood renewal programme's impact on health inequalities. *Soc Sci Med.* 2016;152:41–49
111. Carey G, Crammond B, De Leeuw E. Towards health equity: a framework for the application of proportionate universalism. *Int J Equity Health.* 2015;14:81
112. *Team Marmot Report. Fair Society, Healthy Lives. The Marmot Review.* London, UK: University College of London Institute of Health Equity; 2010
113. Jaffee SR, Bowes L, Ouellet-Morin I, et al. Safe, stable, nurturing relationships break the intergenerational cycle of abuse: a prospective nationally representative cohort of children in the United Kingdom. *J Adolesc Health.* 2013;53(4, suppl):S4–S10
114. National Scientific Council on the Developing Child. *Building the Brain's "Air Traffic Control" System: How Early Experiences Shape the Development of Executive Function*: Working Paper No. 11. Cambridge, MA: National Scientific Council on the Developing Child; 2011. Available at: https://developingchild.harvard.edu/resources/building-the-brains-air-traffic-control-system-how-early-experiences-shape-the-development-of-executive-function/. Accessed June 28, 2021
115. National Scientific Council on the Developing Child. *The Timing and Quality of Early Experiences Combine to Shape Brain Architecture.*: Working Paper No. 5. Cambridge, MA: National Scientific Council on the Developing Child; 2007. Available at: https://developingchild.harvard.edu/resources/the-timing-and-quality-of-early-experiences-combine-to-shape-brain-architecture/. Accessed June 28, 2021
116. Schore AN. Attachment and the regulation of the right brain. *Attach Hum Dev.* 2000;2(1):23–47
117. Feldman R. The adaptive human parental brain: implications for

children's social development. *Trends Neurosci.* 2015;38(6):387–399

118. Watamura S, Kim P. *Two Open Windows: Infant and Parent Neurobiological Change.* Washington, DC: Aspen Institute; 2015
119. Feldman R. The neurobiology of human attachments. *Trends Cogn Sci.* 2017;21(2):80–99
120. Feldman R. The neurobiology of mammalian parenting and the biosocial context of human caregiving. *Horm Behav.* 2016;77:3–17
121. Bethell C, Jones J, Gombojav N, Linkenbach J, Sege R. Positive childhood experiences and adult mental and relational health in a statewide sample: associations across adverse childhood experiences levels. *JAMA Pediatr.* 2019;173(11):e193007
122. Heard-Garris N, Davis MM, Szilagyi M, Kan K. Childhood adversity and parent perceptions of child resilience. *BMC Pediatr.* 2018;18(1):204
123. Fritz J, de Graaff AM, Caisley H, van Harmelen AL, Wilkinson PO. A systematic review of amenable resilience factors that moderate and/or mediate the relationship between childhood adversity and mental health in young people. *Front Psychiatry.* 2018;9:230
124. Ellis WR, Dietz WH. A new framework for addressing adverse childhood and community experiences: the building community resilience model. *Acad Pediatr.* 2017;17(7S):S86–S93
125. COUNCIL ON COMMUNICATIONS AND MEDIA. Media and young minds. *Pediatrics.* 2016;138(5):e20162591
126. Sege RD, Harper Browne C. Responding to ACEs with HOPE: Health Outcomes From Positive Experiences. *Acad Pediatr.* 2017;17(7S):S79–S85
127. Sege R, Bethell C, Linkenbach J, Jones J, Kilkao B, Pecora PJ. *Balancing Adverse Childhood Experiences with HOPE: New Insights Into the Role of Positive Experience on Child And Family Development.* Boston, MA: The Medical Foundation; 2017
128. Shah R, DeFrino D, Kim Y, Atkins M. Sit down and play: a preventive primary care-based program to enhance parenting practices. *J Child Fam Stud.* 2017;26(2):540–547
129. Zuckerman B, Augustyn M. Books and reading: evidence-based standard of care whose time has come. *Acad Pediatr.* 2011;11(1):11–17
130. Needlman R, Toker KH, Dreyer BP, Klass P, Mendelsohn AL. Effectiveness of a primary care intervention to support reading aloud: a multicenter evaluation. *Ambul Pediatr.* 2005;5(4):209–215
131. Ellis BJ, Boyce WT. Differential susceptibility to the environment: toward an understanding of sensitivity to developmental experiences and context. *Dev Psychopathol.* 2011;23(1):1–5
132. Blair C. Stress and the development of self-regulation in context. *Child Dev Perspect.* 2010;4(3):181–188
133. Ellis BJ, Essex MJ, Boyce WT. Biological sensitivity to context: II. Empirical explorations of an evolutionary-developmental theory. *Dev Psychopathol.* 2005;17(2):303–328
134. Boyce WT, Ellis BJ. Biological sensitivity to context: I. An evolutionary-developmental theory of the origins and functions of stress reactivity. *Dev Psychopathol.* 2005;17(2):271–301
135. Humphreys KL, Telzer EH, Flannery J, et al. Risky decision making from childhood through adulthood: contributions of learning and sensitivity to negative feedback. *Emotion.* 2016;16(1):101–109
136. Essex MJ, Armstrong JM, Burk LR, Goldsmith HH, Boyce WT. Biological sensitivity to context moderates the effects of the early teacher-child relationship on the development of mental health by adolescence. *Dev Psychopathol.* 2011;23(1):149–161
137. Weisleder A, Cates CB, Harding JF, et al. Links between shared reading and play, parent psychosocial functioning, and child behavior: evidence from a randomized controlled trial. *J Pediatr.* 2019;213:187–195.e1
138. Needlman RD, Dreyer BP, Klass P, Mendelsohn AL. Attendance at well-child visits after Reach Out and Read. *Clin Pediatr (Phila).* 2019;58(3):282–287
139. Zuckerman B, Khandekar A. Reach Out and Read: evidence based approach to promoting early child development. *Curr Opin Pediatr.* 2010;22(4):539–544
140. Sanders MR. Triple P-Positive Parenting Program as a public health approach to strengthening parenting. *J Fam Psychol.* 2008;22(4):506–517
141. Sanders MR, Bor W, Morawska A. Maintenance of treatment gains: a comparison of enhanced, standard, and self-directed Triple P-Positive Parenting Program. *J Abnorm Child Psychol.* 2007;35(6):983–998
142. Duffee JH, Mendelsohn AL, Kuo AA, Legano LA, Earls MF; COUNCIL ON COMMUNITY PEDIATRICS; COUNCIL ON EARLY CHILDHOOD; COMMITTEE ON CHILD ABUSE AND NEGLECT. Early childhood home visiting. *Pediatrics.* 2017;140(3):e20172150
143. Garner AS. Home visiting and the biology of toxic stress: opportunities to address early childhood adversity. *Pediatrics.* 2013;132(suppl 2):S65–S73
144. Katkin JP, Kressly SJ, Edwards AR, et al; TASK FORCE ON PEDIATRIC PRACTICE CHANGE. Guiding principles for team-based pediatric care. *Pediatrics.* 2017;140(2):e20171489
145. Feigelman S, Dubowitz H, Lane W, Grube L, Kim J. Training pediatric residents in a primary care clinic to help address psychosocial problems and prevent child maltreatment. *Acad Pediatr.* 2011;11(6):474–480
146. Garg A, Sarkar S, Marino M, Onie R, Solomon BS. Linking urban families to community resources in the context of pediatric primary care. *Patient Educ Couns.* 2009
147. Sege R, Preer G, Morton SJ, et al. Medical-legal strategies to improve infant health care: a randomized trial. *Pediatrics.* 2015;136(1):97–106
148. Halfon N, Long P, Chang DI, Hester J, Inkelas M, Rodgers A. Applying a 3.0 transformation framework to guide large-scale health system reform. *Health Aff (Millwood).* 2014;33(11):2003–2011
149. Duby JC. Early childhood behavioral health: can the medical neighborhood move us forward? *Pediatrics.* 2018;141(5):e20180156
150. Help Me Grow National Center. The HMG Model System Model. Available at: https://helpmegrownational.org/hmg-system-model/. Accessed June 21, 2021
150. Zuckerman B, Parker S, Kaplan-Sanoff M, Augustyn M, Barth MC. Healthy

Steps: a case study of innovation in pediatric practice. *Pediatrics.* 2004;114(3):820–826

151. Valado T, Tracey J, Goldfinger J, Briggs R. HealthySteps: transforming the promise of pediatric care. *Future Child.* 2019;29:99–122
152. DISASTER PREPAREDNESS ADVISORY COUNCIL; COMMITTEE ON PEDIATRIC EMERGENCY MEDICINE. Ensuring the health of children in disasters. *Pediatrics.* 2015;136(5):e1407–e1417
153. Schonfeld DJ, Demaria T; DISASTER PREPAREDNESS ADVISORY COUNCIL AND COMMITTEE ON PSYCHOSOCIAL ASPECTS OF CHILD AND FAMILY HEALTH. Providing psychosocial support to children and families in the aftermath of disasters and crises. *Pediatrics.* 2015;136(4):e1120–e1130
154. Heymann J, Sprague AR, Nandi A, et al. Paid parental leave and family wellbeing in the sustainable development era. *Public Health Rev.* 2017;38:21
155. Schuster MA, Chung PJ. Time off to care for a sick child–why family-leave policies matter. *N Engl J Med.* 2014;371(6):493–495
156. Ahlin EM, Gibbs JC, Kavanaugh PR, Lee J. Support for restorative justice in a sample of U.S. university students. *Int J Offender Ther Comp Criminol.* 2017;61(2):229–245
157. Riedl K, Jensen K, Call J, Tomasello M. Restorative justice in children. *Curr Biol.* 2015;25(13):1731–1735
158. Wenzel M, Okimoto TG, Feather NT, Platow MJ. Retributive and restorative justice. *Law Hum Behav.* 2008;32(5):375–389
159. Brown CM, Perkins J, Blust A, Kahn RS. A neighborhood-based approach to population health in the pediatric medical home. *J Community Health.* 2015;40(1):1–11
160. Beck AF, Sandel MT, Ryan PH, Kahn RS. Mapping neighborhood health geomarkers to clinical care decisions to promote equity in child health. *Health Aff (Millwood).* 2017;36(6):999–1005
161. Garg A, Sandel M, Dworkin PH, Kahn RS, Zuckerman B. From medical home to health neighborhood: transforming the medical home into a community-based health neighborhood. *J Pediatr.* 2012;160(4):535–536.e1
162. Chang S, Lee TH. Beyond evidence-based medicine. *N Engl J Med.* 2018;379(21):1983–1985
163. Marsac ML, Kassam-Adams N, Hildenbrand AK, et al. Implementing a trauma-informed approach in pediatric health care networks. *JAMA Pediatr.* 2016;170(1):70–77
164. Derrington SF, Paquette E, Johnson KA. Cross-cultural interactions and shared decision-making. *Pediatrics.* 2018;142(suppl 3):S187–S192
165. Ruberton PM, Huynh HP, Miller TA, Kruse E, Chancellor J, Lyubomirsky S. The relationship between physician humility, physician-patient communication, and patient health. *Patient Educ Couns.* 2016;99(7):1138–1145
166. Trent M, Dooley DG, Dougé J, SECTION ON ADOLESCENT HEALTH; COUNCIL ON COMMUNITY PEDIATRICS; COMMITTEE ON ADOLESCENCE. The impact of racism on child and adolescent health. *Pediatrics.* 2019;144(2):e20191765
167. Hagiwara N, Elston Lafata J, Mezuk B, Vrana SR, Fetters MD. Detecting implicit racial bias in provider communication behaviors to reduce disparities in healthcare: challenges, solutions, and future directions for provider communication training. *Patient Educ Couns.* 2019;102(9):1738–1743
168. Schnierle J, Christian-Brathwaite N, Louisias M. Implicit bias: what every pediatrician should know about the effect of bias on health and future directions. *Curr Probl Pediatr Adolesc Health Care.* 2019;49(2):34–44
169. Poitevien P, Osman C. Tackling implicit and explicit bias through objective structured teaching exercises for faculty. *J Grad Med Educ.* 2018;10(3):353–354
170. Dehon E, Weiss N, Jones J, Faulconer W, Hinton E, Sterling S. A systematic review of the impact of physician implicit racial bias on clinical decision making. *Acad Emerg Med.* 2017;24(8):895–904
171. Johnson TJ, Winger DG, Hickey RW, et al. Comparison of physician implicit racial bias toward adults versus children. *Acad Pediatr.* 2017;17(2):120–126
172. Garner AS, Forkey H, Szilagyi M. Translating developmental science to address childhood adversity. *Acad Pediatr.* 2015;15(5):493–502
173. Lieberman MD. *Social: Why Our Brains Are Wired to Connect.* 1st ed. New York, NY: Broadway Books; 2013
174. Wilkinson RG, Pickett K. *The Spirit Level: Why Greater Equality Makes Societies Stronger.* New York, NY: Bloomsbury Press; 2010
175. Putnam RD. *Bowling Alone: the Collapse and Revival of American Community.* New York, NY: Simon & Schuster; 2000
176. Putnam RD. *Our Kids: the American Dream in Crisis.* 1st ed. New York, NY: Simon & Schuster; 2015
177. Way N, Ali A, Gilligan C, Noguera P, Kirkland DE. *The Crisis of Connection: Roots, Consequences, and Solutions.* New York, NY: New York University Press; 2018
178. Pantell M, Rehkopf D, Jutte D, Syme SL, Balmes J, Adler N. Social isolation: a predictor of mortality comparable to traditional clinical risk factors. *Am J Public Health.* 2013;103(11):2056–2062
179. Koss KJ, Hostinar CE, Donzella B, Gunnar MR. Social deprivation and the HPA axis in early development. *Psychoneuroendocrinology.* 2014;50:1–13
180. Tottenham N, Hare TA, Quinn BT, et al. Prolonged institutional rearing is associated with atypically large amygdala volume and difficulties in emotion regulation. *Dev Sci.* 2010;13(1):46–61
181. Murray DR, Haselton MG, Fales M, Cole SW. Subjective social status and inflammatory gene expression. *Health Psychol.* 2019;38(2):182–186
182. Sheikh MA. The potential protective effect of friendship on the association between childhood adversity and psychological distress in adulthood: a retrospective, preliminary, three-wave population-based study. *J Affect Disord.* 2018;226:21–27
183. Brooks D. A nation of weavers. *The New York Times.* February 18, 2019
184. Jennings V, Bamkole O. The Relationship between social cohesion and urban green space: an avenue for health promotion. *Int J Environ Res Public Health.* 2019;16(3):E452

185. Rugel EJ, Carpiano RM, Henderson SB, Brauer M. Exposure to natural space, sense of community belonging, and adverse mental health outcomes across an urban region. *Environ Res*. 2019;171:365–377

186. Breuer J, Freud S. *Sigmund Freud Collection (Library of Congress). Studies on Hysteria*. New York, NY: Basic Books; 1957

187. Lanius RA, Vermetten E, Pain C. *The Impact of Early Life Trauma on Health and Disease: the Hidden Epidemic*. Cambridge, UK: Cambridge University Press; 2010

188. Goldhagen JL, Shenoda S, Oberg C, et al. Rights, justice, and equity: a global agenda for child health and wellbeing. *Lancet Child Adolesc Health*. 2020;4(1):80–90

189. Douglas MD, Josiah Willock R, Respress E, et al. Applying a health equity lens to evaluate and inform policy. *Ethn Dis*. 2019;29(suppl 2):329–342

190. Mohammed M, Simha S, Clarke-Pearson K, et al. Community engagement and equitable policy: promoting resilience and stability for children in immigrant families in North Carolina. *N C Med J*. 2019;80(2):94–100

191. Welsh J, Strazdins L, Ford L, et al. Promoting equity in the mental wellbeing of children and young people: a scoping review. *Health Promot Int*. 2015;30(suppl 2):ii36–ii76

192. Center on the Developing Child at Harvard University. Three Principles to Improve Outcomes for Children and Families, 2021 Update. Available at: https://developingchild.harvard.edu/resources/three-early-childhood-development-principles-improve-child-family-outcomes/. Accessed May 5, 2019

193. Center for the Study of Social Policy. *Pediatricians Supporting Parents*. Washington, DC: Center for the Study of Social Policy; 2019

194. Doyle S, Chavez S, Cohen S, Morrison S. *Fostering Social and Emotional Health Through Pediatric Primary Care: Common Threads to Transform Practice and Systems*. Washington, DC: Center for Study of Social Policy; 2019

195. Schonfeld DJ, Demaria T; COMMITTEE ON PSYCHOSOCIAL ASPECTS OF CHILD AND FAMILY HEALTH, DISASTER PREPAREDNESS ADVISORY COUNCIL. Supporting the grieving child and family. *Pediatrics*. 2016;138(3):e20162147

196. Yogman M, Garfield CF; COMMITTEE ON PSYCHOSOCIAL ASPECTS OF CHILD AND FAMILY HEALTH. Fathers' roles in the care and development of their children: the role of pediatricians. *Pediatrics*. 2016;138(1):e20161128

197. Healey A, Mendelsohn A; COUNCIL ON EARLY CHILDHOOD. Selecting appropriate toys for young children in the digital era. *Pediatrics*. 2019;143(1):e20183348

198. Hall RL, Jacobson PD. Examining whether the health-in-all-policies approach promotes health equity. *Health Aff (Millwood)*. 2018;37(3):364–370

199. Rigby E, Hatch ME. Incorporating economic policy into a 'health-in-all-policies' agenda. *Health Aff (Millwood)*. 2016;35(11):2044–2052

200. Shankardass K, Muntaner C, Kokkinen L, et al. The implementation of Health in All Policies initiatives: a systems framework for government action. *Health Res Policy Syst*. 2018;16(1):26

201. American Academy of Pediatrics. *Bright Futures Guidelines for Health Supervision of Infants, Children, and Adolescents*. 4th ed. Elk Grove Village, IL: American Academy of Pediatrics; 2017

202. Cochran J, Kaplan GS, Nesse RE. Physician leadership in changing times. *Healthc (Amst)*. 2014;2(1):19–21

203. Hobson WL, Carey JC, Bale JF Jr. Academy of pediatric education and leadership: preparing leaders for educational innovation. *Pediatrics*. 2011;128(1):1–4

204. Price J, Brandt ML, Hudak ML; COMMITTEE ON CHILD HEALTH FINANCING. Principles of financing the medical home for children. *Pediatrics*. 2020;145(1):e20193451

205. Cohen Ross D, Guyer J, Lam A, Toups M. *Fostering Social and Emotional Health Through Pediatric Primary Care: a Blueprint for Leveraging Medicaid and CHIP to Finance Change*. Washington, DC: Center for the Study of Social Policy; 2019

206. Sijtsema JJ, Nederhof E, Veenstra R, Ormel J, Oldehinkel AJ, Ellis BJ. Family cohesion, prosocial behavior, and aggressive/delinquent behavior in adolescence: moderating effects of biological sensitivity to context. *Dev Psychopathol*. 2013;25(3):699–712

Preventing Home Medication Administration Errors

- *Policy Statement*

POLICY STATEMENT Organizational Principles to Guide and Define the Child Health Care System and/or Improve the Health of all Children

American Academy of Pediatrics
DEDICATED TO THE HEALTH OF ALL CHILDREN™

Preventing Home Medication Administration Errors

H. Shonna Yin, MD, MSc, FAAP,[a] Daniel R. Neuspiel, MD, MPH, FAAP,[b] Ian M. Paul, MD, MSc, FAAP,[c]
COUNCIL ON QUALITY IMPROVEMENT AND PATIENT SAFETY, COMMITTEE ON DRUGS

Medication administration errors that take place in the home are common, especially when liquid preparations are used and complex medication schedules with multiple medications are involved; children with chronic conditions are disproportionately affected. Parents and other caregivers with low health literacy and/or limited English proficiency are at higher risk for making errors in administering medications to children in their care. Recommended strategies to reduce home medication errors relate to provider prescribing practices; health literacy–informed verbal counseling strategies (eg, teachback and showback) and written patient education materials (eg, pictographic information) for patients and/or caregivers across settings (inpatient, outpatient, emergency care, pharmacy); dosing-tool provision for liquid medication measurement; review of medication lists with patients and/or caregivers (medication reconciliation) that includes prescription and over-the-counter medications, as well as vitamins and supplements; leveraging the medical home; engaging adolescents and their adult caregivers; training of providers; safe disposal of medications; regulations related to medication dosing tools, labeling, packaging, and informational materials; use of electronic health records and other technologies; and research to identify novel ways to support safe home medication administration.

BACKGROUND

Errors in pediatric medication administration in the home environment are common[1–3] and can result in serious consequences.[4–6] These errors include dosing mistakes (both underdosing and overdosing), errors in frequency or duration of dosing (including missed doses), administration of incorrect medications or formulations, wrong route of administration, incorrect preparation or storage, and use of expired medications.[2–4,7–9] Many root causes have been identified that may contribute to errors,

abstract

[a]*Departments of Pediatrics and Population Health, Grossman School of Medicine, New York University, New York, New York;* [b]*Department of Pediatrics, Atrium Health, Charlotte, North Carolina (retired); and* [c]*Departments of Pediatrics and Public Health Sciences, College of Medicine, Pennsylvania State University, Hershey, Pennsylvania*

Drs Yin, Neuspiel, and Paul participated in the conceptualization, drafting, and revision of the policy statement; and all authors approved the final manuscript as submitted.

DOI: https://doi.org/10.1542/peds.2021-054666

PEDIATRICS (ISSN Numbers: Print, 0031-4005; Online, 1098-4275).

FINANCIAL DISCLOSURE: The authors have indicated they have no financial relationships relevant to this article to disclose.

FUNDING: No external funding.

To cite: Yin HS, Neuspiel DR, Paul IM, et al. Preventing Home Medication Administration Errors. *Pediatrics*. 2021;148(6): e2021054666

including provider prescribing practices,[10–12] pharmacy dispensing practices,[6,13] confusing measurement units and dosing tools for liquid medications,[14–19] involvement of more than one caregiver,[5,9] and health literacy and language barriers.[17,20–24] This policy statement reviews this information and recommends strategies to reduce the incidence of pediatric medication administration errors at home, including those involving prescription and over-the-counter (OTC) medications, as well as vitamins and supplements.

STATEMENT OF PROBLEM

More than half of children in the United States take 1 medication or more each week,[25] and caregivers commonly make errors in administering medications to children.[2,3,19,26] One study showed that nearly half of caregivers gave a dose of medication that deviated more than 20% from what was prescribed after their child was discharged from the emergency department of a public hospital; 1 in 4 caregivers gave a dose that deviated by more than 40%.[3] A second study in a similar setting found comparable rates.[19] In another study, more than half of caregivers gave doses of OTC medications outside of the recommended range for their child.[26] Although for the majority of commonly used medications, a single dosing error is unlikely to cause a clinically significant injury, persistent errors across multiple doses raise concerns for harm. OTC medications as well as vitamins and supplements are widely used and are perceived to be safe by many caregivers[25,27–32] but may cause serious harm when used incorrectly.[5,33–36] Regimen-related factors, involving multiple medications[37–39] or requirements for more frequent administration (eg, 3 times a day instead of 1 time a day), are associated with more errors.[40,41] Regimens in which acetaminophen and ibuprofen are given continuously in an alternating fashion are also difficult to follow and prone to error,[42–44] unless explicit instructions and/or charts are clearly provided to support understanding. Other regimen-related factors that place children at risk for errors include scenarios involving liquid medications or other special preparations (eg, granules that need to be mixed with food),[1,45] situations in which a combination of single and multiple ingredient prescription and OTC medications are given (in which confusion between generic and brand names may result in families being unaware that a child is being given medications with overlapping active ingredients),[22,46,47] when medications are available in more than one concentration and/or formulation,[22,48,49] or when medications with narrow therapeutic windows are involved.[50–52] Home medication errors are of particular concern in the management of children with chronic conditions and special needs, such as cancer, sickle cell disease, epilepsy, and autism, as these children are often prescribed multiple medications or medications that have complex administration instructions, and there is an increased potential for harm when errors occur.[9,53–58] Medication administration in pediatrics is also challenging as more than one caregiver may be involved in the care of a child and more than one child in a family may be taking medications.[9,59] Confusion about whether a medication has already been given can lead to double dosing or missed doses of medicines; miscommunication between caregivers has contributed to cases of significant pediatric morbidity.[5] Adolescents with less caregiver supervision may also have more frequent home medication errors, particularly when their prescriptions are for conditions treated confidentially, without caregiver knowledge, such as sexually transmitted infections.[59–63] In the outpatient pediatric setting, medication administration errors are believed to account for the majority of preventable pediatric adverse drug events.[37,64]

IMPACT OF HEALTH CARE PROVIDER PRESCRIBING AND PHARMACY DISPENSING PRACTICES

Health care provider prescribing practices contribute to medication errors; providers can prescribe in ways that can make medication administration by caregivers and patients easier or more complex. Missing or unclear information (eg, related to route, frequency, duration, indication) can affect the understandability of medication instructions.[10,65] In addition, providers may not follow safe prescribing practices recommended by The Joint Commission, resulting in caregiver confusion; The Joint Commission standards apply to both inpatient and outpatient settings and recommend inclusion of leading zeros (eg, 0.X), avoidance of trailing zeros (eg, X.0), and avoidance of confusing abbreviations that may not be familiar to families, such as U (unit) and QD (daily), when prescriptions are ordered.[66] Because pediatric providers often rely on weight-based dosing and may prescribe in milligrams (mg), which may lead to complex dose amounts (eg, 4.8 mL) prescribed when milligrams are converted to milliliters, rather than simpler and easier-to-measure doses rounded to a whole number (eg, 5 mL).[67,68] Pediatric providers may also use multiple units of measurement in their instructions[18,19] and may believe that caregivers are more comfortable with instructions using teaspoon or tablespoon terms.[69]

Limitations in the functionality of electronic health record (EHR) systems may further contribute to these issues by not allowing rounding or by defaulting to instructions that use multiple units.[67,70,71] Providers who have not performed a thorough medication review or reconciliation process may also not be aware of all the medications a child is taking and whether caregivers are administering medications correctly, including avoiding giving medications that interact; the medical home model seeks to prevent this by having a coordinating health care provider with oversight over all medications for an individual patient.[72] Providers can simplify medication regimens by avoiding prescribing medications that are not essential as well as deprescribing, or discontinuing, unnecessary medications.[73]

Pharmacist dispensing practices may also contribute to incorrect medication administration, because dispensing practices can affect the clarity of instructions given to caregivers.[6,13] Several studies have shown that units of measurement included on prescriptions were frequently changed in the pharmacy setting (eg, one unit switched to another unit or additional unit of measure added), which can become a source of caregiver confusion, particularly if the units used as part of instructions are different from the units mentioned during medication counseling in the clinical setting.[18,19] State pharmacy regulations also allow pharmacists to fill a prescription using a different strength and/or concentration of medication than prescribed, as long as the dose in milligrams is equivalent; if pharmacists do not inform caregivers of this change, this practice can contribute to confusion.[13,74] Like providers, pharmacists also can alter the display of doses involving decimals.[13,75] Pharmacy dispensing errors have contributed to cases of significant pediatric morbidity (eg, related to changing units of measurement).[6,13] Use of pharmacy software to support safe pharmacist dispensing practices and use of a universal formulary that limits the number of medication concentrations available (including for medications requiring compounding) have been suggested as ways to decrease the potential for pharmacist dispensing error as well as caregiver administration error.[13,76] The US Food and Drug Administration (FDA)–funded Standardize 4 Safety initiative, led by the American Society of Health-System Pharmacists, seeks to create national standards around medication concentrations for intravenous and oral medications to reduce the risk of medication errors.[76]

ROLE OF HEALTH LITERACY AND LIMITED ENGLISH PROFICIENCY

For caregivers, the task of understanding how to correctly administer medications to children may be challenging from a health-literacy perspective, and advanced health-literacy skills may be required to manage complex medication regimens. Health literacy refers to an individual's ability to read, understand, and process health information for informed decision-making regarding health issues and includes the ability to navigate the health care system.[77,78] Nearly 30% of parents in the United States, or approximately 21 million US parents, have low health literacy,[79] placing them at increased risk of making medication administration errors.[17,41,79,80] Notably, only 15% of parents are considered to have proficient levels of health literacy, indicating that the majority of caregivers struggle with some health-literacy challenges.[79] Caregivers with low health literacy have greater difficulty understanding prescription and OTC labels and are more likely to use nonstandard kitchen spoons, to misunderstand active ingredient information, and to be unaware of weight-based dosing.[23,47,79–84] Among caregivers, limited health literacy has been linked to an increased odds of liquid medication dosing errors by 1.5-fold to 2.5-fold.[17,24,82,83]

Approximately 12% of US adults have limited English proficiency.[85,86] Patients with limited English proficiency are at increased risk for misunderstanding instructions and making errors, especially when the information provided is not in the language of their preference and the quality of translated instructions is poor.[21,37,86–91] Cultural factors may also affect adherence to medication regimens[22,92,93]; assessing culturally based health beliefs related to medication use can help providers understand issues that may have significant implications for how caregivers or patients understand and will act on the instructions provided. Provision of instructions in the caregiver's and/or patient's native or preferred language is considered to be an essential first step to achieving understanding of medication instructions; use of trained interpreters and certified translation experts is necessary to facilitate high-quality translation and interpretation.[94,95] Suboptimal access to high-quality medical interpretation and pharmacy label translations is common and can have important clinical consequences.[88,96–98] Notably, those with limited English proficiency are disproportionately affected by low health literacy.[24] Compared with those with low health literacy or limited English proficiency alone, caregivers with both low health literacy and limited English

proficiency are at even greater risk of medication errors.[24]

CHALLENGES FOR EFFECTIVE PROVIDER-PATIENT AND CAREGIVER COMMUNICATION IN CLINICAL AND PHARMACY SETTINGS

Communication obstacles in the clinical setting can be challenging for caregivers and patients regardless of literacy level and English proficiency, but these issues are especially difficult for those with low health literacy and limited English proficiency.[20,77,79,87,99–101] Provider counseling may be incomplete, leaving out key information, such as indication, dose, route, frequency, and duration, or may not address side effects or drug interactions.[102,103] Provider counseling may also not be explicit enough (eg, medication instructions say to give "twice a day" instead of "in the morning" and "in the afternoon") or may not be accurate (eg, "give every 8 hours" leads to the impression that a child would need to be woken up from sleep when this may not be true)[13,22]; it is best if these more explicit instructions are verbally presented to families by the provider and conveyed to the pharmacist for inclusion on the prescription. Use of a Universal Medication Schedule (UMS) approach, in which frequency information is presented by using 4 specific times of day (eg, "morning," "noon," "evening," and "bedtime" instead of as number of times per day) has been associated with improved patient understanding of medication instructions.[104,105] Lack of explicit provider counseling regarding route of administration may lead to medications inadvertently being put in the wrong location (eg, oral antibiotic for an ear infection placed in the ear canal instead of in the mouth), resulting in treatment failure.[2,22] Confusion may also result from the language used on the prescription (eg, for the instruction "once a day," Spanish-speaking families may misinterpret "once" to be "11," resulting in a serious overdose).[77,106] EHRs could be leveraged to facilitate provision of complete instructions (eg, hard stops unless information on dose, frequency, route, and duration are included) and can support provision of explicit standard dosing intervals (eg, Universal Medication Schedule [UMS] approach) as well as appropriate language translations.[104,107]

The majority of pediatric providers do not routinely use health literacy–informed "advanced counseling" strategies,[108,109] such as demonstration, drawings/pictures, or teachback/showback, even though use of these strategies has been associated with reduced caregiver dosing errors and improved understanding of medication instructions,[3,109,110] with benefits observed for families across literacy levels.[111] For patients who are being discharged from the hospital with complex medication regimens, emphasis on demonstration and showback, as part of a rooming-in process, may be beneficial for a safe transition to home.[112] Use of simulation may also be helpful for caregivers and providers to learn important aspects of medication administration and effective counseling strategies, respectively.[113–115]

Although use of written information as part of counseling has been found to be beneficial in reducing cognitive load,[116,117] health care providers often do not use written information to supplement provider verbal medication counseling.[108,118] Plain-language written instructions can give clinicians a framework for low-literacy counseling, helping to provide an easy-to-understand "script," as well as ensuring that key concepts are covered; optimally, these patient- and regimen-specific instructions would be given to families to take home and share with other caregivers.[3,119] Provision of a pictographic dosing diagram as part of written instructions, which visually illustrates the amount of medication to provide within a recommended dosing tool, has been found to be a promising strategy to enhance caregiver understanding of the appropriate dose, with benefits observed across health-literacy levels[82,120]; in 1 study, researchers found a more than fivefold reduction in dosing errors with prescribed daily dose medications with the use of a pictographic medication instruction sheet–based intervention to supplement provider verbal counseling.[3] Use of the intervention, which included a pictographic printed log to help caregivers track medication use, was also associated with an increased likelihood of families completing ≥80% of the recommended medication course.[3] Technological advances represent a promising avenue for promoting provider adoption of such tools.[67,121,122] For example, incorporation of tools into the EHR workflow could allow providers to quickly generate pictographic patient- and medication-specific low-literacy instruction sheets at the point of prescribing. Providing families with a printout of the after-visit summary allows them to have a tangible resource to refer to when they have questions about how to take medications at home; families may not be able to access this information online from home.

There are many ways EHRs could support the provision of tailored written medication instructions for pediatric patients.[67,122] For example, a typical precaution for a

drug that causes sedation is "do not drive a car or operate heavy machinery," which might be disregarded by a caregiver of a young child who would then overlook the potential risk of sedation. EHRs could automatically adjust messaging based on the age of the patient; for example, a child-focused precaution for a drug that causes sedation could be "watch your child when he or she is riding a bike, climbing stairs, or doing other activities where being awake and alert is important." In addition, EHRs could provide pediatric-centric information about the frequency or severity of adverse reactions in children because this information may differ from information targeted for adult patients.

Use of other visual modalities, as well as online and mobile technology resources, can also help support safe medication administration. Linkages to online pediatric information, as well as apps,[123] could be made more easily accessible to families seen in health care settings. Videos can also help support adherence to medication instructions.[123] Use of text messaging could also be leveraged to support caregivers in administering medications to children,[124,125] but text messaging of protected health information must comply with the Health Insurance Portability and Accountability Act of 1996.[126,127]

Because all patients and families benefit from simple, clear instructions, a "universal precautions" communications approach is generally recommended.[100,101,128,129] There is growing acceptance of the concept that health literacy is a fluid state that can be affected by stress, anxiety, and context, rather than a fixed trait.[77,129,130] It is, therefore, best to use health literacy–informed communication with all individuals.

In the pharmacy setting, caregivers often do not receive or opt out of verbal counseling from staff.[131] Prescription bottle labels may not be designed in a patient-centered manner[132–134] and may not incorporate health-literacy principles. For example, although prescription labels that include a pictographic dosing diagram have been found to be beneficial, especially for reducing large dosing errors (in 1 study, researchers found a twofold decreased odds of error with the use of text-plus-pictographic dosing instructions compared with text-only instruction[82]), use of pictographic diagrams on medication labels has not been adopted as part of standard care. Finally, written materials provided to families at the time of medication dispensing are often written at a ninth-grade reading level or higher[16,135,136]; experts recommend a sixth- to eighth- grade reading level for the average person and a fifth-grade level or below for people with low literacy.[137–139]

Empowering families during clinical and pharmacy encounters can help reduce the risk of home medication errors.[140–144] Health care providers, including pharmacists, can encourage caregivers to ask questions when they are unsure of how to give medications at home by increasing awareness that caregiver difficulty with administering medications is common and that questions are expected (eg, "It is common for caregivers to have questions about how to give these medications. What questions do you have for me?").[142,145–147] Caregiver awareness that both prescribers and pharmacists are responsible for providing information on how to administer medications safely to their child may prompt them to ask questions when they are confused.[142]

ROLE OF LIQUID FORMULATIONS IN HOME MEDICATION ERRORS IN CHILDREN

Liquid formulations of medications, on which pediatric providers rely, especially for young children and children who have feeding tubes,[13,148,149] are involved in more than 80% of pediatric home medication errors.[1] For children with feeding tubes, care is further complicated by the need to give a water flush after medication dosing to facilitate removal of any remaining medication in the tube.[148] Compared with tablets and capsules, liquid medications may be more complex to administer[1,150]; in certain contexts, switching from liquid to tablets or chewable formulation may simplify therapeutic regimens and promote adherence.[151,152] Dosing errors are easier to make with liquid formulations compared with solid-form medications, with confusion related to the measurement of liquids resulting in wide variation in dosing, ranging from large multifold overdoses to significant underdosing.[13,19,83] Overdosing medications is problematic given concerns related to drug toxicity and side effects, but underdosing can also have serious implications, including lack of therapeutic effect and symptom relief as well as potential contributions to antibiotic drug resistance.[2,4,8,80,83,153,154]

Many caregivers are unaware that use of nonstandard kitchen spoons for dose measurement should be avoided because kitchen spoons vary widely in size and shape.[14,23,155,156] Caregiver use of kitchen spoons is associated with higher rates of dosing errors[50,155,157,158]; although a teaspoon is considered to be equivalent to 5 mL, kitchen teaspoons have been found to measure between 2 and 9 mL.[159] The American Academy of Pediatrics

(AAP) has long recommended that liquid medications be measured using standard dosing tools.[14,160] A wide range of tools with standard measurement markings are available, including oral syringes, cups, dosing spoons, droppers, and measuring spoons[17]; these standard tools have calibrated markings that can be used to help caregivers measure doses accurately.[156,158,160] The FDA has recommended inclusion of a dosing tool with standard measurement markings (also called a standard dosing tool) for all OTC liquid medications.[161–163] Despite these recommendations, it is not standard practice for dosing tools to be provided in the clinical or pharmacy setting.[3,109,164] Use of health literacy–informed advanced counseling strategies (such as teachback, showback, and demonstration) has been found to be especially effective when conducted in conjunction with provision of a standard dosing tool.[109]

With prescription and OTC products, it is recommended that only the tool provided with the medication be used for administering that medication[15,162,165]; caregivers can be counseled to ask for a dosing tool at the time of medication purchase if they are not given one.[166] Colocation of dosing tools with their associated medications and storing the tool with the medication up, away, and out of sight of children can promote caregiver use of the correct tool and prevent unintentional medication ingestions.[166–169] The quality of dosing tool used has implications for correct medication measurement; some dosing tools that are designed for single or limited use have markings that rub off. Repeated use of such tools can result in hard-to-read markings that make it difficult for caregivers and/or patients to determine the right level to which to fill the tool; the US Pharmacopeia recommends the use of dosing tools with indelible markings.[170]

Caregivers vary in their ability to dose accurately with different types of standard dosing tools.[17,82,83,171,172] Dosing cups may be especially difficult to measure with; caregivers may confuse the entire cup as the dose, may not place the cup on a level surface when measuring, or may not look at the markings at eye level; markings on devices may also not be printed clearly (eg, etched versus printed).[17,166,173] Dosing cups have been associated with a more than threefold increased odds of error compared with oral syringes,[17,80,83] and the potential for multifold errors with cups is especially high with small-dose volumes.[80,82,83] Oral syringes are typically preferred by health care providers for increased accuracy in dose measurement and are generally recommended when dosing accuracy is essential[14,83]; this is especially important with medications that have a narrow therapeutic window.[50,83] Oral syringes are typically recommended for administering medication to young children, especially when small doses are involved.[83] To determine the optimal dosing tool to give to families, it is also important for providers to consider the relationship between the size of the dosing tool and the prescribed dose amount.[80,82,83] Dispensing a tool that is too large for a dose (eg, a 10-mL syringe for a 1-mL dose) increases the risk of multifold errors because there is a large amount of extra space that can be filled, resulting in overdosing.[82,173] Dispensing a tool that is too small for a dose (eg, 5-mL syringe for a 7.5-mL dose) results in the need to fill a tool multiple times, requiring the use of numeracy skills (eg, $5 + 2.5 = 7.5$ mL).[16,82,120] Dosing cups may be adequate for larger doses (eg, >10 mL), particularly for lower-risk medications with wide therapeutic margins.[82] With the growing use of electronic prescribing,[174,175] information on optimal dosing tools for prescribed medications could be automatically generated at the point of prescribing in the EHR or at the point of dispensing within pharmacy software systems, providing information to clinicians and pharmacists about which tool is best to use based on the recommended dose amount.

Confusion about units of measurement also contributes to dosing errors with liquid medicines.[13–15,19,81,176] A variety of terms, such as milliliter, teaspoon, and tablespoon, and their associated abbreviations (mL, tsp, TBSP, respectively) may be used interchangeably as part of verbal and written communication of dosing instructions and associated dosing tools; milligram (mg) may also be used.[13,15,18,19,177] Variability in the use of units is common; in 1 study, researchers found that in more than one-third of cases, medication bottle labels did not contain the same units found on the prescription,[19] and in another study, researchers found that labels and associated dosing tools included with top-selling OTC liquid medications frequently did not use consistent text for unit terms.[15] Confusion between volumetric unit terms increases the risk of multifold errors by caregivers and providers (eg, teaspoon confused for milliliter can lead to a fivefold under or overdose)[13]; confusion between volumetric and nonvolumetric terms (eg, milliliter and milligram) can also lead to confusion.[18,177] Spoon-based terms inadvertently endorse the use of nonstandard dosing tools; in 1 study, caregivers had a fourfold increased odds of choosing a kitchen spoon (ie, kitchen teaspoon or tablespoon) when teaspoon units were present on the medication label.[81] Dosing in milliliters has been associated with fewer

caregiver errors compared with dosing using spoon-based terms.[82,83] Concerns about unit-of-measurement–related errors has led the Centers for Disease Control and Prevention, via its PROTECT (Prevention of Overdoses and Treatment Errors in Children Taskforce) Initiative, to recommend milliliter-only dosing and elimination of spoon-based terms.[178] As a member of this initiative, the AAP has endorsed milliliter-only dosing, joining groups such as the American Academy of Family Physicians, American Pharmacists Association, American Association of Poison Control Centers, US Pharmacopeia, the Institute for Safe Medication Practices, and the Pediatric Pharmacy Advocacy Group.[13,14,179–181] Although people with low health literacy may especially benefit from a simpler, milliliter-only dosing system, those with low health literacy are more likely to prefer teaspoon units and perceive that a move to a milliliter-only unit system will be difficult.[182] EHR systems can be leveraged to support milliliter-only dosing (eg, limiting unit choices and defaulting to milliliter-only dosing).[14,69]

OTC MEDICATIONS

Caregivers and patients often do not receive guidance from health care providers on the use of OTC products[20]; they may not be aware that pharmacists are trained to counsel families about how to select and use OTC products and are available for consultation.[183] Caregivers and patients, therefore, often rely on their own health-literacy skills or those of family members to determine which medications to purchase and how to appropriately administer them.[20,84] Nearly 60% of US caregivers report difficulty understanding OTC labels, with 1 in 3 reporting "great" or "moderate" difficulty.[79] Many caregivers struggle to appropriately select medications, including distinguishing between different formulations or strengths, and recognizing that 2 or more medications with the same active ingredient should not be given at the same time (to avoid double dosing).[4,7,47,184] Caregivers also struggle to navigate dosing charts to determine the correct amount of medication to give to their child and fail to recognize that dosing should generally be based on child weight rather than age.[23,26,185] This issue may be especially confusing for caregivers of children who are overweight or obese.[186,187] In addition, caregivers may confuse the child's weight in kilograms versus pounds; consistent provider use and communication of weight in kilograms could reduce inadvertent caregiver dosing errors.[187,188] Dosing charts also may not include dosing information for the youngest children; for example, for children younger than 2 years, the dosing chart for acetaminophen states "ask your doctor,"[189,190] contributing to caregiver confusion.

Caregivers are frequently confused about how to correctly administer OTC cough/cold products.[84,191,192] Several issues have been specifically identified that contribute to caregiver errors with OTC cough/cold products, including confusion with age restriction information, difficulty recognizing that some cough cold medications contain multiple active ingredients (and may include an antipyretic), and confusion interpreting dosing charts.[47,192,193]

In 2008, the FDA, spurred by cases of fatalities in young children, several of which involved home administration errors by caregivers,[194–196] issued a public health advisory recommending that cough/cold products not be used in children younger than 2 years[191]; this recommendation was later voluntarily extended to children 4 years and younger by manufacturers of OTC cough/cold products.[197] Although rates of adverse events related to cough/cold medication in children have decreased after these efforts, caregivers of young children continue to use these products.[8,28,192]

MEDICATION RECONCILIATION AND THE MEDICAL HOME

Because children are often taking a combination of medications, which may include both single and multi-ingredient prescription and OTC products, as well as vitamins and other supplements, a medication reconciliation process is recommended at all relevant clinical encounters, such as when a new provider is taking over the care of a patient, when there has been a long gap between clinical encounters, or a when a new medication is being prescribed.[198–201] Caregivers may not realize that 2 medications interact or may not realize that 2 medications their child is taking contain the same active ingredients, leading to a multifold overdose.[28,47] For children with special health care needs, in particular, having a medical home with a primary care provider responsible for coordinating care among all providers is helpful for promoting a safe home medication–use environment.[72]

Review of each medication a patient is taking (to determine if the medication is being administered correctly, if the medication is still necessary, and if the administration instructions need to be updated [eg, dose adjusted to account for weight gain]) is considered an important safety practice.[100,101,202] EHRs could be used to generate medication lists for families to review and bring to provider visits to support the medication reconciliation process.[199,203] Encouraging

caregivers to bring in medications to provider visits and describe how medications are being administered can also be helpful in identifying potential errors in medication use.[100,101,198]

MEDICATION DISPOSAL

Caregivers often keep medications in their homes even after medications are expired or are no longer in use.[204,205] Having medications in the home that are no longer in use may increase the likelihood that these medications will be confused with medications in use and may lead to inadvertent administration of the wrong medication to the child that the medication was intended for or another person in the home[206]; with unused opioids in the home, there are also concerns about the abuse and diversion potential for adolescents and other adults in the home.[207] Saving leftover medicine prescribed for an acute illness for a later illness episode may lead to ineffective treatment of a child's illness because there may not be sufficient medication remaining to properly treat a subsequent illness and medication potency may be reduced for expired medications.[206,208]

Recommendations exist about how to safely dispose of medications.[209,210] Recent federal guidelines state that prescription or OTC medications are not to be flushed down the toilet or poured down a sink unless patient information material specifically states that it is safe to do so. If no disposal instructions are given as part of the medication labeling information, FDA guidelines recommend the following actions:

- Taking advantage of programs that allow the public to take unused drugs to a central location for proper disposal. Local law enforcement agencies may sponsor medicine take-back programs. City or county government household trash and recycling services may also have specific medication disposal options and guidelines.
- Transferring unused medicines to collectors registered with the Drug Enforcement Administration (DEA). The DEA website has information on how to find an authorized collector (http://www.deadiversion.usdoj.gov/drug_disposal/index.html).[211]

Pharmacies may also have drug disposal kits available for safe medication disposal in the trash or drop-off kiosks where families can dispose of unused medications.[210]

If there are no disposal instructions given on the drug label and no take-back program or disposal kits are available, medications can be thrown out in the household trash. Before throwing out medications, removal of medications from their original containers and mixing them with an undesirable substance, such as used coffee grounds, dirt, or kitty litter, is recommended (this makes the drug less appealing to children and pets and unrecognizable to people who may intentionally go through the trash seeking drugs).[210] Placement of the mixture in a sealable bag, empty can, or other container will prevent the drug from leaking or breaking out of a garbage bag.[209]

RECOMMENDATIONS

The following actions can reduce home medication administration errors:

1. Improve communication to caregivers and patients (Table 1):
   - Make medication regimens as simple as possible (eg, avoid prescribing unnecessary medications, reduce number of medications prescribed, discontinue medications when possible, reduce administration frequency, and avoid unnecessary multiingredient combination products).
   - Use appropriate dosing units (eg, use mL-only and avoid spoon-based or nonmetric units; avoid nonvolumetric units [eg, mg] in describing the dose amount).
   - Use only kilograms (kg) for child weight to reduce inadvertent mix-ups (with pounds) and potential for error.
   - Learn and use health literacy–informed verbal counseling strategies (eg, plain language, pictures/drawings, and teachback/showback) for use in clinical and pharmacy settings, including as part of hospital discharge.
   - Provide verbal counseling in the language of caregiver/patient preference, using a trained interpreter if the provider does not have fluency in the patient's preferred language.
   - Provide written patient education materials on medication use appropriate for the literacy level and languages spoken by patients and caregivers.
   - Provide a printout of the after-visit summary for families to take home and refer to for information about their medication instructions.
   - Make an extra effort to verify caregiver/patient understanding in cases involving specific higher-risk medication regimens or at-risk populations (Table 2). This includes the following:
     - Counseling caregivers about OTC medications and addressing common sources of caregiver confusion with

TABLE 1 Recommended Provider Counseling Practices to Promote Safe Home Administration of Pediatric Medications

Recommended Practice	Explanation
Provide straightforward and actionable instructions	Medication counseling conveys key instructions, including: • Medication name • Medication purpose (indication) • Dose amount • Frequency • Duration • Route of administration • Side effects Provide dose amount using milliliter units only, using the abbreviation "mL." • Avoid spoon-based units (eg, teaspoon [tsp] and tablespoon [TBSP]) • Avoid dosing in cubic centimeters (ie, cc) • Use mL units consistently in verbal and written communication Provide dose amounts that are easy to measure.: avoid fraction or decimal amounts when possible (use whole number amounts); include leading zeros if decimal amounts are used (eg, 0.X); avoid trailing zeros (eg, X.0); and avoid confusing abbreviations, such as U (unit) and QD (daily) (eg, for insulin dosing, spell out the word "unit"). • Avoid fraction or decimal amounts when possible (use whole number amounts) • Include leading zeros if decimal amounts are used (eg, 0.X) • Avoid trailing zeros (eg, X.0) • Avoid confusing abbreviations, such as U (unit) and QD (daily) (eg, for insulin dosing, spell out the word "unit") Give explicit instructions regarding timing: • Provide information on time of day (eg, in the morning and in the evening) instead of providing only frequency information (eg, 2 times a day) • Include information on explicit timing on prescriptions
Incorporate health literacy–informed counseling strategies and educational materials for caregivers as part of care provided in inpatient, outpatient, emergency care, and pharmacy settings	Use a universal precautions approach to counseling (perspective that all patients would benefit from receiving evidence-based, health literacy–informed communication strategies) Use the following health literacy–informed verbal communication strategies: • Plain, "living room" language • Demonstration (eg, for liquid medications, consider using an oral syringe to demonstrate the amount of medication the caregivers should measure out; for asthma, consider having a staff member demonstrate how to use the spacer with inhaler) • Teachback: ask caregivers to say in their own words how they will give the medication (eg, "I want to make sure I did a good job explaining to you how much medication you should give. Can you tell me how much medication you will give to Jennifer each time?") • Showback (eg, have caregiver demonstrate how much medication they plan to give each time using an oral syringe). Provide patient- and regimen-specific written instructions that can be taken home and shared with family members: • Incorporate written instructions into verbal counseling to reduce cognitive load • Use pictures and/or drawings to supplement counseling (eg, for liquid medications, provide a pictographic dosing diagram which visually shows the right amount of medication to give within a standard dosing tool) • Provide a log for caregivers to keep track of medications given and help promote adherence to the full course of medication • Written information recommended to be at a sixth- to eighth-grade reading level for the general population and a ≤5th grade reading level for patients with low literacy.
For liquid medications, promote caregiver use of standard dosing tools	• Counsel caregivers to use standard dosing tools (eg, tools with standard measurement markings, such as oral syringes, cups, dosing spoons, and droppers) and avoid the use of nonstandard kitchen spoons. • For prescribed medications, it is recommended that health care providers or pharmacists provide a standard dosing tool to caregivers to take home if no tool is provided as part of packaging (in particular, providers dispensing the medication are responsible for making sure that families have an appropriate tool to use to measure the prescribed medication). ◦ Provide oral syringes when dosing accuracy is important, especially when smaller doses are recommended (eg, <5 mL). ◦ Provide tool with the smallest size to fit the dose without the need to fill the tool multiple times for a single dose. • Warn caregivers regarding potential known pitfalls of dosing cup use.

TABLE 1 Continued

Recommended Practice	Explanation
	◦ Avoid cups for smaller doses (eg, <5 mL). ◦ Place cups on a level surface when measuring; look at markings at eye level when measuring. • Promote dosing-tool best practices. ◦ For prescription medications, use tool provided by health care provider or pharmacy for specific medication prescribed. ◦ For OTC medications, use dosing tool included in packaging. ◦ Colocation of dosing tool with prescribed medication.
Provide language concordant care	Verbal counseling and written information should be provided in the language of patient and/or family preference. • High-quality translations should be provided. • Trained/certified professional interpreters should be used.
Empower caregivers to engage in care	• Empower caregivers to ask questions. ◦ Acknowledge that many caregivers have difficulty with administering medications and that questions are expected (eg, "I just gave you a lot of information. It is common for caregivers to have questions about how to give these medications. What questions do you have for me?") • Encourage caregivers to request a dosing tool if one is not provided.
Reconcile medications at each relevant patient encounter	Conduct regular reviews of medication lists with patients and caregivers. • Systematically review each medication taken (eg, name, strength, indication, dose, frequency, and expected duration) • OTC medications, and vitamins and/or supplements, should be included.

OTC medications, including age restrictions, active ingredient information, and dosing instructions (eg, prioritization of weight versus age).

- Providing anticipatory guidance for adolescent patients to address their evolving responsibility in managing their own health care, including the responsible use of medications and review of their medication use with adult caregivers.
- Encouraging families with multiple caregivers to develop a communication strategy about medication administration to prevent overdoses and maintain correct dosing intervals.
- Encouraging families to avoid use of products that have "do not use" statements on the label that apply to their child, such as for OTC

TABLE 2 Scenarios Involving Increased Risk for Medication Error

Regimens involving:
- Medications with a narrow therapeutic window, including warfarin and tacrolimus
- "High-alert" medications (see Institute for Safe Medication Practices' High-Alert ambulatory list: https://www.ismp.org/recommendations/high-alert-medications-community-ambulatory-list)
- Complex instructions (eg, multiple medications, multiple administrations in a day, nonwhole number doses, or more than one unit of measurement used), including medications that require compounding in which standard concentrations may not exist
- Medications requiring special preparation (eg, mixing and diluting)
- OTC medications (eg, caregiver confusion related to age restrictions, active ingredient information, and dosing chart interpretation)
- Regimens involving alternating acetaminophen/ibuprofen dosing
- Cough/cold medications, especially in young children

Populations at risk:
- Children with chronic health conditions and special needs
- Multiple caregivers are involved
- More than one child in the family is taking the same medication
- Adolescents
- Caregivers/patients with low health literacy
- Caregivers/patients with limited English proficiency

cough/cold medications.

2. Encourage the use of a standardized dosing tool with all liquid medications. This may be already included in packaging or provided by the pediatric clinician or pharmacist.
   - Provide oral syringes when dosing accuracy is essential, especially when smaller doses are recommended (eg, <5 mL) and when medications are for young children.
3. Provide a dosing tool with the smallest size to fit the dose without the need for filling the instrument multiple times for a single dose.
4. Demonstrate the prescribed dose of medication by using a dosing tool and have the patient/caregiver teachback/showback the dose.
5. Counsel caregivers about colocation of dosing tool for ease of access of the tool when medications are administered; store dosing tools with medications safely (eg, up, away, and out of sight).
6. Encourage caregivers to ask for a dosing tool with all prescribed medications and to use their medication-specific tool each time.
7. If a dosing tool comes packaged with a medication, caregivers should use that tool to measure that medication.
8. On all prescriptions, it is best to do the following:
   - Include patient weight so that pharmacists can double check the dose.
9. Include indications so that pharmacists can provide a second check on the dose (some medications are dosed differently on the basis of indication or may be used off-label), except in cases that involve sensitive issues, such as psychiatric or substance use disorders.
10. Reconcile medications at all relevant patient encounters (such as when a new provider is taking over the care of a patient, when there has been a long gap between clinical encounters, or when a new medication is being prescribed) by systematically reviewing each medication being taken (eg, name, strength, indication, dose, frequency, and expected duration); OTC medications, and vitamins and supplements, should be included in this review.
    - Medication information provided to families, including at the time of discharge from both inpatient units and emergency departments, needs to include key administration information, such as medication dose, route, frequency, and duration.
11. Providers involved in discharge, from both inpatient units and emergency departments, are responsible for giving information to the patient's primary care provider such that the medication plan initiated in the hospital is appropriately executed at home. For chronic medications, information about whether the medication needs to be adjusted for weight is considered an essential piece of information.
12. Encourage caregivers to bring for review their actual medications, or a list of medications, to provider visits.
13. Providers should access educational modules and other resources for safe prescribing practices (including mL-only dosing), health literacy–informed patient education and counseling, and safe storage and administration of home medications (Table 3).
14. Professional organizations should make educational modules and other resources to promote safe home medication administration available to providers and incorporate them as part of continuing medical education and maintenance-of-certification opportunities.
15. To avoid unintentional ingestions and use of expired prescription medications, promote safe disposal of unused medications after course completion. Common household OTC medications should also be safely disposed of when expired.
16. Encourage governmental agencies and industry to adopt measures to promote home medication safety, including the following:
    - Standardization of dosing units.
17. Ensuring that appropriate dosing tools are packaged with oral liquid medications.
18. Optimization of medication labels and packaging to decrease caregiver confusion.
19. Standardization of formulations to reduce confusion between infant versus children's formulations of medications.
20. Provision of health literacy –informed patient information materials in the language of patient and/or family preference.
21. Removal of "ask your doctor" from OTC medication labels and replacement with more precise instructions when possible (eg, acetaminophen for children aged <2 years).
22. Promotion of EHR functionality that supports safe pediatric medication use (eg, automatic rounding to whole numbers for liquid medications, limitation or default to mL-only dosing, limitation to one concentration of medication, default standard dosing based on weight, explicit standard dosing intervals [eg, morning and night versus twice a day], hard stops to facilitate acquisition of a complete set of information [eg, dose, frequency, and duration], prompts about drug interactions, and provision of

TABLE 3 Helpful Resources

	Resources
Safe prescribing practices	AAP Policy Statement: "Metric Units and the Preferred Dosing of Orally Administered Liquid Medications" (April 2015)[14]: http://pediatrics.aappublications.org/content/135/4/784/
	The Joint Commission "Do not use" list[66]: https://www.jointcommission.org/-/media/tjc/documents/resources/patient-safety-topics/patient-safety/do_not_use_list_9_14_18.pdf
	American Board of Pediatrics Safe Prescribing Performance Improvement Module[212]: https://pim.abp.org/rxwriting/faq/
Health literacy–informed counseling strategies	American Board of Pediatrics Performance Improvement Module on Health Literacy[213]: https://pim.abp.org/health_literacy/faq/
	AHRQ Universal Precautions Toolkit (includes information on verbal and written communication strategies, medication reconciliation)[100,101]: https://www.ahrq.gov/professionals/quality-patient-safety/quality-resources/tools/literacy-toolkit/index.html and https://www.ahrq.gov/sites/default/files/publications/files/healthlittoolkit2_3.pdf
	AHRQ How to Create a Pill Card[214]: https://www.ahrq.gov/sites/default/files/wysiwyg/patients-consumers/diagnosis-treatment/treatments/pillcard/pillcard.pdf
	Plain language pediatrics: Health Literacy Strategies and Communication Resources for Common Pediatric Topics. Abrams MA, Dreyer BP, eds. Elk Grove Village, IL: Elk Grove, IL: American Academy of Pediatrics; 2008[22]: https://ebooks.aappublications.org/content/plain-language-pediatrics
	HELPix Pictographic Medication Instruction Sheets[215]: https://med.nyu.edu/helpix/helpix-intervention/instructions-providers and https://www.helpix-program.org
	Universal Medication Schedule White Paper[104]: https://ncpdp.org/NCPDP/media/pdf/WhitePaper/NCPDP-UMS-WhitePaper201304.pdf
Safe disposal recommendations/ resources	Where and How to Dispose of Unused Medicines (FDA)[209]: https://www.fda.gov/ForConsumers/ConsumerUpdates/ucm101653.htm
	Disposal of Unused Medicines: What You Should Know (FDA)[210]: https://www.fda.gov/drugs/safe-disposal-medicines/disposal-unused-medicines-what-you-should-know
	Drug Disposal Information (US Department of Justice and DEA)[211]: http://www.deadiversion.usdoj.gov/drug_disposal/index.html

AHRQ, Agency for Healthcare Research and Quality.

information in the patient's preferred language).

23. Continued support for child-proof packaging.
24. Encourage research funding for novel ways to support safe home medication administration, including identifying strategies to evaluate and support appropriate dosing, and improve medication tracking and feedback to support caregiver and patient adherence to instructions.

LEAD AUTHORS

H. Shonna Yin, MD, MSc, FAAP
Daniel R. Neuspiel, MD, MPH, FAAP
Ian M. Paul, MD, MSc, FAAP

COUNCIL ON QUALITY IMPROVEMENT AND PATIENT SAFETY EXECUTIVE COMMITTEE, 2014–2020

Wayne Franklin, MD, MPH, MMM, FAAP
Joel S. Tieder, MD, MPH, FAAP
Terry Adirim, MD, MPH, FAAP
Francisco Alvarez, MD, FAAP
Jeffrey M. Brown, MD, MPH, CPE, FAAP
David Gordon Bundy, MD, FAAP
Laura Elizabeth Ferguson, MD, FAAP
Sean Patrick Gleeson, MD, MBA, FAAP
Michael Leu, MD, MS, MHS, FAAP
Brigitta U. Mueller, MD, MHCM, FAAP
Daniel Robert Neuspiel, MD, MPH, FAAP
Shannon Connor Phillips, MD MPH, FAAP
Ricardo A. Quinonez, MD, FAAP
Corinna Rea, MD
Michael L. Rinke, MD, PhD, FAAP
Ulfat Shaikh, MD, FAAP
Richard N. Shiffman, MD, MCIS, FAAP
Elizabeth (Tess) Vickers Saarel, MD, FAAP
Sandra P. Spencer Cockerham, MD, FAAP
Kathleen Mack Walsh, MD, FAAP
H. Shonna Yin, MD, MS, FAAP

LIAISONS

Scott David Berns, MD, MPH, FAAP–*National Institute for Children's Health Quality*
Kate Conrad–*Children's Hospital Association*
Keith Mann, MD, MEd, FAAP–*American Board of Pediatrics*
Kamila Mistry, PhD–*Agency for Healthcare Research & Quality*
Virginia A. Moyer, MD, MPH, FAAP–*American Board of Pediatrics*
Suzette Olu Busola Oyeku, MD, MPH, FAAP–*National Institute for Children's Health Quality*
Mimi Saffer–*Children's Hospital Association*
Ellen Schwalenstocker, MBA–*Children's Hospital Association*

STAFF

Cathleen Guch, MPH
Lisa Krams, MAHS

ACKNOWLEDGMENTS

We thank Jessica J. Velazquez, MPH, and Alejandro Torres, MD, for their work related to the oversight and coordination of the reference identification and/or verification process for the policy statement.

We also thank the following individuals for their assistance in conducting literature review and reference identification and/or verification: Carrie Vuong, MD, Victoria Maldonado, MD, Karen Encalada, MBS, Yadira Siguencia, BS, Gloribeth Fernandez, BA, Joselyn Alvarez-Beza, BA, Marivxy Quinteros, BA, Michelle Paguay, BA, Valeria Rodriguez Alfaro, BS, Yubrainy Pascual, BA, and Joanna Dominguez, BS.

ABBREVIATIONS

AAP: American Academy of Pediatrics
DEA: Drug Enforcement Administration
EHR: electronic health record
FDA: Food and Drug Administration
mg: milligram
mL: milliliter
OTC: over-the-counter
TBSP: tablespoon
tsp: teaspoon
UMS: Universal Medication Schedule

POTENTIAL CONFLICT OF INTEREST: Dr Yin reports a National Institutes of Health/*Eunice Kennedy Shriver* National Institute of Child Health and Human Development. research relationship; Dr Paul reports an expert panel relationship with Denver Health, advisory board relationships with Pfizer, Consumer Healthcare Produce Association, and Johnson & Johnson, and a consulting relationship with Merck and Evidera; and Dr Neuspiel has indicated he has no potential conflicts of interest to disclose.

REFERENCES

1. Smith MD, Spiller HA, Casavant MJ, Chounthirath T, Brophy TJ, Xiang H. Out-of-hospital medication errors among young children in the United States, 2002-2012. *Pediatrics.* 2014; 134(5):867–876
2. Gummin DD, Mowry JB, Spyker DA, Brooks DE, Osterthaler KM, Banner W. 2017 Annual Report of the American Association of Poison Control Centers' National Poison Data System (NPDS): 35th annual report. *Clin Toxicol (Phila).* 2018;56(12):1213–1415
3. Yin HS, Dreyer BP, van Schaick L, Foltin GL, Dinglas C, Mendelsohn AL. Randomized controlled trial of a pictogram-based intervention to reduce liquid medication dosing errors and improve adherence among caregivers of young children. *Arch Pediatr Adolesc Med.* 2008;162(9):814–822
4. Tzimenatos L, Bond GR; Pediatric Therapeutic Error Study Group. Severe injury or death in young children from therapeutic errors: a summary of 238 cases from the American Association of Poison Control Centers. *Clin Toxicol (Phila).* 2009;47(4):348–354
5. Dart RC, Paul IM, Bond GR, et al. Pediatric fatalities associated with over the counter (nonprescription) cough and cold medications. *Ann Emerg Med.* 2009;53(4):411–417
6. AANA News Bulletin. ISMP Calls for Elimination of "Teaspoonful" and Other Non-Metric Measurements to Prevent Errors. *AANA J Suppl.* 2009;63(7):6–7. Available at: https://www.proquest.com/openview/8fbde830f1b8602a645efcfc7e741301/1?pq-origsite=gscholar&cbl=41335. Accessed October 20, 2021
7. Schillie SF, Shehab N, Thomas KE, Budnitz DS. Medication overdoses leading

to emergency department visits among children. *Am J Prev Med.* 2009;37(3):181–187

8. Kang AM, Brooks DE. US Poison Control Center calls for infants 6 months of age and younger. *Pediatrics.* 2016;137(2):e20151865
9. Walsh KE, Mazor KM, Stille CJ, et al. Medication errors in the homes of children with chronic conditions. *Arch Dis Child.* 2011;96(6):581–586
10. Kaushal R, Goldmann DA, Keohane CA, et al. Medication errors in paediatric outpatients. *Qual Saf Health Care.* 2010;19(6):e30
11. Rinke ML, Moon M, Clark JS, Mudd S, Miller MR. Prescribing errors in a pediatric emergency department. *Pediatr Emerg Care.* 2008;24(1):1–8
12. Miller MR, Robinson KA, Lubomski LH, Rinke ML, Pronovost PJ. Medication errors in paediatric care: a systematic review of epidemiology and an evaluation of evidence supporting reduction strategy recommendations. *Qual Saf Health Care.* 2007;16(2):116–126
13. National Council for Prescription Drug Programs. NCPDP Recommendations And Guidance for Standardizing the Dosing Designations on Prescription Container Labels of Oral Liquid Medications. 2014. Available at: https://ncpdp.org/NCPDP/media/pdf/WhitePaper/DosingDesignations-OralLiquid-MedicationLabels.pdf. Accessed August 10, 2020
14. Paul I, Neville K, Galinkin JL, et al; American Academy of Pediatrics Committee on Drugs. Policy statement. Metric units and the preferred dosing of orally administered liquid medications. *Pediatrics.* 2015;135(4):784–787
15. Yin HS, Wolf MS, Dreyer BP, Sanders LM, Parker RM. Evaluation of consistency in dosing directions and measuring devices for pediatric nonprescription liquid medications. *JAMA.* 2010;304(23):2595–2602
16. Wallace LS, Keenum AJ, DeVoe JE. Evaluation of consumer medical information and oral liquid measuring devices accompanying pediatric prescriptions. *Acad Pediatr.* 2010;10(4):224–227
17. Yin HS, Mendelsohn AL, Wolf MS, et al. Parents' medication administration errors: role of dosing instruments and health literacy. *Arch Pediatr Adolesc Med.* 2010;164(2):181–186
18. Shah R, Blustein L, Kuffner E, Davis L. Communicating doses of pediatric liquid medicines to parents/caregivers: a comparison of written dosing directions on prescriptions with labels applied by dispensed pharmacy. *J Pediatr.* 2014;164(3):596–601.e1
19. Yin HS, Dreyer BP, Ugboaja DC, et al. Unit of measurement used and parent medication dosing errors. *Pediatrics.* 2014;134(2). Available at: www.pediatrics.org/cgi/content/full/134/2/e354
20. Rothman RL, Yin HS, Mulvaney S, Co JP, Homer C, Lannon C. Health literacy and quality: focus on chronic illness care and patient safety. *Pediatrics.* 2009;124(Suppl 3). Available at: https://pediatrics.aappublications.org/content/124/Supplement_3/S315
21. Leyva M, Sharif I, Ozuah PO. Health literacy among Spanish-speaking Latino parents with limited English proficiency. *Ambul Pediatr.* 2005;5(1):56–59
22. Abrams M, Dreyer B. *Plain Language Pediatrics: Health Literacy Strategies and Communication Resources for Common Pediatric Topics.* Elk Grove Village, IL: American Academy of Pediatrics; 2008
23. Yin HS, Dreyer BP, Foltin G, van Schaick L, Mendelsohn AL. Association of low caregiver health literacy with reported use of nonstandardized dosing instruments and lack of knowledge of weight-based dosing. *Ambul Pediatr.* 2007;7(4):292–298
24. Harris LM, Dreyer BP, Mendelsohn AL, et al. Liquid medication dosing errors by Hispanic parents: role of health literacy and English proficiency. *Acad Pediatr.* 2017;17(4):403–410
25. Vernacchio L, Kelly JP, Kaufman DW, Mitchell AA. Medication use among children <12 years of age in the United States: results from the Slone Survey. *Pediatrics.* 2009;124(2):446–454
26. Li SF, Lacher B, Crain EF. Acetaminophen and ibuprofen dosing by parents. *Pediatr Emerg Care.* 2000;16(6):394–397
27. Mazer-Amirshahi M, Rasooly I, Brooks G, Pines J, May L, van den Anker J. The impact of pediatric labeling changes on prescribing patterns of cough and cold medications. *J Pediatr.* 2014;165(5):1024–8.e1
28. Hanoch Y, Gummerum M, Miron-Shatz T, Himmelstein M. Parents' decision following the Food and Drug Administration recommendation: the case of over-the-counter cough and cold medication. *Child Care Health Dev.* 2010;36(6):795–804
29. Vernacchio L, Kelly JP, Kaufman DW, Mitchell AA. Cough and cold medication use by US children, 1999-2006: results from the Slone Survey. *Pediatrics.* 2008;122(2). Available at: www.pediatrics.org/cgi/content/full/122/2/e323
30. Picciano MF, Dwyer JT, Radimer KL, et al. Dietary supplement use among infants, children, and adolescents in the United States, 1999-2002. *Arch Pediatr Adolesc Med.* 2007;161(10):978–985
31. Simon HK, Weinkle DA. Over-the-counter medications. Do parents give what they intend to give? *Arch Pediatr Adolesc Med.* 1997;151(7):654–656
32. Sharfstein JM, North M, Serwint JR. Over the counter but no longer under the radar–pediatric cough and cold medications. *N Engl J Med.* 2007;357(23):2321–2324
33. Green JL, Wang GS, Reynolds KM, et al. Safety profile of cough and cold medication use in pediatrics. *Pediatrics.* 2017;139(6):e20163070
34. Vassilev ZP, Kabadi S, Villa R. Safety and efficacy of over-the-counter cough and cold medicines for use in children. *Expert Opin Drug Saf.* 2010;9(2):233–242
35. Rajakumar K, Reis EC, Holick MF. Dosing error with over-the-counter vitamin D supplement: a risk for vitamin D toxicity in infants. *Clin Pediatr (Phila).* 2013;52(1):82–85
36. Kara C, Gunindi F, Ustyol A, Aydin M. Vitamin D intoxication due to an erroneously manufactured dietary supplement in seven children. *Pediatrics.* 2014;133(1). Available at: www.pediatrics.org/cgi/content/full/133/1/e240
37. Zandieh SO, Goldmann DA, Keohane CA, Yoon C, Bates DW, Kaushal R.

Risk factors in preventable adverse drug events in pediatric outpatients. *J Pediatr*. 2008;152(2):225–231

38. Glick AF, Farkas JS, Nicholson J, et al. Parental management of discharge instructions: a systematic review. *Pediatrics*. 2017;140(2):e20164165
39. Grover G, Berkowitz CD, Lewis RJ. Parental recall after a visit to the emergency department. *Clin Pediatr (Phila)*. 1994;33(4):194–201
40. Willson MN, Greer CL, Weeks DL. Medication regimen complexity and hospital readmission for an adverse drug event. *Ann Pharmacother*. 2014;48(1):26–32
41. Bailey SC, Pandit AU, Yin S, et al. Predictors of misunderstanding pediatric liquid medication instructions. *Fam Med*. 2009;41(10):715–721
42. Wong T, Stang AS, Ganshorn H, et al. Combined and alternating paracetamol and ibuprofen therapy for febrile children. *Evid Based Child Health*. 2014;9(3):675–729
43. Sullivan JE, Farrar HC; Section on Clinical Pharmacology and Therapeutics; Committee on Drugs. Fever and antipyretic use in children. *Pediatrics*. 2011;127(3):580–587
44. Yue Z, Jiang P, Sun H, Wu J. Association between an excess risk of acute kidney injury and concomitant use of ibuprofen and acetaminophen in children, retrospective analysis of a spontaneous reporting system. *Eur J Clin Pharmacol*. 2014;70(4):479–482
45. van Riet-Nales DA, Ferreira JA, Schobben AFAM, de Neef BJ, Egberts TCG, Rademaker CMA. Methods of administering oral formulations and child acceptability. *Int J Pharm*. 2015;491(1-2):261–267
46. Berman A. Reducing medication errors through naming, labeling, and packaging. *J Med Syst*. 2004;28(1):9–29
47. Yin HS, Mendelsohn AL, Nagin P, van Schaick L, Cerra ME, Dreyer BP. Use of active ingredient information for low socioeconomic status parents' decision-making regarding cough and cold medications: role of health literacy. *Acad Pediatr*. 2013;13(3):229–235
48. Fernandez CV, Gillis-Ring J. Strategies for the prevention of medical error in pediatrics. *J Pediatr*. 2003;143(2):155–162
49. McPhillips HA, Stille CJ, Smith D, et al. Potential medication dosing errors in outpatient pediatrics. *J Pediatr*. 2005;147(6):761–767
50. Beckett VL, Tyson LD, Carroll D, Gooding NM, Kelsall AW. Accurately administering oral medication to children isn't child's play. *Arch Dis Child*. 2012;97(9):838–841
51. Sullivan JE, Buchino JJ. Medication errors in pediatrics–the octopus evading defeat. *J Surg Oncol*. 2004;88(3):182–188
52. Taylor JA, Winter L, Geyer LJ, Hawkins DS. Oral outpatient chemotherapy medication errors in children with acute lymphoblastic leukemia. *Cancer*. 2006;107(6):1400–1406
53. Neuspiel DR, Taylor MM. Reducing the risk of harm from medication errors in children. *Health Serv Insights*. 2013;6:47–59
54. Walsh KE, Dodd KS, Seetharaman K, et al. Medication errors among adults and children with cancer in the outpatient setting. *J Clin Oncol*. 2009;27(6):891–896
55. Walsh KE, Roblin DW, Weingart SN, et al. Medication errors in the home: a multisite study of children with cancer. *Pediatrics*. 2013;131(5). Available at: www.pediatrics.org/cgi/content/full/131/5/e1405
56. Walsh KE, Cutrona SL, Kavanagh PL, et al. Medication adherence among pediatric patients with sickle cell disease: a systematic review. *Pediatrics*. 2014;134(6):1175–1183
57. Spencer D, Marshall J, Post B, et al. Psychotropic medication use and polypharmacy in children with autism spectrum disorders. *Pediatrics*. 2013;132(5):833–840
58. Feinstein JA, Feudtner C, Kempe A. Adverse drug event-related emergency department visits associated with complex chronic conditions. *Pediatrics*. 2014;133(6). Available at: www.pediatrics.org/cgi/content/full/133/6/e1575
59. Winnick S, Lucas DO, Hartman AL, Toll D. How do you improve compliance? *Pediatrics*. 2005;115(6). Available at: https://pediatrics.aappublications.org/content/115/6/e718
60. Staples B, Bravender T. Drug compliance in adolescents: assessing and managing modifiable risk factors. *Paediatr Drugs*. 2002;4(8):503–513
61. Swanson J. Compliance with stimulants for attention-deficit/hyperactivity disorder: issues and approaches for improvement. *CNS Drugs*. 2003;17(2):117–131
62. Marcell AV, Burstein GR; Committee on Adolescence. Sexual and reproductive health care services in the pediatric setting. *Pediatrics*. 2017;140(5):e20172858
63. Society for Adolescent Health and Medicine. The use of medication by adolescents and young adults. *J Adolesc Health*. 2017;61(3):396–399
64. Kaushal R, Goldmann DA, Keohane CA, et al. Adverse drug events in pediatric outpatients. *Ambul Pediatr*. 2007;7(5):383–389
65. Jeetu G, Girish T. Prescription drug labeling medication errors: a big deal for pharmacists. *J Young Pharm*. 2010;2(1):107–111
66. Joint Commission. Official "do not use" list: the Joint Commission fact sheet. 2020. Available at: https://www.jointcommission.org/resources/news-and-multimedia/fact-sheets/facts-about-do-not-use-list/. Accessed September 21, 2021
67. Spooner SA; Council on Clinical Information Technology; American Academy of Pediatrics. Special requirements of electronic health record systems in pediatrics. *Pediatrics*. 2007;119(3):631–637
68. Johnson KB, Lee CK, Spooner SA, Davison CL, Helmke JS, Weinberg ST. Automated dose-rounding recommendations for pediatric medications. *Pediatrics*. 2011;128(2). Available at: www.pediatrics.org/cgi/content/full/128/2/e422
69. Lovegrove MC, Sapiano MRP, Paul IM, Yin HS, Wilkins TL, Budnitz DS. Primary care provider perceptions and practices regarding dosing units for oral liquid medications. *Acad Pediatr*. 2018;18(4):405–408
70. Jones AN, Miller JL, Neely S, et al. Prevalence of unrounded medication doses and associated factors among hospitalized pediatric patients. *J Pediatr Pharmacol Ther*. 2017;22(4):286–292

71. Benjamin L, Frush K, Shaw K, Shook JE, Snow SK; American Academy of Pediatrics Committee on Pediatric Emergency Medicine; American College of Emergency Physicians Pediatric Emergency Medicine Committee; Emergency Nurses Association Pediatric Emergency Medicine Committee. Pediatric medication safety in the emergency department. *Pediatrics.* 2018;141(3):1–8

72. Medical Home Initiatives for Children With Special Needs Project Advisory Committee. American Academy of Pediatrics. The medical home. *Pediatrics.* 2002;110(1 Pt 1):184–186

73. Scott IA, Hilmer SN, Reeve E, et al. Reducing inappropriate polypharmacy: the process of deprescribing. *JAMA Intern Med.* 2015;175(5):827–834

74. New York State Education Department. Education Law Article 137, Pharmacy §6801-§6831. 2018. Available at: www.op.nysed.gov/prof/pharm/article137.htm. Accessed November 27, 2018

75. Endriukaitis LA, Briars LA, Bursua AJ. Encouraging pharmacist intervention and standardization of labeling and dispensing of oral liquid medications. *J Am Pharm Assoc (2003).* 2017;57(3):412–413

76. American Society of Health-System Pharmacists. Standardize 4 Safety initiative. Available at: https://www.ashp.org/Pharmacy-Practice/Standardize-4-Safety-Initiative. Accessed July 16, 2018

77. Institute of Medicine. *Health Literacy: A Prescription to End Confusion.* Washington, DC: The National Academies Press; 2004

78. Schwartzberg J, VanGeest J, Wang C. *Understanding Health Literacy: Implications for Medicine And Public Health.* Chicago, IL: American Medical Association; 2005

79. Yin HS, Johnson M, Mendelsohn AL, Abrams MA, Sanders LM, Dreyer BP. The health literacy of parents in the United States: a nationally representative study. *Pediatrics.* 2009;124(Suppl 3). Available at: https://pediatrics.aappublications.org/content/124/Supplement_3/S289

80. Yin HS. Health literacy and child health outcomes: parental health literacy and medication errors. In: Conneely R, Turner T, eds. *Health Literacy and Child Health Outcomes: Promoting Effective Health Communication Strategies to Improve Quality of Care.* Cham, Switzerland: Springer Briefs in Public Health; 2017

81. Yin HS, Parker RM, Sanders LM, et al. Effect of medication label units of measure on parent choice of dosing tool: a randomized experiment. *Acad Pediatr.* 2016;16(8):734–741

82. Yin HS, Parker RM, Sanders LM, et al. Pictograms, units and dosing tools, and parent medication errors: a randomized study. *Pediatrics.* 2017;140(1):e20163237

83. Yin HS, Parker RM, Sanders LM, et al. Liquid medication errors and dosing tools: a randomized controlled experiment. *Pediatrics.* 2016;138(4):e20160357

84. Lokker N, Sanders L, Perrin EM, et al. Parental misinterpretations of over-the-counter pediatric cough and cold medication labels. *Pediatrics.* 2009;123(6):1464–1471

85. US Census Bureau. Language use in the United States: 2011 American Community Survey reports. 2011. Available at: https://www.census.gov/library/publications/2013/acs/acs-22.html. Accessed November 10, 2020

86. Bailey SC, Sarkar U, Chen AH, Schillinger D, Wolf MS. Evaluation of language concordant, patient-centered drug label instructions. *J Gen Intern Med.* 2012;27(12):1707–1713

87. Bailey SC, Agarwal N, Sleath B, Gumusoglu S, Wolf MS. Improving drug labeling and counseling for limited English proficient adults. *J Health Care Poor Underserved.* 2011;22(4):1131–1143

88. Sharif I, Tse J. Accuracy of computer-generated, Spanish-language medicine labels. *Pediatrics.* 2010;125(5):960–965

89. Bailey SC, Pandit AU, Curtis L, Wolf MS. Availability of Spanish prescription labels: a multi-state pharmacy survey. *Med Care.* 2009;47(6):707–710

90. Masland MC, Kang SH, Ma Y. Association between limited English proficiency and understanding prescription labels among five ethnic groups in California. *Ethn Health.* 2011;16(2):125–144

91. Wilson E, Chen AH, Grumbach K, Wang F, Fernandez A. Effects of limited English proficiency and physician language on health care comprehension. *J Gen Intern Med.* 2005;20(9):800–806

92. McQuaid EL, Landier W. Cultural issues in medication adherence: disparities and directions. *J Gen Intern Med.* 2018;33(2):200–206

93. Kleinman A, Eisenberg L, 2Good B. Culture, illness, and care: clinical lessons from anthropologic and cross-cultural research. *Ann Intern Med.* 1978;88(2):251–258

94. Chen AH, Youdelman MK, Brooks J. The legal framework for language access in healthcare settings: Title VI and beyond. *J Gen Intern Med.* 2007;22(Suppl 2):362–367

95. Moch R, Nassery HG, Fareed MT. Incorporating medical interpretation into your practice. *Fam Pract Manag.* 2014;21(2):16–21

96. Flores G. The impact of medical interpreter services on the quality of health care: a systematic review. *Med Care Res Rev.* 2005;62(3):255–299

97. Bradshaw M, Tomany-Korman S, Flores G. Language barriers to prescriptions for patients with limited English proficiency: a survey of pharmacies. *Pediatrics.* 2007;120(2). Available at: www.pediatrics.org/cgi/content/full/120/2/e225

98. Flores G, Laws MB, Mayo SJ, et al. Errors in medical interpretation and their potential clinical consequences in pediatric encounters. *Pediatrics.* 2003;111(1):6–14

99. Williams MV, Davis T, Parker RM, Weiss BD. The role of health literacy in patient-physician communication. *Fam Med.* 2002;34(5):383–389

100. DeWalt DA, Callahan LF, Hawk VH, Broucksou KA, Hink A, Rudd R, Brach C; Agency for Healthcare Research and Quality. AHRQ health literacy universal precautions toolkit. 2010. Available at: https://www.ahrq.gov/professionals/quality-patient-safety/quality-resources/tools/literacy-toolkit/index.html. Accessed November 17, 2017

101. Brega AG, Barnard J, Mabachi NM, Weiss BD, et al. *Agency for Healthcare Research and Quality. AHRQ Health Literacy Universal Precautions Toolkit*, 2nd ed. Rockville, MD: Colorado Health Outcomes Program, University of Colorado Anschutz Medical Campus; 2015

102. Lemer C, Bates DW, Yoon C, Keohane C, Fitzmaurice G, Kaushal R. The role of advice in medication administration errors in the pediatric ambulatory setting. *J Patient Saf.* 2009;5(3):168–175

103. Hummelinck A, Pollock K. Parents' information needs about the treatment of their chronically ill child: a qualitative study. *Patient Educ Couns.* 2006;62(2):228–234

104. National Council for Prescription Drug Programs. Universal medication schedule white paper. 2013. Available at: https://ncpdp.org/NCPDP/media/pdf/WhitePaper/NCPDP-UMS-WhitePaper201304.pdf. Accessed November 10, 2020

105. Wolf MS, Davis TC, Curtis LM, et al. A patient-centered prescription drug label to promote appropriate medication use and adherence. *J Gen Intern Med.* 2016;31(12):1482–1489

106. Institute for Safe Medication Practices. ISMP medication safety alert: volume 2, issue 6. 1997. Available at: https://www.ismp.org/newsletters/acute-care. Accessed July 17, 2018

107. Institute of Medicine. *Standardizing Medication Labels: Confusing Patients Less: Workshop Summary.* Washington, DC: The National Academies Press; 2008

108. Turner T, Cull WL, Bayldon B, et al. Pediatricians and health literacy: descriptive results from a national survey. *Pediatrics.* 2009;124(Suppl 3). Available at: https://pediatrics.aappublications.org/content/124/Supplement_3/S299

109. Yin HS, Dreyer BP, Moreira HA, et al. Liquid medication dosing errors in children: role of provider counseling strategies. *Acad Pediatr.* 2014;14(3):262–270

110. Yin HS, Gupta RS, Mendelsohn AL, et al. Use of a low-literacy written action plan to improve parent understanding of pediatric asthma management: a randomized controlled study. *J Asthma.* 2017;54(9):919–929

111. DeWalt DA, Hink A. Health literacy and child health outcomes: a systematic review of the literature. *Pediatrics.* 2009;124(Suppl 3). Available at: https://pediatrics.aappublications.org/content/pediatrics/124/Supplement_3/S265.full.pdf

112. Griffin T, Abraham M. Transition to home from the newborn intensive care unit: applying the principles of family-centered care to the discharge process. *J Perinat Neonatal Nurs.* 2006;20(3):243–249, quiz 250–251

113. Arnold J, Diaz MC. Simulation training for primary caregivers in the neonatal intensive care unit. *Semin Perinatol.* 2016;40(7):466–472

114. Cheng A, Lang TR, Starr SR, Pusic M, Cook DA. Technology-enhanced simulation and pediatric education: a meta-analysis. *Pediatrics.* 2014;133(5). Available at: www.pediatrics.org/cgi/content/full/133/5/e1313

115. Sawyer T, French H, Soghier L, et al. Educational perspectives: boot camps for neonatal-perinatal medicine fellows. *Neoreviews.* 2014;15(2):e46–e55

116. Pusic MV, Ching K, Yin HS, Kessler D. Seven practical principles for improving patient education: Evidence-based ideas from cognition science. *Paediatr Child Health.* 2014;19(3):119–122

117. Johnson A, Sandford J. Written and verbal information versus verbal information only for patients being discharged from acute hospital settings to home: systematic review. *Health Educ Res.* 2005;20(4):423–429

118. Schwartzberg JG, Cowett A, VanGeest J, Wolf MS. Communication techniques for patients with low health literacy: a survey of physicians, nurses, and pharmacists. *Am J Health Behav.* 2007;31(Suppl 1):S96–S104

119. Yin HS, Gupta RS, Tomopoulos S, et al. A low-literacy asthma action plan to improve provider asthma counseling: A randomized study. *Pediatrics.* 2016;137(1)

120. Yin HS, Mendelsohn AL, Fierman A, van Schaick L, Bazan IS, Dreyer BP. Use of a pictographic diagram to decrease parent dosing errors with infant acetaminophen: a health literacy perspective. *Acad Pediatr.* 2011;11(1):50–57

121. Bowens FM, Frye PA, Jones WA. Health information technology: integration of clinical workflow into meaningful use of electronic health records. *Perspect Health Inf Manag.* 2010;7(Fall):1d

122. Ancker JS, Send A, Hafeez B, Osorio SN, Abramson E. Health IT usability focus section: adapting EHR-based medication instructions to comply with plain language guidance—a randomized experiment. *Appl Clin Inform.* 2017;8(4):1127–1143

123. Yeung DL, Alvarez KS, Quinones ME, et al. Low-health literacy flashcards & mobile video reinforcement to improve medication adherence in patients on oral diabetes, heart failure, and hypertension medications. *J Am Pharm Assoc (2003).* 2017;57(1):30–37

124. DeKoekkoek T, Given B, Given CW, Ridenour K, Schueller M, Spoelstra SL. mHealth SMS text messaging interventions and to promote medication adherence: an integrative review. *J Clin Nurs.* 2015;24(19-20):2722–2735

125. Miloh T, Annunziato R, Arnon R, et al. Improved adherence and outcomes for pediatric liver transplant recipients by using text messaging. *Pediatrics.* 2009;124(5). Available at: www.pediatrics.org/cgi/content/full/124/5/e844

126. US Department of Health and Human Services. Standards for Privacy of Individually Identifiable Health Information, Final Rule. 45 CFR §160 and §164 (2010)

127. Department of Health and Human Services. Guidance on risk analysis requirements under the HIPAA security rule. 2010. Available at: https://www.hhs.gov/sites/default/files/ocr/privacy/hipaa/administrative/securityrule/rafinalguidancepdf.pdf. Accessed December 21, 2018

128. Lee S-YD, Arozullah AM, Cho YI. Health literacy, social support, and health: a research agenda. *Soc Sci Med.* 2004;58(7):1309–1321

129. Baker DW. The meaning and the measure of health literacy. *J Gen Intern Med.* 2006;21(8):878–883

130. Smith SG, Curtis LM, Wardle J, von Wagner C, Wolf MS. Skill set or mind set? Associations between health literacy, patient activation and health. *PLoS One.* 2013;8(9):e74373

131. Feifer RA, Greenberg L, Rosenberg-Brandl S, Franzblau-Isaac E. Pharmacist counseling at the start of therapy: patient receptivity to offers of in-person and subsequent telephonic clinical support. *Popul Health Manag.* 2010;13(4):189–193

132. Shrank WH, Agnew-Blais J, Choudhry NK, et al. The variability and quality of medication container labels. *Arch Intern Med.* 2007;167(16):1760–1765

133. Wallace LS, Keenum AJ, DeVoe JE. Characteristics of container labeling in a sample of commonly prescribed children's oral medications. *Res Social Adm Pharm.* 2010;6(4):272–279

134. US Pharmacopeial Convention. USP–NF General Chapter <17> Prescription Container Labeling. 2012. Available at: www.usp.org/health-quality-safety/usp-nf-general-chapter-prescription-container-labeling. Accessed August 10, 2018

135. Wolf MS, Davis TC, Shrank WH, Neuberger M, Parker RM. A critical review of FDA-approved medication guides. *Patient Educ Couns.* 2006;62(3):316–322

136. Wolf MS, King J, Wilson EAH, et al. Usability of FDA-approved medication guides. *J Gen Intern Med.* 2012;27(12):1714–1720

137. Doak C, Doak LG, Root JH. *Teaching Patients With Low Literacy Skills*. 2nd ed. Philadelphia, PA: Lippincott Company; 1996

138. Weiss BD. *Health Literacy and Patient Safety: Help Patients Understand*. Chicago, IL: American Medical Association Foundation; 2007. Available at: http://www.partnershiphp.org/Providers/HealthServices/Documents/Health-%20Education/CandLToolKit/2%20Manual%20for%20Clinicians.pdf. Accessed October 21, 2021

139. Weiss BD. Communicating with patients who have limited literacy skills. Report of the National Work Group on literacy and health. *J Fam Pract.* 1998;46(2):168–176

140. US Department of Health Human Services. Working to reduce medication errors. 2019. Available at: https://www.fda.gov/drugs/resourcesforyou/consumers/ucm143553.htm. Accessed October 21, 2021

141. Gillette C, Blalock SJ, Rao JK, Williams D, Loughlin C, Sleath B. Discussions between medical providers and children/caregivers about the benefits of asthma-control medications. *J Am Pharm Assoc (2003).* 2014;54(3):251–257

142. Levine S, Cohen MR. Medication errors. In: Cohen MR, ed. *Preventing Medication Errors in Pediatric and Neonatal Patients*. 2nd ed. Washington, DC: American Pharmacists Association; 2007

143. Awé C, Lin S-J. A patient empowerment model to prevent medication errors. *J Med Syst.* 2003;27(6):503–517

144. Roundtable on Health Literacy; Board on Population Health and Public Health Practice. Institute of Medicine. The other side of the coin: attributes of a health literate healthcare organization. In: Schillinger D, Keller D, eds. *How Can Health Care Organizations Become More Health Literate: Workshop Summary*. Washington, DC: National Academies Press (US); 2012

145. Institute for Healthcare Improvement. Ask me 3: good questions for your good health. Available at: www.ihi.org/resources/Pages/Tools/Ask-Me-3-Good-Questions-for-Your-Good-Health.aspx. Accessed March 28, 2019

146. Cassel CK, Guest JA. Choosing wisely: helping physicians and patients make smart decisions about their care. *JAMA.* 2012;307(17):1801–1802

147. Agency for Healthcare Research and Quality. Questions to ask your doctor: questions are the answer. 2018. Available at: www.ahrq.gov/patients-consumers/patient-involvement/ask-your-doctor/index.html. Accessed March 28, 2019

148. Adams RC, Elias ER; Council On Children With Disabilities. Nonoral feeding for children and youth with developmental or acquired disabilities. *Pediatrics.* 2014;134(6). Available at: https://pediatrics.aappublications.org/content/134/6/e1745

149. Williams NT. Medication administration through enteral feeding tubes. *Am J Health Syst Pharm.* 2008;65(24):2347–2357

150. Ivanovska V, Rademaker CM, van Dijk L, Mantel-Teeuwisse AK. Pediatric drug formulations: a review of challenges and progress. *Pediatrics.* 2014;134(2):361–372

151. Nahirya-Ntege P, Cook A, Vhembo T, et al; Arrow Trial Team. Young HIV-infected children and their adult caregivers prefer tablets to syrup antiretroviral medications in Africa. *PLoS One.* 2012;7(5):e36186

152. Lajoinie A, Henin E, Kassai B, Terry D. Solid oral forms availability in children: a cost saving investigation. *Br J Clin Pharmacol.* 2014;78(5):1080–1089

153. Gribetz B, Cronley SA. Underdosing of acetaminophen by parents. *Pediatrics.* 1987;80(5):630–633

154. Morrison AK, Myrvik MP, Brousseau DC, et al. Parents' pain medication underdosing is associated with more emergency department visits in sickle cell disease. *Pediatr Blood Cancer.* 2018;65(4):e26906

155. Wansink B, van Ittersum K. Spoons systematically bias dosing of liquid medicine. *Ann Intern Med.* 2010;152(1):66–67

156. Madlon-Kay DJ, Mosch FS. Liquid medication dosing errors. *J Fam Pract.* 2000;49(8):741–744

157. Falagas ME, Vouloumanou EK, Plessa E, Peppas G, Rafailidis PI. Inaccuracies in dosing drugs with teaspoons and tablespoons. *Int J Clin Pract.* 2010;64(9):1185–1189

158. McMahon SR, Rimsza ME, Bay RC. Parents can dose liquid medication accurately. *Pediatrics.* 1997;100(3 Pt 1):330–333

159. Hyam E, Brawer M, Herman J, Zvieli S. What's in a teaspoon? Underdosing with acetaminophen in family practice. *Fam Pract.* 1989;6(3):221–223

160. Yaffe SJ, Bierman CW, Cann HM, et al. Inaccuracies in administering liquid medication. *Pediatrics.* 1975;56(2):327–328

161. US Department of Health and Human Services; US Food and Drug Administration; Center for Drug Evaluation and Research. *Guidance Document: Safety Considerations for Product Design to Minimize Medication Errors*. Rockville, MD: US Food and Drug Administration; 2016

162. US Department of Health Human Services; US Food and Drug Administration. Guidance document: dosage delivery devices for orally ingested OTC liquid drug products. 2011. Available at: www.fda.gov/downloads/Drugs/GuidanceComplianceRegulatoryInformation/Guidances/UCM188992.pdf. Accessed March 29, 2019

163. US Department of Health and Human Services; US Food and Drug

Administration. Guidance document: safety considerations for container labels and carton labeling design to minimize medication errors. 2013. Available at: https://www.fda.gov/downloads/drugs/guidances/ucm349009.pdf. Accessed March 28, 2021

164. Honey BL, Condren M, Phillips C, Votruba A. Evaluation of oral medication delivery devices provided by community pharmacies. *Clin Pediatr (Phila)*. 2013;52(5):418–422
165. American Academy of Pediatrics. How to use liquid medications. 2015. Available at: https://www.healthychildren.org/English/safety-prevention/at-home/medication-safety/Pages/Using-Liquid-Medicines.aspx. Accessed March 28, 2019
166. Institute for Safe Medication Practices. Tips for measuring liquid medicines safely. 2017. Available at: www.consumermedsafety.org/tools-and-resources/medication-safety-tools-and-resources/taking-your-medicine-safely/measure-liquid-medications. Accessed October 6, 2017
167. Centers for Disease Control and Prevention. Nonfatal, unintentional medication exposures among young children–United States, 2001-2003. *MMWR Morb Mortal Wkly Rep*. 2006;55(1):1–5
168. Safe Kids Worldwide. Safe storage, safe dosing, safe kids: a report to the nation on safe medication. 2012. Available at: https://www.safekids.org/sites/default/files/medicine-safety-study-2012.pdf. Accessed November 10, 2017
169. Up and Away. Put your medicine up and away and out of sight. 2017. Available at: www.upandaway.org/. Accessed May 1, 2017
170. US Pharmacopeial Convention. Revision bulletin: (659) packaging and storage requirements. 2017. Available at: https://www.uspnf.com/sites/default/files/usp_pdf/EN/USPNF/revisions/659_rb_notice.pdf. Accessed April 18, 2019
171. Grießmann K, Breitkreutz J, Schubert-Zsilavecz M, Abdel-Tawab M. Dosing accuracy of measuring devices provided with antibiotic oral suspensions. *Paediatr Perinat Drug Ther*. 2007;8(2):61–70
172. Sobhani P, Christopherson J, Ambrose PJ, Corelli RL. Accuracy of oral liquid measuring devices: comparison of dosing cup and oral dosing syringe. *Ann Pharmacother*. 2008;42(1):46–52
173. Litovitz T. Implication of dispensing cups in dosing errors and pediatric poisonings: a report from the American Association of Poison Control Centers. *Ann Pharmacother*. 1992;26(7-8):917–918
174. The Office of the National Coordinator for Health Information Technology. E-Prescribing trends in the United States. 2014. Available at: https://www.healthit.gov/sites/default/files/oncdatabriefe-prescribingincreases2014.pdf. Accessed February 21, 2019
175. National Council for Prescription Drug Programs. *Challenges and Opportunities for Stakeholders Regarding ePrescribing Technologies and Formulary Compliance*. Scottsdale, AZ: National Council for Prescription Drug Programs; 2013.
176. van Ittersum K, Wansink B. Stop spoon dosing: milliliter instructions reduce inclination to spoon dosing. *BMC Res Notes*. 2016;9:33
177. Parker RM, Wolf MS, Jacobson KL, Wood AJ. Risk of confusion in dosing Tamiflu oral suspension in children. *N Engl J Med*. 2009;361(19):1912–1913
178. Centers for Disease Control and Prevention. The PROTECT initiative: advancing children's medication safety. 2016. Available at: www.cdc.gov/MedicationSafety/protect/protect_Initiative.html. Accessed May 26, 2016
179. American Association of Poison Control Centers. AAPCC Resolution - Standardizing Volumetric Measures for Oral Medications Intended for Use by Children. In: *NCPDP White Papers, 2014*. Arlington, VA: American Association of Poison Control Centers; 2010
180. American Academy of Family Physicians. Preferred unit of measurement for liquid medications. 2011. Available at: https://www.aafp.org/about/policies/all/preferred-unit.html. Accessed April 15, 2018
181. Eiland LS, Benner K, Gumpper KF, et al. ASHP–PPAG guidelines for providing pediatric pharmacy services in hospitals and health systems. *J Pediatr Pharmacol Ther*. 2018;23(3):177–191
182. Torres A, Parker RM, Sanders LM, et al. Parent preferences and perceptions of milliliters and teaspoons: role of health literacy and experience. *Acad Pediatr*. 2018;18(1):26–34
183. Sansgiry SS, Bhansali AH, Bapat SS, Xu Q. Abuse of over-the-counter medicines: a pharmacist's perspective. *Integr Pharm Res Pract*. 2016;6:1–6
184. Barrett TW, Norton VC. Parental knowledge of different acetaminophen concentrations for infants and children. *Acad Emerg Med*. 2000;7(6):718–721
185. Frush KS, Luo X, Hutchinson P, Higgins JN. Evaluation of a method to reduce over-the-counter medication dosing error. *Arch Pediatr Adolesc Med*. 2004;158(7):620–624
186. Xiong Y, Fukuda T, Knibbe CAJ, Vinks AA. Drug dosing in obese children: challenges and evidence-based strategies. *Pediatr Clin North Am*. 2017;64(6):1417–1438
187. Matson KL, Horton ER, Capino AC; Advocacy Committee for the Pediatric Pharmacy Advocacy Group. Medication dosage in overweight and obese children. *J Pediatr Pharmacol Ther*. 2017;22(1):81–83
188. Institute for Safe Medication Practices. 2020-2021 Targeted medication safety best practices for hospitals. 2017. Available at: https://www.ismp.org/sites/default/files/attachments/2020-02/2020-2021%20TMSBP-%20FINAL_1.pdf. Accessed July 16, 2018
189. DailyMed. Label: childrens acetaminophen liquid. 2016. Available at: https://dailymed.nlm.nih.gov/dailymed/druglnfo.cfmsetid=b23302bd-170e-46ec-8f4f-524c378fa405. Accessed October 21, 2021
190. DailyMed. Label: Children's Tylenol – acetaminophen suspension. 2016. Available at: https://dailymed.nlm.nih.gov/dailymed/druglnfo.cfm?setid=a51c2deb-c703-4dc8-9255-8ac9fe635170&audience=consumer. Accessed October 21, 2021
191. Schaefer MK, Shehab N, Cohen AL, Budnitz DS. Adverse events from

cough and cold medications in children. *Pediatrics*. 2008;121(4):783–787

192. Yang M, So TY. Revisiting the safety of over-the-counter cough and cold medications in the pediatric population. *Clin Pediatr (Phila)*. 2014;53(4): 326–330

193. Varney SM, Bebarta VS, Pitotti RL, Vargas TE. Survey in the emergency department of parents' understanding of cough and cold medication use in children younger than 2 years. *Pediatr Emerg Care*. 2012;28(9):883–885

194. US Department of Health and Human Services; US Food and Drug Administration. Over the counter cough and cold medications for pediatric use; Notice of Public Hearing. In. *73 FR 50033*. Vol. E8-196572008:50033-50036. Rockville, MD: US Food and Drug Administration; 2008

195. Rimsza ME, Newberry S. Unexpected infant deaths associated with use of cough and cold medications. *Pediatrics*. 2008;122(2). Available at: www.pediatrics.org/cgi/content/full/122/2/e318

196. Centers for Disease Control and Prevention . Infant deaths associated with cough and cold medications–two states, 2005. *MMWR Morb Mortal Wkly Rep*. 2007;56(1):1–4

197. Consumer Healthcare Products Association. Program on OTC Oral Pediatric Cough and Cold Medicines. 2008. Available at: https://www.chpa.org/public-policy-regulatory/voluntary-codes-guidelines/program-otc-oral-pediatric-cough-and-cold. Accessed October 21, 2021

198. Agency for Healthcare Research and Quality. Chapter 3. Developing change: Designing the medication reconciliation process. Medications at transitions and clinical handoffs (MATCH) toolkit for medication reconciliation. 2012. Available at: https://www.ahrq.gov/professionals/quality-patient-safety/patient-safety-resources/resources/match/match3.html. Accessed March 28, 2019

199. The Joint Commission. 2021 National Patient Safety Goals. Available at: https://www.jointcommission.org/standards/national-patient-safety-goals/. Accessed October 21, 2021

200. American Academy of Pediatrics Committee on Pediatric Emergency Medicine; American College of Emergency Physicians Pediatric Emergency Medicine Committee; Emergency Nurses Association Pediatric Committee. Handoffs: transitions of care for children in the emergency department. *Pediatrics*. 2016;138(5):e20162680

201. Lye PS; American Academy of Pediatrics Committee on Hospital Care and Section on Hospital Medicine. Clinical report–physicians' roles in coordinating care of hospitalized children. *Pediatrics*. 2010;126(4): 829–832

202. Joint Commission. Preventing pediatric medication errors: issue 39. 2021. Available at: https://www.jointcommission.org/-/media/tjc/documents/resources/patient-safety-topics/sentinel-event/sea-39-ped-med-errors-rev-final-4-14-21.pdf. Accessed October 21, 2021

203. Council on Clinical Information Technology. Health information technology and the medical home. *Pediatrics*. 2011;127(5):978–982

204. Wieczorkiewicz SM, Kassamali Z, Danziger LH. Behind closed doors: medication storage and disposal in the home. *Ann Pharmacother*. 2013;47(4):482–489

205. Seehusen DA, Edwards J. Patient practices and beliefs concerning disposal of medications. *J Am Board Fam Med*. 2006;19(6):542–547

206. Wu PE, Juurlink DN. Unused prescription drugs should not be treated like leftovers. *CMAJ*. 2014; 186(11):815–816

207. Binswanger IA, Glanz JM. Pharmaceutical opioids in the home and youth: implications for adult medical practice. *Subst Abus*. 2015;36(2):141–143

208. The Medical Letter. Drugs past their expiration date. *Med Lett Drugs Ther*. 2002;44(1142): 93–94

209. US Food and Drug Administration. Where and how to dispose of unused medicines. 2017. Available at: https://www.fda.gov/ForConsumers/ConsumerUpdates/ucm101653.htm. Accessed January 10, 2018

210. US Food and Drug Administration. Disposal of unused medicines: what you should know. Available at: https://www.fda.gov/Drugs/ResourcesForYou/Consumers/BuyingUsingMedicineSafely/EnsuringSafeUseofMedicine/SafeDisposalofMedicines/ucm186187.htm. Accessed February 12, 2018

211. US Department of Justice Drug Enforcement Administration: Diversion Control Division. Drug disposal information. Available at: https://www.deadiversion.usdoj.gov/drug_disposal/index.html. Accessed January 10, 2018

212. American Board of Pediatrics. Health Literacy: Performance Improvement Module. Available at: https://pim.abp.org/health_literacy/ faq/. Accessed November 13, 2017

213. American Board of Pediatrics. Safe prescription writing: performance improvement module. Available at: https://pim.abp.org/rxwriting/faq/. Accessed November 13, 2017

214. Agency for Healthcare Research and Quality. How to create a pill card. 2012. Available at: https://www.ahrq.gov/patients-consumers/diagnosis-treatment/treatments/pillcard/index.html. Accessed November 13, 2017

215. New York University Langone Health. The HELPix intervention: instructions for providers. Available at: https://med.nyu.edu/helpix/helpix-intervention/instructions-providers. Accessed November 9, 2017

Prevention of Drowning

- *Technical Report*

TECHNICAL REPORT

American Academy of Pediatrics
DEDICATED TO THE HEALTH OF ALL CHILDREN™

Prevention of Drowning

Sarah A. Denny, MD, FAAP,[a] Linda Quan, MD, FAAP,[b] Julie Gilchrist, MD, FAAP,[c] Tracy McCallin, MD, FAAP,[d,e] Rohit Shenoi, MD, FAAP,[f] Shabana Yusuf, MD, Med, FAAP,[f] Jeffrey Weiss, MD, FAAP,[g,h] Benjamin Hoffman, MD, FAAP,[i]
COUNCIL ON INJURY, VIOLENCE, AND POISON PREVENTION

Drowning is a leading cause of injury-related death in children. In 2018, almost 900 US children younger than 20 years died of drowning. A number of strategies are available to prevent these tragedies. As educators and advocates, pediatricians can play an important role in prevention of drowning.

INTRODUCTION

Background

Drowning is the leading cause of unintentional injury–related death in US children 1 through 4 years of age and, as of 2018, has surpassed birth defects as the most common cause of death among this age group. Drowning is the third leading cause of unintentional injury–related death among US children and adolescents 5 through 19 years of age.[1] In 2018, almost 900 US children and youth under 20 years died of drowning and more than 7200 were seen at a hospital emergency department (ED) for a drowning event, with 35% of those children either hospitalized or transferred for further care.[1] Rates of drowning death vary with age, sex, and race; those at greatest risk are toddlers and male adolescents. Underlying medical conditions, such as seizures and autism, also increase risk. Fortunately, childhood unintentional drowning fatality rates have decreased steadily from 2.68 per 100 000 in 1985 to 1.09 per 100 000 in 2018. Most victims of nonfatal drowning do well, but severe long-term neurologic deficits are seen with extended submersion times, prolonged resuscitation efforts, and lack of early bystander-initiated cardiopulmonary resuscitation (CPR).[2–4]

The American Academy of Pediatrics (AAP) has revised this technical report because of new information and research regarding (1) populations at increased risk; (2) racial and sociodemographic disparities in drowning rates; (3) water competency (water safety knowledge and attitudes, basic swim skills, and response to a swimmer in trouble)[5,6]; (4) the need for close, constant, attentive, and capable adult supervision when children are in and around water as well as life

abstract

[a]*Nationwide Children's Hospital and College of Medicine, The Ohio State University, Columbus, Ohio;* [b]*Pediatric Emergency Medicine, Seattle Children's Hospital, University of Washington School of Medicine, Seattle, Washington;* [c]*US Public Health Service (Retired);* [d]*Children's Hospital of San Antonio, San Antonio, Texas;* [e]*Baylor College of Medicine, Houston, Texas;* [f]*Section of Emergency Medicine, Department of Pediatrics, Baylor College of Medicine, Houston, Texas;* [g]*Phoenix Children's Hospital Medicine, Phoenix Children's Hospital, Phoenix, Arizona;* [h]*University of Arizona College of Medicine-Phoenix, Phoenix, Arizona; and* [i]*Doernbecher Children's Hospital and Oregon Health and Science University, Portland, Oregon*

DOI: https://doi.org/10.1542/peds.2021-052227

Address correspondence to Sarah Denny, MD, FAAP. E-mail: sarah.denny@nationwidechildrens.org

PEDIATRICS (ISSN Numbers: Print, 0031-4005; Online, 1098-4275).

FINANCIAL DISCLOSURE: The authors have indicated they have no financial relationships relevant to this article to disclose.

To cite: Denny S A, Quan L, Gilchrist J, et al; AAP Council on Injury, Violence, and Poison Prevention. Prevention of Drowning. *Pediatrics*. 2021;148(2):e2021052227

jacket use among children and adults; (5) the importance of physical barriers to prevent access to water when children are not expected to be around water; and (6) the Drowning Chain of Survival and importance of bystander CPR (Table 1).

In 2002, the World Congress on Drowning and the World Health Organization revised the definition of drowning to be "the process of experiencing respiratory impairment from submersion/immersion in liquid." Drowning outcomes are classified as death, no morbidity, or morbidity (further divided into moderately disabled, severely disabled, vegetative state/coma, and brain death). Terms such as wet, dry, near, secondary, active, passive, and silent drowning should not be used. The 2002 revised definition and classification is more consistent with other medical conditions and injuries and should help in drowning surveillance and collection of more reliable and comprehensive epidemiological information.[7]

Sociodemographic Factors

Rates of drowning vary by sociodemographic factors, such as age, sex, race and ethnicity, and the presence of neurodevelopmental disorders such as epilepsy, autism spectrum disorder (ASD), and intellectual disability. Drowning rates are reported on the basis of the population under examination, not on the basis of the group's exposure; exposure-based rates might increase disparities among groups.[8] The highest rate of drowning is in the 0- to 4-year age group (2.26 per 100 000 population), with children aged 12 to 36 months being at highest risk (3.38 per 100 000). There is a second peak incidence in adolescence (1.90 per 100 000 among boys aged 15 to 19 years), attributable largely to a high number of male drowning deaths. Approximately 75% of childhood drowning victims are boys,[1] and, after the first year of life (during which risks are often similar), boys are at greater risk of drowning than are girls at each age. Among children and preteens, drowning death is roughly twice as common in boys as in girls, but among adolescents, the rate is almost 10 times higher among boys (Table 2).[1] The higher drowning rate for boys has been explained by greater exposure to aquatic environments, overestimation of swimming ability, higher risk taking, and greater alcohol use.[9,10]

Among children aged 0 to 19 years overall, drowning rates from 2014 to 2018 are highest among Black (1.79 per 100 000) and American Indian (AI) and Alaska native (AN) (1.49 per 100 000) individuals; drowning rates are lower among white (1.06 per 100 000), Asian American and Pacific Islander (0.85 per 100 000), and Hispanic (0.82 per 100 000) individuals.[1] One analysis of 11 years of fatal drowning data among people younger than 30 years reveals that AI and AN individuals have the highest rates of fatal drowning (2.57 per 100 000), higher than both Black (1.90 per 100 000) and white (1.32 per 100 000) individuals. AI and AN individuals have the lowest drowning risk of all races and ethnicities in swimming pools but the highest in natural water settings (1.22 per 100 000 among AI and AN versus 0.63 per 100 000 among Black and 0.42 per 100 000 among white individuals). AI and AN individuals could not be included in additional analyses of race and ethnicity (eg, white, Black, Hispanic) by single year of age because of small numbers. When considering race and ethnicity as a risk factor, age dramatically influences drowning disparities. The highest rates were among children aged 1 year, with rates for white children (5.22 per 100 000) higher than those for Hispanic (4.14 per 100 000) and Black (2.98 per 100 000) children. Between the ages of 1 and 5 years, drowning rates decreased significantly for each racial and ethnic group but decreased less among Black children. However, the drowning rates for Black children were significantly higher than those for white and Hispanic children at every age from 5 years to 18 years, and this difference persisted when examining drowning in swimming pools and natural water settings. An analysis that was focused specifically on swimming pool drowning deaths in the 5- to 24-year age group demonstrated that Black males had higher drowning rates than either white or Hispanic males, even when adjustments were made for income. Although the majority of white children drowned in residential pools, Black children were more likely to die in a public pool, often at a motel or hotel.[11] In swimming pools, Black children aged 5 to 19 years were 5.5 times more likely to drown than white children of the same age.[12] With no physiologic differences to explain the difference in drowning risk, race and ethnicity are likely a proxy for social and cultural differences

TABLE 1 Key Evidence-Based Strategies

Assess all children for drowning risk on the basis of risk and age, and prioritize evidence-based strategies:
• Barriers
• Supervision
• Swim lessons
• Life jackets
• CPR

TABLE 2 Unintentional Drowning Deaths, United States, 2014–2018

	Average Annual (Crude Rate No. Deaths Per 100 000)		
Age Group, y	Boys	Girls	Total[a]
<1	19 (0.93)	17 (0.90)	36 (0.91)
1–2	175 (4.32)	93 (2.40)	269 (3.38)
3–4	104 (2.55)	41 (1.05)	145 (1.81)
0–4	298 (2.93)	152 (1.56)	450 (2.26)
5–9	95 (0.91)	36 (0.36)	131 (0.64)
10–14	71 (0.68)	27 (0.26)	98 (0.47)
15–19	205 (1.90)	21 (0.21)	226 (1.07)
0–19	670 (1.60)	236 (0.59)	906 (1.10)

Source: Centers for Disease Control and Prevention Web-based Injury Statistics Query and Reporting System.
[a] Totals may not add up because of rounding.

between the groups. The reasons that Black children and teenagers are at higher risk of drowning have not been thoroughly studied, but poor swimming skills in both children and their parents, lack of early training, and lack of lifeguards at motel and hotel pools may be important factors.[11,13–15]

Risks related to race and ethnicity are likely related to differences in exposure, behavior, knowledge, and skills. In Ontario, Canada, African, Hispanic, and Asian people have higher age-adjusted drowning rates compared with those of European descent.[16] In a survey targeting poor children of color, approximately 57.5% of Black youth and 56.2% of Hispanic youth reported being unable to swim or being uncomfortable in the deep end of the pool. [14] Black females report fear of drowning; this negatively affects seeking swimming instruction and swimming abilities.[15] Certain religious beliefs may prevent children from taking swimming lessons because of lack of single-sex aquatic settings or type of clothing restrictions.[17] Socioeconomic disparities account for some, but not all, of the disparities. Inadequate funding for pools, swimming programs, and lifeguards, as well as the cost associated with swimming lessons, may affect water competency and community resources for low-income populations. Differences persist after controlling for socioeconomic status, cultural and historical factors, and access.[11] Finally, the role of race and ethnicity as a risk factor may vary at the local level, necessitating examination of risk at the level of individual communities.[18]

Further research is imperative to learn more about racial and ethnic disparities in drowning and guide effective prevention interventions. A study performed in Alaska to decrease injury in AN territories successfully increased the use of float coats (summer-weight coats that doubled as personal flotation devices) by using an aggressive education campaign, increased enforcement, and increased availability of float coats. This project was successful because of partnership with tribal elders in developing culturally appropriate messaging.[19] In addition, understanding the historical relationships that affect risk perception around water safety helps inform aquatic risk communication to different cultural and ethnic groups.[20] The drowning research agenda should include understanding the disparities affecting immigrants, refugees, and various ethnic and racial populations and establish evidence-based interventions to improving water competency and decreasing drowning rates in these disproportionately affected groups.

The role of socioeconomic status and income on drowning rates, independent of race, is not well known. Worldwide, drowning rates are much higher in low-income, resource-limited countries, possibly because of the increased exposure to natural bodies of water.[21,22] In contrast, a study of pool drowning conducted in California found that among children younger than 10 years, drowning rates were actually associated with higher family income and parental education. This association was attributed to increased exposure to residential swimming pools in more affluent communities.[23] In the Netherlands, individuals of ethnic minorities were more likely to drown than those of Dutch heritage, even after adjusting for age, sex, income, and urbanization.[24] Among Black males in the United States, swimming pool drowning risk remained higher even after controlling for income,[11] and among urban youth, Black children reported lower swimming ability after controlling for income.[13] Underlying reasons are not well understood but may include cultural, historical (such as segregation and lack of access), and environmental influences.

Temporal and Geographic Variation

Among all causes of unintentional injury death in the United States, drowning shows the greatest seasonal variation.[25] For drowning victims younger than 15 years, 70% of deaths occurred from May to August; the risk of drowning significantly increased (up to 69%) when the outside temperature exceeded 30°C (86°F).[26] Drowning also occurred disproportionately on Saturdays and Sundays. In 2016, in Maricopa County, Arizona, 47% of the 131 life-threatening pool-related incidents among children aged 0 to 4 years occurred on the weekend. The peak time of day was 6 PM to 8 PM, with 75% of all incidents

occurring between noon and 9 PM.[27] In another report, approximately one-half of drownings occurred between 4 PM and 6 PM, coinciding with the busiest swim times as well as distractions secondary to meal preparation.[28]

For the period 2014–2018, the 3 US states with the highest number of drowning deaths in the 0- to 19-year age group were California (419 per 100 000), Florida (489 per 100 000), and Texas (516 per 100 000). For the same age group, the states with the highest rates of drowning deaths per 100 000 population aged 0 to 19 years were Louisiana (2.3), Florida (2.1), and Mississippi (2.0). The lowest drowning death rates were reported in some of the New England and mid-Atlantic states.[25]

Setting

Age is an important determinant of drowning location. Most infants drown in bathtubs and buckets, whereas the majority of preschool-aged children drown in swimming pools. Older children and adolescents are more likely to drown in natural bodies of water. In a large national study of 1420 drowning deaths in children younger than 20 years, 47% of drownings in all age groups occurred in fresh water, 32% in artificial pools, 9% in the home (bathtubs, buckets), and 4% in salt water.[29] In a study from Washington state, natural bodies of water were the setting in 35% of drownings in the 0- to 4-year age group, 69% of the drownings in the 5- to 14-year age group, and 95% of the drownings of adolescents.[30] Similar findings were found in another study conducted in Massachusetts.[31] In contrast, for nonfatal drowning involving children and adults, 57% occurred in pools, 25% occurred in natural bodies of water, 9% occurred in bathtubs, and 8% were unspecified.[32]

Most infant drowning deaths occur in bathtubs (62%–71%) and large buckets (16%).[25,29] Almost all parents report believing a child should be at least 6 years old before being allowed to bathe alone.[33] However, approximately 15% to 30% of caregivers have reported leaving their children younger than 2 years unsupervised in the bath for a period ranging from 1 minute to slightly over 5 minutes.[34,35] In fact, in this study, 33% of parents reported leaving children younger than 2 years for a little over 1 minute and 24% for more than 2 minutes but less than 5 minutes.34 The caregivers were distracted by a phone, getting diapers or clothes for the child, or completing household chores.[34] Of note, first-time parents were less likely to leave children in the bathtub when compared with parents with an older child.[36] The association of unsupervised bathtub drowning deaths with the use of bathtub seats and rings was recognized more than 2 decades ago.[37] The bath seat and ring are designed to position the infant in a sitting position with 3 to 4 legs and suction cups at their base. Three hazard scenarios have been described with these devices: (1) the seat tipping over from suction cup failure, (2) the child becoming entrapped in leg openings that are too big, and (3) the child climbing out of the seat.[37] Additionally, infant tubs pose another risk contributing to bathtub drownings. Between January 2004 and December 2015, a total of 247 incidents were reported to the Consumer Product Safety Commission (CPSC) involving infant tubs, 31 fatal and 216 nonfatal.[38]

In a national study, 56% of drownings in children aged 0 to 4 years occurred in swimming pools, but a sizable portion (26%) occurred in fresh bodies of water (rivers, creeks, lakes, ponds, canals, and quarries).[29] In children younger than 5 years, the largest numbers of natural water drownings occur in ponds, whereas older children more commonly drown in lakes.[39]

Although children aged 5 to 14 years are slightly more likely to drown in a natural body of water than in a swimming pool, a high proportion (69%) of adolescents aged 15 to 19 years drowned in natural bodies of water.[29] More than one-half of natural water drownings occur in children younger than 14 years, and a greater proportion of these occur in urban settings with populations of more than 1 million.[39]

In-ground Pools

As opposed to open bodies of water, swimming pools have fewer drowning hazards, such as unknown depths, undefined areas, and presence of currents and waves.[12] However, swimming pools can pose a serious risk to toddlers and young children and older children who do not know how to swim. There are an estimated 6700 pool- or spa-related, hospital ED-treated, nonfatal drowning injuries and 379 pool- or spa-related fatal drownings each year involving US children younger than 15 years.[40] Of these, 75% involve children younger than 5 years. The recurring drowning scenario in pools and spas for young children includes unexpected, unsupervised access to the water. Only 17% had been last seen in or near the pool or spa before the incident and 10% had compromised or circumvented a pool or spa barrier.[40]

Pediatric swimming pool drownings occur in single-family and multifamily residences or public pools. Pediatric swimming pool drownings in single-family and multifamily residences are best predicted by the number of pools by

housing type and the number of children aged 0 to 17 years by housing type.[41] The risk of a submersion is 2.7 times higher for a child at a multifamily than a single-family residence and 28 times more likely in a swimming pool at a multifamily property than a pool at a single-family residence.[41]

Fixed and Portable Aboveground Pools

Aboveground pools can be fixed or portable. Aboveground pools can vary in size and height from small inflatable pools to larger versions that can hold thousands of gallons of water.[42] A portable pool is any movable structure intended for swimming or other water recreation, including wading pools, inflatable pools, and "soft-sided, self-rising" pools. Portable pools are increasingly popular compared with fixed aboveground pools because they can be set up and taken down or moved to another location with relative ease. Portable pools in residential settings also pose a risk of submersion-related morbidity and mortality to children.

From 2014 to 2016, there were, on average, 363 fatalities each year associated with pool or spa drownings involving children younger than 15 years. Aboveground pools accounted for 19% and portable pools accounted for 5% of these fatalities.[43]

The CPSC recommends that all pools, in-ground and aboveground, have a barrier, optimally 4-sided isolation fencing. The pool structure can serve as a barrier if the walls of the pool are high enough to meet the recommended 4-foot height for barrier fencing. Alternatively, a barrier can be mounted onto the top of the pool structure. The CPSC also recommends that, if the pool walls are not high enough, the steps or ladder leading to the pool be secured, locked, or removed or surrounded by a barrier to prevent access when the pool is not in use.[42] The American Society for Testing and Materials (ASTM) has published a standard (F 2666-16) for aboveground pools for residential use that addresses structural integrity, sanitation, electrical safety, and safety message labeling.[44]

Unfortunately, many parents do not consider fencing for an inflatable or portable pool, and such pools often fall outside of local building codes that require pool fencing. Because they contain such large amounts of water, these pools are often left filled for weeks at a time, presenting a continuous danger. The soft sides of some models allow children to lean over and easily fall into the pool headfirst. Ladders supplied with inexpensive aboveground pools generally cannot be locked to block access and are cumbersome to remove from the pools. Whether portable or fixed, children may be able to gain access to the water more easily than parents and caregivers intend. Children can enter the pool using the pool ladder (68%) or by climbing on a nearby object (20%).[45] In a study of aboveground pools, children between 42 and 54 months of age were shown to be able to climb into a pool with a 48-inch wall, even if the ladder was removed.[46]

It is important to stress that no single intervention is fully protective. Rather, multiple layers of protection are recommended. Industry is advised to develop affordable and effective products that include isolation fencing, safety covers, and alarms for portable pools. Extensive public education should stress that children can drown in portable pools. These efforts should be combined with strategies that reduce drowning risk, such as close supervision, CPR education, and methods to prevent unsupervised children from gaining access to these pools.[47]

Drain Entrapment

Entrapment and hair entanglement remain causes of injury and drowning in the pediatric population. The CPSC reported 11 victims of circulation entrapment from 2014 to 2018 (4 pool and 7 spa), including 2 fatalities, all in children aged 0 to 14 years, with the peak in the 5- to 9-year age group.[48] A circulation entrapment is defined as an entrapment involving the water circulation system of the product. Hair entanglement typically involves girls with long hair who are underwater near a suction outlet. The water flow into the drain sweeps the hair into and around the drain cover, where it becomes entangled in the holes and protrusions of the cover. Other types of entrapment involve a limb or body part. This scenario often involves a child playing with an open drain, inserting a hand or foot into the pipe, and then becoming trapped by increasing suction and resulting tissue swelling. Deaths occur from drowning.

Entrapment and entanglement can be prevented by the use of special drain covers, safety vacuum release systems (SVRSs), filter pumps with multiple drains, and a variety of other pressure-venting filter construction techniques.[49] Unfortunately, many parents and pool and spa owners are not aware of the risk of entrapment and entanglement; only 15% have installed antivortex drain covers, only 14% have multiple drain systems, and only 12% have SVRSs in their pools or spas.[50] In 2007, Congress passed the Virginia Graeme Baker Pool and Spa Safety Act, which requires drain covers, unblockable drains, and SVRSs for all public pools and spas in the United States.[51] The act markedly reduced the number of injuries and deaths attributable to drain entrapment.[52] Although the act does

not apply to private pools, residential pool owners can protect against entrapment by implementing the recommendations reflected in the legislation.

Lapses in Adult Supervision

Although poor supervision is often cited as a contributing factor for childhood drowning, especially for younger children,[18,53,54] an accepted definition for adequate supervision is lacking.[55] Supervisory behavior has been described as being composed of 3 components: proximity, attention, and continuity.[56] Attention and continuity are related to awareness, and proximity is related to the ability to intervene if needed. Proximity might be particularly important for young children and/or nonswimmers. For beginning swimmers, adequate supervision should include "touch supervision" in which the supervising adult is within arm's reach of the child so they can pull the child from the water if the child's head becomes submerged. High levels of all 3 components are likely necessary to keep children safe when around water. When children are not intended to be in or around the water, differing levels of the components may be appropriate, but the inevitable decreases in attention and proximity and lapses in continuity highlight the need for barriers to prevent water entry. It is important to note that supervision cannot replace barriers, and barriers cannot eliminate the need for supervision; they should work in conjunction with each other.

Drowning most often occurs quickly and quietly during periods of inadequate supervision. In Bangladesh, a case-control study of unintentional injury deaths among children younger than 5 years found that fatalities were 3 times more likely to occur in unsupervised children compared with matched, alive children.[22] Among 127 drowning deaths in children examined by a state's child death review teams, 38 (30%) were not in the care of an adult (4% unsupervised entirely, 25% with other children or friends, 4% at a location with lifeguards present). In deaths occurring among children younger than 5 years, teams identified inadequate supervision and isolated neglect as a factor in 68% (21 of 31) of cases.[18] When responding to an online questionnaire, parents admitted that they talked to others (38%), read (18%), ate (17%), and talked on the phone (11%) while supervising their child near water.[57] In a study of 496 drowning deaths in children younger than 14 years that were reviewed by state child death review teams, only 10% were completely unsupervised at the time of the drowning.[57] A more recent examination of national child death review data found that supervision was assessed to be lacking in 49% of incidents involving children drowning in pools. Caregivers often provided inadequate supervision because of drug or alcohol impairment, injury or illness, or distraction. Necessary supervision was noted to be lacking more often among drowning deaths involving younger children compared with older children.[54] Similarly, in an Australian study of 339 unintentional drowning deaths among children aged 0 to 14 years, coroners identified lack of supervision as a contributory factor in 72% of cases.[53]

Parental perceptions regarding necessary levels of supervision change as children progress through swim training, potentially to the detriment of the child's safety.[58,59] In a survey of parents of children aged 2 to 5 years enrolled in community swim lessons 4 times over 8 months, as parents' perceptions of their child's swim skill increased, their belief in the child's ability to keep themselves safe in the water increased and their perception regarding the need for parental supervision decreased.[59] The sociocultural norms and environment of a community can also influence parental perceptions and resultant supervisory behavior that is deemed appropriate.[60]

Alcohol

Alcohol plays a significant role in drowning risk related to boating, swimming, and supervision. A meta-analysis found that 30% to 70% of swimming and boating fatal drowning victims had a measurable blood alcohol concentration (BAC) and that 10% to 30% of these deaths could be attributed specifically to alcohol use.[61] In boating, there is evidence that the relative risk of drowning death is directly related to BAC, with a 16-fold greater risk when BAC was greater than 0.10 (100 mg/dL).[62] Boat passengers are at risk for alcohol-related drowning regardless of the alcohol use of the boat operator.[63] Most drownings associated with alcohol occur during recreational periods, over weekends, and in the afternoon. A longitudinal study showed that a decrease in regional unintentional drowning rates was associated with a decrease in deaths attributable to alcohol use.[64,65]

Alcohol may increase the risk of drowning not only by impairing judgment and performance but also through physiologic effects (eg, poor balance, impaired orientation, hypothermia) that affect survival once submersion occurs.[62] Alcohol use while boating is also significantly associated with low or no life jacket use.[66] Little information is available regarding the association of drug use and

drowning. In a 10-year retrospective study from Ohio, researchers found that only 3% of 141 accidental drowning deaths were associated with illicit drugs.[67]

Studies examining the relationship of caregiver alcohol use and unintentional childhood injury indicate that caregiver-reported number of drinks predicted decreased caregiver supervision and a higher likelihood of children sustaining injury.[68,69] Avoidance of alcohol and drug intake positively affects caregivers' prevention of and recognition and response to a child struggling to swim in water, resulting in better drowning surveillance. Alcohol and other drug use should be avoided when swimming, boating, or supervising children in and around the water. Boaters should be educated about the dangers of consuming alcohol when operating or riding in a watercraft, and authorities should enforce local Boating Under the Influence legislation.

At-Risk Populations

Certain populations are at increased risk of drowning because of behavioral, skill, or environmental factors as well as underlying medical conditions.

Toddlers

For the period 2014–2018, the highest rate of drowning occurred in the 0- to 4-year age group (2.26 per 100 000 population), with children aged 12 to 36 months being at highest risk (3.38 per 100 000). Most infants drown in bathtubs and buckets, whereas the majority of preschool-aged children drown in swimming pools.[29] These children are developmentally curious and drawn to water but lack the awareness of its dangers. For instance, as many as 35% of typically developing children aged 10 to 18 months can climb into a bathtub.[70]

Therefore, the primary problem for this young age group is lack of barriers to prevent unanticipated, unsupervised access to water, including swimming pools, hot tubs and spas, bathtubs, natural bodies of water, and standing water in homes (buckets, tubs, and toilets). The CPSC found that 69% of children younger than 5 years were not expected to be at or in the pool at the time of a drowning incident.[71]

Adolescents

Older adolescents (aged 15 to 19 years) have the second-highest fatal drowning rates. In this age group, approximately one-half of all drownings occur in natural water settings.[72] In 2016, SafeKids Worldwide reported that the natural water fatal drowning rate for adolescents aged 15 to 17 years was more than 3 times higher than that for children aged 5 to 9 years and twice the rate for children younger than 5 years.[54] Adolescence is a formative period, often involving seeking high-intensity and exciting experiences and sensations.[73] During this time, adolescents are especially vulnerable to the presence of peers. The mere presence of peers promotes risk-taking activity, especially if the adolescent has experienced previous social isolation.[74] This behavioral psychology plays a role in vulnerable teenagers, especially adolescent boys of racial and ethnic minorities, in social aquatic activities. The increased risk for fatal drowning in adolescents can be attributed to several factors, including overestimation of skills, underestimation of dangerous situations, engagement in high-risk and impulsive behaviors, and substance use.[75] Alcohol remains a leading factor in drowning deaths among adolescents and adults, contributing to 30% to 70% of recreational water deaths among US adolescents and adults.[76] Providing drowning prevention anticipatory guidance to adolescents and their caregivers, especially relating to alcohol use, can help address reported low rates of water safety knowledge in this age group.[77]

Boaters

In 2019, the US Coast Guard reported 46 boating deaths in individuals aged 19 years and younger, with 59% attributed to drowning; the remainder were mostly attributable to trauma. The majority (78%) of the boating deaths in this age group occurred while riding in an open motorboat (39%) or canoe or kayak (39%). Analysis of all fatal boating incidents revealed that 70% of the operators had not had boating safety instruction, and 23% of the incidents cited alcohol as a leading factor.[78]

Most boating-related drowning deaths (86%) occur among individuals who are not wearing a life jacket.[78] In children younger than 14 years, nearly 45% of those who died in a boating-related incident were not wearing a life jacket.[57] Federal law requires life jacket use for children younger than 13 years on recreational boats in the United States. In an observational study of small boats, researchers found that 90% of children younger than 5 years wore life vests, but only 13% among those aged 14 years or older wore life vests.[79] Trends in life jacket use from 1999 to 2010 showed an increase in life jacket use across all pediatric age groups in all boat types, but only an increase among adult boaters in sailboats.[80] Another observational study of swimmers and waders in designated swim areas revealed that life jacket and other flotation device use decreased with increasing age,

with 50% of children younger than 6 years using a life jacket compared with 3% of adults.[81]

Underlying Medical Conditions

Epilepsy

Epilepsy is a known risk factor in drowning, and drowning is the most common cause of death from unintentional injury for people with epilepsy, most commonly in bathtubs.[82] Children with epilepsy have a relative risk for fatal and nonfatal drowning 7.5-fold to 10-fold higher than children without seizures.[83,84] Drowning risk is dependent on such factors as age, severity of illness, degree of exposure to water, and level of supervision.[83–85]

Despite this drowning risk, water-based activities such as swimming can be safe for children with epilepsy, especially for those with well-controlled seizures (as defined by the child's neurologist). Many children with epilepsy learn to swim (and can do so safely), and some children with epilepsy swim competitively. Children with poorly controlled seizures (as defined by the child's neurologist) might be safest with one-to-one direct supervision (ie, constantly attentive and ready to quickly intervene) during water-based activities. Bathtubs and shallow water can present a hazard for any child with epilepsy, and showers are preferred over baths when age appropriate.[17]

Parents of children with poorly controlled seizure disorders should have a discussion with their child's neurologist or pediatrician before any swim activity. Whenever possible, children with epilepsy should also consider swimming only at locations where there is a lifeguard to add a layer of protection to their one-to-one supervision.

Autism

Children with ASD are at increased risk of drowning. A 2017 study revealed that unintentional injury deaths were nearly 3 times as likely for all individuals with ASD compared with the general population.[86] This excess risk was particularly high for children with greater degrees of intellectual disability[87] and for those younger than 15 years, who were reportedly 40 times more likely to die of injury.[86] Drowning, specifically, is a leading cause of unintentional injury deaths among children with ASD.[86] Wandering was the most commonly reported behavior leading to drowning, accounting for nearly 74% of fatal drowning incidents among children with ASD.[88] It has been proposed that swimming lessons be provided to children after the diagnosis of ASD is made.[86] A small pilot study of an 8-hour aquatic group therapy program demonstrated a statistically significant increase in water safety skills among children with ASD.[89] However, swimming instruction alone may not confer the necessary ability to transfer learned skills from one water setting to another. Supervision and barriers with alarms are critical layers of protection against drowning for children with ASD and other disabilities. Additionally, removal of enticing toys from the pool area when the pool is not in use is advised. The National Autism Association's Big Red Safety Box[90] is a resource that aids in development of a safety plan for public places where there is a handoff of supervision so that children with ASD and other disabilities do not wander off.

Attention-Deficit/Hyperactivity Disorder

Although it has not been specifically examined, children with a diagnosis of attention-deficit/hyperactivity disorder (ADHD) may have an increased risk of drowning related to increased risk taking and impulsivity. Studies suggest a strong association between ADHD and risk of all unintentional injuries.[91,92] Studies have demonstrated a reduction in unintentional injury risk among those children diagnosed with ADHD who are being treated with medication.[92,93]

Other Neurologic Diagnoses

For children with neuromuscular junction and muscle diseases or peripheral neuropathies, risk of participation in water-based activities may depend on the degree of fatigability and whether the disease is rapidly degenerative. If engaging in water-based activities, consultation with the child's neurologist and one-to-one adult supervision (ie, constantly attentive and ready to quickly intervene) is advised. Children with movement disorders, hemiplegia or diplegia (eg, cerebral palsy, stroke), white matter diseases (eg, adrenoleukodystrophy), and neuroimmunological disorders (eg, multiple sclerosis), have varied effects of the diseases on water safety and may have individualized capabilities. Therefore, consultation with a child's neurologist is advised regarding participation in water-based activities. Children with implantable devices (eg, ventriculoperitoneal shunts, vagus nerve stimulators) are also advised to consult their neurosurgeon about water safety.

Cardiac Arrhythmias

Exertion while swimming can trigger arrhythmia among individuals with long QT syndrome.[94] Although the condition is rare and such cases represent a small percentage of drownings, long QT syndrome should be considered as a possible cause for unexplained submersion injuries among proficient swimmers in low-risk

settings. Additionally, Brugada syndrome and catecholaminergic polymorphic ventricular tachycardia may also lead to increased risk.[95] This increased drowning risk underscores the need to counsel on the importance of close supervision for any child or adolescent with these conditions when in or around water.

Interventions

In the Haddon matrix of injury prevention, safety interventions are aimed at changing the environment, the individual at risk, or the agent of injury (in this case, water). For drowning prevention, the environment and the individual are the prime targets (Table 3). Experts generally recommend multiple layers of protection be used to prevent drowning because no single strategy is likely to prevent all submersion deaths and injuries. Such layers might include environmental changes, such as adult supervision, antientrapment and antientanglement measures, pool fencing, pool covers, water entry alarms, lifeguards, and CPR training. Additional prevention layers focused on the individual would include strategies such as swimming and survival skills training and use of life jackets. A concise list of recommendations can be found in the AAP policy statement "Prevention of Drowning."[96]

Adult Supervision

Close, attentive, and constant supervision of young children when they are in or around any body of water is an essential preventive strategy.[18,53] Appropriate supervision also includes examination of any unfamiliar environment for water hazards (eg, unfenced pool or pond) and prevention measures (eg, doors locked, gates closed). Adequate supervision should include being capable of recognizing and responding appropriately to a swimmer in distress. Diligent supervision, along with other measures, may be increasingly important among children with conditions that increase drowning risks, such as ASD or seizures, as noted above. Additionally, supervision is paramount in environments where barrier fencing is not possible.

Unfortunately, parents and caregivers may have misperceptions about what drowning looks like and how to appropriately supervise children.[54,97] In a survey of 1003 parents of children aged 0 to 12 years with access to a pool, researchers found that 48% of parents mistakenly believed they would be able to hear splashing or crying if their child was in trouble in the water, 56% believed that a lifeguard, if present, is the primary person responsible for supervising their child, and 32% reported leaving their child entirely unsupervised in a pool for 2 minutes or longer.[54]

Because young children who fall into water often make no noise and can be hard to see below the water surface, proper care of a young nonswimmer or beginning swimmer requires the supervising adult to be constantly attentive, in close proximity (ie, within arm's reach) and prepared to intervene. To stress the importance of supervision, as part of a water safety program, some communities promote "water watchers," encouraging a designated adult (identified with a hat or lanyard) to be responsible for constant supervision without engaging in any distracting activities.[39] However, these programs have not been evaluated. In an attempt to improve parental supervisory behaviors at public pools, an educational program (Keep Watch @ Public Pools) was piloted in Melbourne, Australia. At intervention pools, researchers observed improved attention, proximity, and preparedness among parents of children aged 6 to 10 years but no significant changes among parents of younger or older swimmers.[98]

Appropriate adult supervision for children around water is close, constant, competent, and attentive. In addition, supervisors need to know what a distressed swimmer looks like and how to safely intervene if needed. Development and evaluation of effective water safety education for parents are still needed.

Antientrapment and Antientanglement Measures

Entrapment and entanglement prevention measures include use of special drain covers, SVRSs, filter pumps with multiple drains, and a variety of other pressure-venting filter construction techniques.[49] Although such devices are required in commercial pools, they are often not required in residential pools.[47] Residential pool owners should be educated to include these effective safety measures.

Pool Fencing

Pool fencing is one of the most important prevention strategies to decrease the risk of drowning in swimming pools when children are not supposed to have access to the water. Compared with no fencing, installation of 4-sided fencing that isolates the pool from the house and yard has been demonstrated to decrease the number of pool immersion injuries among young children by more than 50%.[99–101] A Cochrane meta-analysis of available studies found that the odds ratio for a drowning in a fenced versus an unfenced pool was 0.27 (95% confidence interval [CI]: 0.16–0.47). In this analysis, 4-sided fencing

TABLE 3 Haddon Matrix for Drowning Prevention Strategies With Associated Levels of Evidence

	Personal	Equipment	Physical Environment	Social Environment
Pre-event	Provide close, constant, attentive supervision of children and poor swimmers[a]	Install 4-sided fencing that completely isolates the pool from the house and yard[b]	Swim where there are lifeguards[a]	Mandate 4-sided residential pool fencing[b]
	Evaluate preexisting health condition[c]	Install self-closing and latching gates[b]	Attend to warning signage[c]	Mandate life jacket wear[b]
	Develop water competency, including swim ability[a]	Wear life jackets[b]	Swim at designated swim sites[c]	Adopt the Model Aquatic Health Code[c]
	Know how to choose and fit a life jacket[c]	Install compliant pool drains[a]	Remove toys from pools when not in use to reduce temptation for children to enter the pool[c]	Increase availability of lifeguards[a]
	Avoid substance use[a]	Install door locks[c]	Empty water buckets and wading pools[c]	Increase access to affordable and culturally compatible swim lessons[c]
	Know the water's hazards and conditions[c]	Enclosures for natural bodies of water[c]	Lakefront slope gradient[d]	Close high-risk waters during high-risk times[d]
	Swim at a designated swim site[d]	Promote life jacket loaner programs[c]		Develop designated natural water swim sites[d]
	Learn CPR[b]	Role model life jacket use by adults[a]		Enforce Boating Under the Influence laws[b]
	Take a boater education course[c]	Make rescue devices available at swim sites[c]		
	—	Provide ability to call for help[b]		
	—	Ensure functional watercraft[c]		
Event	Water survival skills[c]	Rescue device available[c]	Lifeguard or bystander response[b]	Emergency Medical System[b]
Postevent	—	AED[c]	Early bystander CPR[b]	Advanced medical care[c]
	—	Rescue equipment[c]	EMS response[b]	

[a] Trials or diagnostic studies with minor limitations; consistent findings from multiple observational studies.
[b] Well-designed and conducted trials, meta-analyses on applicable populations.
[c] Expert opinion, case reports, reasoning from first principles.
[d] Single or few observational studies or multiple studies with inconsistent findings or major limitations.

(which isolates the pool from the house and yard) was superior to 3-sided fencing (which allows direct access to the pool from the house) with an odds ratio of 0.17 (95% CI: 0.07–0.44).[101] In an Australian study, researchers found that the risk of a child drowning in a pool with 3-sided fencing was almost twice that seen in pools with 4-sided fencing (incidence rate ratio, 1.78; 95% CI: 1.40–1.79).[28]

Unfortunately, laws and ordinances regarding pool fencing may have dangerous loopholes. The Virginia Graeme Baker Pool and Spa Safety Act defined minimum state law requirements as "the enclosure of all outdoor residential pools and spas by barriers to entry that will effectively prevent small children from gaining unsupervised and unfettered access to the pool or spa."[51] Three-sided fencing with self-locking or alarming doors between the house and pool area are often considered acceptable, and, in some locales, pool covers can substitute for a fence. Often, a fence law pertains only to new pool construction or to homes in which a young child is actually living at the time of the pool installation. Furthermore, in the United States, pool fences are rarely inspected and ordinances are often not enforced. In a recent Australian study, researchers found that government inspections raised the rate of compliance with pool fencing laws from approximately 50% to 97%.[102] Another study from Australia revealed that in the 5 years after enactment of legislation to improve the effectiveness of pool fencing, the number of private swimming pool drowning deaths halved.[103]

Children's ability to climb fences varies with the type of fence. In one study, chain-link fences were easily scaled by children, whereas ornamental iron bar fences proved more difficult to climb.[104] Fences should be at least 4 feet high, and no opening under the fence should be more than 4 inches (some building codes require a 5-foot fence and a maximum fence-to-ground

distance of only 2 inches). Vertical members of the fence should be less than 4 inches apart to keep a child from squeezing through, and there should be no foot- or handholds that could help a young child climb the fence. The fence should not prevent a clear view of the pool. Gates should be self-closing and self-latching, with the latch placed at least 54 inches above the bottom of the gate. The gate should open away from the pool (so that it will not open if leaned on) and should be checked often to ensure good working order. Pool gate alarms may provide additional protection, but no research exists on their efficacy. Detailed guidelines for safety barriers for home pools are available online from the CPSC,[42] but homeowners must also be aware of local laws and building codes regarding pool fence construction and after installation continue to check the fence and gate's integrity.

Pool Covers

Retractable pool covers and pool nets capable of holding the weight of a child have been advertised as effective barriers for drowning prevention. Because these covers must be removed and replaced each time the pool is used, they are less likely to be effective. Active interventions requiring an action each time they are to be used are proven to be less effective than passive interventions, which are always in effect.[105,106] The CPSC states that power safety covers can be installed on pools to serve as a security barrier, especially if the pool is not completely separated from the house and the yard by a fence.[42] However, there is currently no evidence to support this recommendation, and pool covers may impart a false sense of security. Because there are no studies regarding the efficacy of pool covers, they cannot be recommended as a substitute for isolation fencing.

On the contrary, some types of pool covers actually present a hazard for children. In 1980, the CPSC issued a warning about solar pool covers that are designed to keep the water warm and minimize pool chemical and water evaporation. When children try to walk on or remove these thin sheets of plastic, they can drown when they become entangled in the cover or hidden from view.[107] Additionally, even weight-bearing pool covers can make it difficult to see beneath them, potentially concealing a drowning victim.

Alarms

Pool Alarms

The CPSC has evaluated the performance of surface, subsurface, and wristband pool alarms. Several of these alarms functioned properly; however, the report concluded that alarms "should not be relied on as a substitute for supervision or a barrier completely surrounding the pool." No study has demonstrated whether pool alarms prevent drowning.[108] Additional research is needed to evaluate the efficacy of pool alarms, door alarms, and pool covers in the prevention of drowning.

Door Alarms

Many homes with pools, including private residences and homes used as vacation rentals, have doors that open directly into the pool area. It is important that all homes with pools have security measures in place so that children cannot enter the pool area unsupervised. Door alarms are one way to alert that the child has gained access to the pool area. The CPSC recommends that door alarms sound for at least 30 seconds within 7 seconds of the door opening, that the alarm be loud and distinct from other sounds in the house, and that the alarm have an automatic reset feature.[42] Effectiveness of door alarms has not been studied, and they should only be used as an adjunct to other proven layers of protection against drowning.

Lifeguards

Although no formal scientific study has quantified the value of lifeguards, anecdotal reports indicate that drowning rates are lower when lifeguards are present.[109] The United States Lifesaving Association (USLA) reports that more than 75% of drownings at USLA sites occurred at times when the beaches were unguarded, and the estimate that a person will die by drowning while protected by USLA-affiliated lifeguards is 1 in 18 million.[110] In addition to rescue efforts, lifeguards serve to make beaches safer by monitoring the aquatic environment, enforcing rules and regulations, and educating beachgoers about safety and injury prevention. Lifeguards most often perform prevention activities (54.8%), with rescues representing only 1.9% of lifeguard interventions.[111] Studies indicate that lifeguards are cost-effective[112,113] and reduce situations likely to end in injury or drowning.[109] Those choosing to swim in natural bodies of water or other sites accessible to the public should swim in designated swim areas with lifeguards present.

Although lifeguards are an important layer of protection against drowning, they are only one part of a multilayered approach. A study examining fatalities in lifeguarded US swimming pools found that, in fatal incidents, swimmers and pool bystanders were twice as likely to identify the submersion victim as were lifeguards.[114] A survey found that 20% of parents interviewed thought that the lifeguard was the main person responsible for supervising

their child while in the water, leading to a false sense of security and a resultant lack of parental supervision.[57] Nevertheless, trained, professional lifeguards provide a significant layer of protection to swimmers, especially through trained rescue and resuscitation in the event of a significant submersion. However, lifeguards do not take the place of caregiver supervision.

Bystander CPR

Immediate resuscitation at the submersion site, even before the arrival of emergency medical services (EMS) personnel, is the most effective means to improve outcomes in the event of a submersion incident.[2,3] Prompt initiation of bystander CPR and activation of prehospital advanced cardiac life support for the pediatric submersion victim have the greatest effects on survival and significantly improved neurologic prognosis.[4,115]

Although the Centers for Disease Control and Prevention recommends all caregivers and supervisors of children be trained in CPR,[32] several strategies can increase first response skills, including rescue and infant and child CPR training for caregivers of at-risk drowning populations. A video on drowning risk, pool fencing, and CPR shown to pregnant pool owners increased their likelihood of obtaining CPR instruction compared with those not shown the video.[116] Another study, the American Heart Association's "Child CPR Anytime," a 25-minute CPR instruction given to parents while their children were in a community swim lesson, led to significant sustained improvement in parental knowledge and confidence in performing CPR.[117]

Drowning can be described as a continuum, with an initial phase of respiratory arrest but intact circulation that will progress to cardiac arrest if hypoxia persists. In the first stage of the drowning continuum (ie, after a witnessed or brief submersion), rescue breathing to provide effective ventilation of the victim may be sufficient if circulation remains intact. As the drowning victim progresses from respiratory arrest to cardiac arrest (no palpable pulse), resuscitation using the compressions-airway-breathing sequence is initiated. "Hands-only" CPR is not appropriate for drowning victims because hypoxia is almost exclusively the cause of cardiac arrest resulting from drowning.[118] In a recent study on bystander CPR after drowning, resuscitation of victims aged 5 to15 years using compression and ventilation CPR was statistically significantly associated with neurologically favorable survival and survival to hospital discharge compared with compression-only CPR.[119]

Automated external defibrillator (AED) use may not be beneficial in resuscitation of the drowning victim as opposed to other etiologies of cardiac arrest. In a recent study, application of an AED before the arrival of EMS, even for patients found to have a shockable rhythm, was associated with decreased likelihood of favorable neurologic outcome.[115] Authors postulated that lay rescuers may have prioritized AED application over ventilation provided by CPR or had prolonged resuscitation duration until arrival of EMS.[115] The Heimlich maneuver is not recommended because positive-pressure ventilation by mouth or mask will accomplish adequate oxygenation without the delay caused by performing the Heimlich maneuver.[108] Current American Heart Association guidelines recommend that drowning victims who require any form of resuscitation (including only rescue breaths) be transported to the ED for evaluation and monitoring, even if they appear alert with effective cardiopulmonary function at the scene.[120]

Swimming Lessons, Water Survival Training, and Water Competency

All children should eventually learn to swim. Swim skill and water competency may be the most important drowning prevention measures in natural water settings because fencing and lifeguarding may be impractical in these settings. The position of the AAP has focused on the child being "developmentally ready" for formal swimming lessons. Developmental readiness for swim lessons is multifaceted; the determinant of readiness is not the child's age but the confluence of physical, social, behavioral and emotional, and cognitive skills balanced against the environmental risks of drowning.

It has been demonstrated that children aged 2–4 years can acquire the motor skills for swimming and that most children aged 4.5 years are developmentally ready to do so; by 5 or 6 years of age, most can master the front crawl.[121–123] Subsequently, Brenner et al revealed the preschool age group experienced a reduction in fatal drowning risk if they had had swim lessons,[124] as did Yang et al in a study of Chinese preschoolers.[125] School-aged children in the Bangladesh SwimSafe Program were demonstrated to have significantly decreased drowning rates.[126]

Before a case-control study of swimming lessons,[124] concerns about early swim lessons were based on the fear that swim lessons might increase drowning risk,[127] with the premise that parents whose children were in swim programs would have a false sense of security, resulting in inadequate supervision around water. Several studies have shown that parents of small children enrolled in swimming lessons were more likely to endorse the statements "swimming lessons are the best way to prevent drowning,"

"toddlers can learn to save themselves if they fall into water," and "it is better to develop swimming ability rather than rely on adult supervision."[128,129] When these parents were given a targeted educational program to reverse misconceptions about toddler water safety or given feedback about their child's progress or stories of close calls, they were more likely to agree that their child required more, not less, supervision and more likely to disagree that swimming lessons were the best way to prevent drowning.[58,128] Thus, swim lessons should include parental training to improve the parents' understanding of their child's actual swimming abilities and continued risk.

The American Red Cross Scientific Advisory Council defines basic swim skills as the following: ability to enter the water, surface, turn around, propel oneself for at least 25 yards, and then exit the water.[129] It is important to recognize that performance of these water survival skills, usually learned in a pool, is affected by the aquatic environment (water temperature, movement, depth, clothing, distance), for which a person may be unprepared. Demonstration of skills in one aquatic environment may not transfer to another. Effective swim lessons should provide repeated and progressively more experiential training, including swimming in clothes, swimming in life jackets, falling in, and self-rescue. Consequently, achieving basic swim skills requires multiple sessions of lessons. Thus, parents need to be aware of their child's progress and keep their child in lessons until basic water competency skills are achieved. More research is needed to determine which types of swim instruction and water survival skills training are most effective in preventing drowning in children of all ages.

The international drowning prevention community has begun to expand the concept of water competency to include needed skills, knowledge, and behaviors.[5] In addition to basic swim skills, water competency should include knowledge of local hazards in the aquatic environment, risk judgment and self-assessment of abilities, and recognition and response to a person in distress in the water, including safe rescue and CPR.[5] Thus, acquisition of water competency is a protracted process that involves learning in conjunction with developmental maturation and physical skill sets by the child.

Barriers to swim lessons and water competency are more commonly based in cultural norms, economics, and access. Black communities have reported a legacy of reluctance to engage in swimming related to long-standing segregation and exclusion from public pools.[130] Vietnamese immigrant families reported that pool environments are alien and cold and recreational swimming is not valued.[131] Clothing that protects modesty may not be allowed in some pools, and, for some religious and ethnic groups, single-sex aquatic settings are required.[17] In addition, the multiple swim sessions required to achieve basic water competency can be costly, and access to affordable, convenient, and culturally appropriate swim lessons may be limited. Moreover, decreased municipal funding for swimming pools and lifeguards has worsened access to swimming lessons and safe water recreation in many communities. These barriers can, and should, be addressed through community-based programs targeting high-risk groups by providing free or low-cost swim lessons, developing special programs and changing pool policies, using language and culturally appropriate instructors to deliver water safety classes, and working with health care clinics and places of worship to refer families to swim programs.[17,132]

Although early instruction may be beneficial, there are currently no data to support a recommendation for infant swim lessons. Aquatic programs for young children (especially those younger than 1 year) pose some medical concerns, and initiation of a swim program should be discussed between an infant's caregiver and pediatrician. These include the risk of gastrointestinal tract infections, dermatitis, and acute respiratory illness that result from exposure to infectious agents and pool chemicals. Hyponatremia from ingesting water and hypothermia are also health risks to the infant.[133] Fortunately, medical problems from swimming are rare, treatable, and preventable events.[134,135] The World Aquatic Babies and Children Network has published guidelines for the operation of aquatic programs for children younger than 3 years. The guidelines recommend (1) required parental involvement, (2) a fun atmosphere with one-on-one teaching, (3) qualified teachers, (4) warm water to prevent hypothermia, (5) maintenance of water purity, and (6) a limited number of submersions to prevent water ingestion and hyponatremia.[136] The American Red Cross has resources for choosing a swim program.[137]

Multiple studies have found that exposure to chlorination byproducts in swimming pools can damage respiratory epithelium and can result in a child's predisposition to asthma and bronchitis and other allergic conditions.[138–142] However, a longitudinal study of children from birth to age 7 to 10 years revealed no increased risk of respiratory symptoms, allergy, or asthma among those with chronic but

noncompetitive swimming pool exposure. In fact, their lung function was better.[141]

The AAP supports swimming lessons for children older than 1 year. Swim lessons are increasingly available for children with various disabilities, including autism, or other health conditions. A parent's decision about when to initiate swimming lessons must be individualized on the basis of a variety of factors, such as frequency of exposure to water, health concerns, emotional maturity, and physical limitations, while considering that toddlers aged 12 to 36 months are at highest risk of drowning. It must be stressed that swimming lessons, in isolation, will not drown-proof a child. The goal of swim lessons is to reduce the risk of drowning but also to promote and prepare for parent-child activities, exercise, fun, and enjoyment of the long process of acquiring aquatic learning and water competency. Swim ability must be considered as only one part of water competency and of a multilayered protection plan involving effective pool barriers, constant and capable supervision, life jacket use, and lifeguards. Parents and guardians of children should become an integral component of aquatic programs to facilitate and continue development of their child's water competence.

Importantly, parental acquisition of water competency knowledge and behaviors are critical to reinforce and promote the child's water competency. Because parents and caregivers are usually the most immediate layer of protection, they need to learn key physical skill sets, too. Untrained rescuers, such as a parent or bystander, often die when they enter the water to attempt the rescue of a drowning victim.[143–145] Even a small child can drown an untrained rescuer. Sometimes the primary drowning victim survives, whereas the intended rescuer, often a male relative, fatally drowns; other times, both die.[144] Because rescuer safety must be the priority, only people trained in the advanced skills of water rescue should enter the water. Safer rescue techniques should be taught to children and their parents as a part of comprehensive water safety training during swim lessons.[146] These techniques involve reaching with an object or throwing something that floats to avoid water entry ("Reach, throw, or row; don't go"). Safe rescue of a drowning person requires knowing one's limitations, risks, and training to avoid putting oneself at risk.

Life Jackets

Life jackets prevent drowning by keeping the airway out of the water when the user is immersed. Life jacket requirements for boaters have been promoted by the US Coast Guard and watersports organizations. Life jackets prevent drowning deaths; the use of an approved life jacket decreased boat-related drowning morbidity and mortality by 50%.[147,148] Unfortunately, their use remains low; US Coast Guard boating statistics from 2017 indicate that in only 15.5% of fatal drownings among all ages, the victims were wearing a life jacket.[78] However, in the past 10 years, life jacket use among children and teenagers younger than 18 years in boats has increased from 56% to 65% nationally. Reasons commonly cited for not wearing a life jacket include beliefs that drowning risk is low; that life jackets restrict movement, are uncomfortable, or are unattractive; and that wearing a life jacket is a sign of fear or inexperience.[66] Recent changes in life jacket design address some of these concerns. Parents of children who do not always wear life jackets report reasons including the following: (1) the parent is in close proximity to the child, (2) a life jacket for the child is onboard in case of emergency, and/or (3) the child has good swimming skills.[57] Importantly, many drowning incident reports include parents who drown while attempting to help their child.[143,145]

Life jacket use has expanded beyond boating; they are increasingly used for children who are weak swimmers or nonswimmers when near or in the water wading or swimming. In one recent study, 50% of children younger than 5 years wore one when in the water at designated natural water swim sites.[81] Although anecdotal reports remain the only evidence supporting the effectiveness of life jackets for preventing drowning when swimming, the means of protection would be similar by keeping the airway out of the water.

Legislation is the most effective way to increase life jacket use, leading to 90% to 95% compliance among specific groups, such as children, people on personal watercraft, and those in activities such as water skiing.[149] Moreover, local ordinances requiring life jacket use by those near or in the water of specific high-risk waterways have led to observed increases in life jacket wear.[150] Parental modeling[148] and educational campaigns[151] can both increase life jacket use among children and teenagers in boats. Life jacket loaner programs at swimming and boating sites increase access to life jackets, often at no cost, and allow a family to choose to recreate at a safer site. Some states now require camps and other venues to provide life jackets for swimmer use.[152]

To decrease consumer confusion and increase wear, standardization of life jacket wear requirements is needed. Many states that share

bodies of natural water have different laws. Few states mandate life jacket use among boating teenagers; only Louisiana requires use for those younger than 17 years.[153] Using a risk reduction approach, state life jacket laws should include adolescents, the highest risk age group, and address small vessels, including paddle craft.

Newer life jackets address some of the barriers to their use. Inflatable life jackets are light and not bulky but are only for those aged ≥16 years, are costly, and require replacement of the inflating carbon dioxide cylinder. US Coast Guard–approved life jackets now include a model similar to the inflatable arm floats popular among preschoolers because it facilitates floating (eg, the Puddle Jumper). Parents need to check that any life jacket fits appropriately and is US Coast Guard approved because there are many similar products that do not meet safety requirements. It is important to recognize that air-filled swimming aids (such as inflatable armbands) are toys that can deflate or slip off and should not be used in place of life jackets. Information about infant and child life jackets for a variety of aquatic situations is available online from the US Coast Guard.[154]

Boating Safety

Preventing boating-related injuries and deaths requires good boat maintenance and function and safe and sober operators and passengers. Parents can teach boating and water safety to their children and prohibit alcohol use during recreational water activities. They can check that the boat operator has had boater education, does not use or allow drug or alcohol intake while boating, has appropriately sized US Coast Guard–approved life jackets available for each passenger per federal law, and will both wear a life jacket and require children to wear them.

Multiple studies using different methodologies consistently show that life jackets decrease boating-related injuries and deaths by 50%.[148] In a matched cohort control study of all boating deaths reported to the US Coast Guard, boaters who wore life jackets had 50% lower death rates compared with those who did not in the same boat.[147] In Australia, a mandatory life jacket law increased life jacket wear and also decreased boating drowning deaths by 50%.[155]

In contrast to boating requirements, all states mandate that all people wear a life jacket when on a personal watercraft or when being towed behind a boat, such as water skiing or water boarding. Life jacket wear rates among people of all ages participating in these activities are greater than 90%.[156] A national law requires that every boat has available an appropriately sized life jacket for each passenger.[153] Almost all states require children to wear a life jacket when in boats; however, the mandated upper age varies from 5 to 16 years.[153] For states lacking life jacket laws, federal law mandates life jackets be worn by children younger than 13 years on a moving boat.[153] These mandates explain why national wear rates have increased since 1999 only among pediatric age groups, including teenagers. In 2017, wear rates were 94% in children younger than 5 years, 87% in those 6 to 12 years, and 46.5% in those 13 to 17 years.[156] In contrast, despite continued efforts and recommendations by multiple organizations to promote life jacket use while boating, wear rates among adult motor boaters, the largest group of boaters, remain stagnant and low.

Boaters' life jacket wear increases when mandated[149,150,155]; the higher rates observed among teenagers, even when not mandated, may be spillover effects from pediatric laws. Wear rates also increase with adult modeling; in Washington state, if even 1 adult in the boat wore a life jacket, the likelihood of adolescent use rose to 81.4%, compared with only 36.1% of adolescents accompanied by adults not wearing a life jacket.[149]

Drowning Chain of Survival

The Drowning Chain of Survival (Fig 1) refers to a series of steps that, when enacted, attempt to reduce mortality associated with drowning. The steps of the chain are the following: Prevent drowning, recognize distress, provide flotation, remove from water, and provide care as needed. The chain starts with prevention, the most important and effective step to reducing morbidity and mortality from drowning.[157] The subsequent steps of the Drowning Chain of Survival differ uniquely from the Cardiac Arrest Chain of Survival because of the water environment; flotation is needed to keep the victim's airway out of the water and to facilitate getting them to land. The drowning time line (Fig 2) shows the different levels of actions and interventions chronologically that could interrupt each sequence of the drowning process once drowning begins.[158] These interventions may be used by the drowning victim who has swim skills to self-rescue or the parent or lifeguard who needs to recognize the child in trouble, initiate a safe rescue, and provide CPR. The time line shows that rescue and resuscitation of a drowning victim must occur within minutes to save lives. It also shows that the lay rescuers' efforts should take place out of the water to prevent the rescuer from risk of also drowning.[143,144] Moreover, it

FIGURE 1 Drowning chain of survival. Adapted from Szpilman D, Webber J, Quan L, et al. Creating a drowning chain of survival. Resuscitation. 2014;85(9):1151.

underscores the critically time-sensitive role of the parent or supervising adult in preventing a drowning and stopping it from becoming a fatality.

Outcome Predictors

The clinical outcome for pediatric drowning victims can be difficult to predict and depends on multiple factors.[159] Prognosis is ultimately dependent on the extent of cerebral hypoxia and resultant cerebral damage incurred during the initial drowning event and retrieval from the water.[160] Good outcomes (survival with no neurologic sequelae) are increased with submersion durations of less than 6 minutes and EMS response times of less than 10 minutes,[161] which can be facilitated by early rescue and initiation of bystander CPR.[2,115] The Submersion Score, a compilation of clinical signs, has identified pediatric patients at low risk for injury after significant submersion.[162] In addition, a recent study identified that low-risk patients had normal vital signs and pulse oximetry at the time of arrival to the ED.[163] Despite the common belief that young age is protective, a meta-analysis found that young age did not correlate with better outcome.[161]

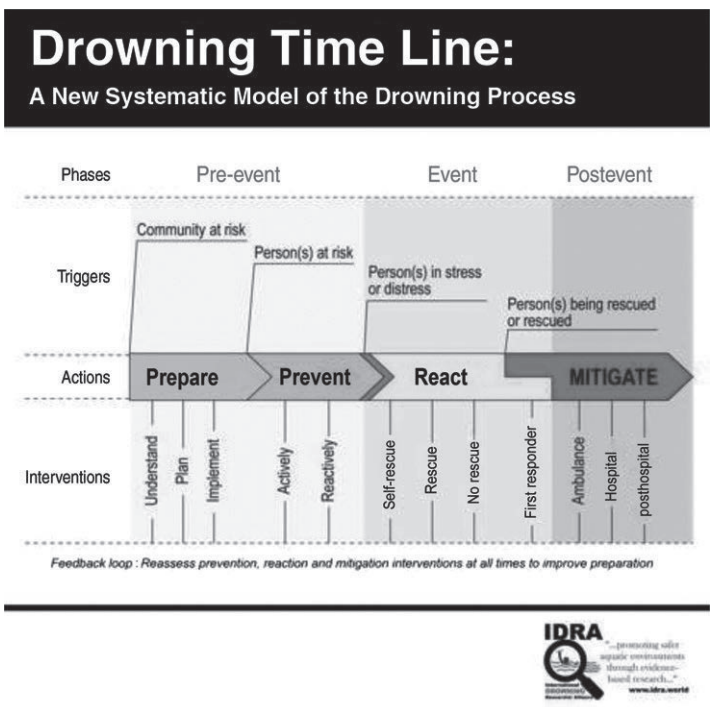


FIGURE 2 Drowning time line. Adapted from Szpilman D, Tipton M, Sempsrott J, et al. Drowning time-line: a new systematic model of the drowning process. Am J Emerg Med. 2016;34(11):2225.

The strongest predictor of poor outcome (death or survival with moderate or severe neurologic sequelae) appears to be increased submersion duration of 6 minutes or longer, with a low likelihood of good outcome after submersion greater than 10 minutes.[118,161] In a recent study on childhood swimming pool submersions, poor outcome was associated with submersions 5 minutes or longer in duration and those occurring on weekdays (possibly because events held at multiresident pools have a higher chance of bystander rescue on weekends).[164] The highest risk ratio in a recent systematic review and meta-analysis was submersion of 15 to 25 minutes' duration, with those longer than 25 minutes being invariably fatal.[161]

In addition to submersion duration, poor outcome predictors include additional prehospital factors (duration of apnea), initial ED presentation (fixed and dilated pupils, bradycardia or asystole, hypothermia, Glasgow coma scale score <5, prolonged CPR duration), and other hospital course determinants (intubation and use of inotropes); however, none are absolutely predictive of outcome.[159,165] Current evidence has not found a protective

effect of colder water temperatures for drowning victims, and hypothermia does not improve chances of survival.[95,161,166] Although acidemia on blood gas analysis (as a surrogate for respiratory failure with hypoxia) and hyperkalemia may suggest poor prognosis, there are insufficient data to adequately predict poor outcome for patients with these laboratory findings.[95]

The majority of pediatric nonfatal drowning victims have a good outcome without neurologic sequelae; however, some survivors may have significant long-term neurologic deficits. Children whose submersion duration exceeded 10 minutes had a significantly poorer health-related quality of life than those who were submerged for shorter durations.[167] Patients admitted to the hospital who demonstrated no neurologic improvement at 48 hours had a poor prognosis.[95] Factors independently associated with higher long-term mortality risk for survivors of nonfatal drownings include age 5 to 15 years and severe neurologic impairment at discharge.[168] Ultimately, because in-hospital treatment has not been demonstrated to improve drowning outcomes,[64] prevention of drowning incidents is critical.

Policy Statement

Advice pediatricians may provide to parents and recommendations for advocacy at the community level is available in the accompanying policy statement.[96]

LEAD AUTHORS

Sarah A. Denny, MD, FAAP
Linda Quan, MD, FAAP
CAPT Julie Gilchrist, MD, FAAP
Tracy McCallin, MD, FAAP
Rohit Shenoi, MD, FAAP
Shabana Yusuf, MD, MEd, FAAP
Jeffrey Weiss, MD, FAAP
Benjamin Hoffman, MD, FAAP

COUNCIL ON INJURY, VIOLENCE, AND POISON PREVENTION, 2019–2020

Benjamin Hoffman, MD, FAAP, Chairperson
Phyllis F. Agran, MD, MPH, FAAP
Michael Hirsh, MD, FAAP
Brian Johnston, MD, MPH, FAAP
Sadiqa Kendi, MD, FAAP
Lois K. Lee, MD, MPH, FAAP
Kathy Monroe, MD, FAAP
Judy Schaechter, MD, MBA, FAAP
Milton Tenenbein, MD, FAAP
Mark R. Zonfrillo, MD, MSCE, FAAP
Kyran Quinlan, MD, MPH, FAAP, Immediate Past Chairperson

LIAISONS

Lynne Janecek Haverkos, MD, MPH, FAAP – *National Institute of Child Health and Human Development*
Jonathan D. Midgett, PhD – *Consumer Product Safety Commission*
Bethany Miller, MSW, Med – *Health Resources and Services Administration*
Judith Qualters, PhD, MPH – *Centers for Disease Control and Prevention*
Alexander W. (Sandy) Sinclair – *National Highway Traffic Safety Administration*
Richard Stanwick, MD, FAAP – *Canadian Pediatric Society*

STAFF

Bonnie Kozial

ACKNOWLEDGMENT

In memory of our friend and colleague, Ruth Brenner, MD, FAAP, in appreciation for her significant contributions to the field of drowning prevention and policy and her commitment to the AAP.

ABBREVIATIONS

AAP: American Academy of Pediatrics
ADHD: attention-deficit/hyperactivity disorder
AED: automated external defibrillator
AI: American Indian
AN: Alaskan native
ASD: autism spectrum disorder
BAC: blood alcohol content
CI: confidence interval
CPR: cardiopulmonary resuscitation
CPSC: Consumer Product Safety Commission
ED: emergency department
EMS: emergency medical services
SVRS: safety vacuum release system
USLA: US Lifesaving Association

FUNDING: No external funding.

POTENTIAL CONFLICT OF INTEREST: The authors have indicated they have no potential conflicts of interest to disclose.

REFERENCES

1. Centers for Disease Control and Prevention. WISQARS—Web-based Injury Statistics Query and Reporting System. Available at: https://www.cdc.gov/injury/wisqars/index.html. Accessed November 2, 2020
2. Kyriacou DN, Arcinue EL, Peek C, Kraus JF. Effect of immediate resuscitation on children with submersion injury. *Pediatrics*. 1994;94(2 Pt 1):137–142
3. Suominen P, Baillie C, Korpela R, Rautanen S, Ranta S, Olkkola KT. Impact of age, submersion time and water temperature on outcome in near-drowning. *Resuscitation*. 2002;52(3):247–254
4. Quan L, Wentz KR, Gore EJ, Copass MK. Outcome and predictors of outcome in

pediatric submersion victims receiving prehospital care in King County, Washington. *Pediatrics.* 1990;86(4):586–593

5. Stallman RK, Moran K, Quan L, Langendorfer S. From swimming skill to water competence: towards a more inclusive drowning prevention future. *Int J Aquat Res Educ.* 2017;10(2): doi: 10.25035/ijare.10.02.03
6. Water Safety USA. Become water competent. Available at: https://www.watersafetyusa.org/water-competency.html. Accessed November 2, 2020
7. Idris AH, Berg RA, Bierens J, et al; American Heart Association. Recommended guidelines for uniform reporting of data from drowning: the "Utstein style". *Circulation.* 2003;108(20):2565–2574
8. Mitchell RJ, Williamson AM, Olivier J. Estimates of drowning morbidity and mortality adjusted for exposure to risk. *Inj Prev.* 2010;16(4):261–266
9. Howland J, Hingson R, Mangione TW, Bell N, Bak S. Why are most drowning victims men? Sex differences in aquatic skills and behaviors. *Am J Public Health.* 1996;86(1):93–96
10. Croft JL, Button C. Interacting factors associated with adult male drowning in New Zealand. *PLoS One.* 2015;10(6):e0130545
11. Saluja G, Brenner RA, Trumble AC, Smith GS, Schroeder T, Cox C. Swimming pool drownings among US residents aged 5-24 years: understanding racial/ethnic disparities. *Am J Public Health.* 2006;96(4):728–733
12. Gilchrist J, Parker EM. Racial and ethnic disparities in fatal unintentional drowning among persons less than 30 years of age–United States, 1999-2010. *J Safety Res.* 2014;50:139–142
13. Irwin R, Drayer J, Irwin C, Ryan T, Southall R. *Constraints Impacting Minority Swimming Participation.* Memphis, TN: University of Memphis; 2008
14. Irwin CC, Irwin RL, Ryan TD, Drayer J. Urban minority youth swimming (in)ability in the United States and associated demographic characteristics: toward a drowning prevention plan. *Inj Prev.* 2009;15(4):234–239
15. Pharr J, Irwin C, Layne T, Irwin R. Predictors of swimming ability among children and adolescents in the United States. *Sports (Basel).* 2018;6(1):17
16. Gallinger ZR, Fralick M, Hwang SW. Ethnic differences in drowning rates in Ontario, Canada. *J Immigr Minor Health.* 2015;17(5):1436–1443
17. Moore E, Ali M, Graham E, Quan L. Responding to a request: gender-exclusive swims in a Somali community. *Public Health Rep.* 2010;125(1):137–140
18. Quan L, Pilkey D, Gomez A, Bennett E. Analysis of paediatric drowning deaths in Washington State using the child death review (CDR) for surveillance: what CDR does and does not tell us about lethal drowning injury. *Inj Prev.* 2011;17(Suppl 1):i28–i33
19. Zaloshnja E, Miller TR, Galbraith MS, et al. Reducing injuries among Native Americans: five cost-outcome analyses. *Accid Anal Prev.* 2003;35(5):631–639
20. Giles AR, Castleden H, Baker AC. "We listen to our Elders. You live longer that way": examining aquatic risk communication and water safety practices in Canada's North. *Health Place.* 2010;16(1):1–9
21. World Health Organization. Global report on drowning: preventing a leading killer. Geneva, Switzerland: World Health Organization; 2014. Available at: http://apps.who.int/iris/bitstream/handle/10665/143893/9789241564786_eng.pdf;jsessionid=6BB144E8B7125631A4655BFC406C2F06?sequence=1. Accessed November 2, 2020
22. Khatlani K, Alonge O, Rahman A, et al. Caregiver supervision practices and risk of childhood unintentional injury mortality in Bangladesh. *Int J Environ Res Public Health.* 2017;14(5):515
23. Morgenstern H, Bingham T, Reza A. Effects of pool-fencing ordinances and other factors on childhood drowning in Los Angeles County, 1990-1995. *Am J Public Health.* 2000;90(4):595–601
24. Stirbu I, Kunst AE, Bos V, van Beeck EF. Injury mortality among ethnic minority groups in the Netherlands. *J Epidemiol Community Health.* 2006;60(3):249–255
25. Centers for Disease Control and Prevention. Wide-ranging Online Data for Epidemiologic Research (WONDER). Available at: wonder.cdc.gov. Accessed November 2, 2020
26. Fralick M, Denny CJ, Redelmeier DA. Drowning and the influence of hot weather. *PLoS One.* 2013;8(8):e71689
27. Flood TJ; Arizona Department of Health Services; Bureau of Public Health Statistics. Drowning-related hospitalization in Arizona and Maricopa County. 2016. Available at: https://www.azdhs.gov/documents/preparedness/public-health-statistics/publications/drngrpt2016-2018.pdf. Accessed November 2, 2020
28. Stevenson MR, Rimajova M, Edgecombe D, Vickery K. Childhood drowning: barriers surrounding private swimming pools. *Pediatrics.* 2003;111(2):E115–E119
29. Brenner RA, Trumble AC, Smith GS, Kessler EP, Overpeck MD. Where children drown, United States, 1995. *Pediatrics.* 2001;108(1):85–89
30. Quan L, Cummings P. Characteristics of drowning by different age groups. *Inj Prev.* 2003;9(2):163–168
31. Lee LK, Mao C, Thompson KM. Demographic factors and their association with outcomes in pediatric submersion injury. *Acad Emerg Med.* 2006;13(3):308–313
32. Centers for Disease Control and Prevention. Drowning–United States, 2005-2009. *MMWR Morb Mortal Wkly Rep.* 2012;61(19):344–347
33. Porter TR, Crane LA, Dickinson LM, Gannon J, Drisko J, DiGuiseppi C. Parent opinions about the appropriate ages at which adult supervision is unnecessary for bathing, street crossing, and bicycling. *Arch Pediatr Adolesc Med.* 2007;161(7):656–662
34. Simon HK, Tamura T, Colton K. Reported level of supervision of young children while in the bathtub. *Ambul Pediatr.* 2003;3(2):106–108
35. Lee LK, Thompson KM. Parental survey of beliefs and practices about bathing and water safety and their children: guidance for drowning prevention. *Accid Anal Prev.* 2007;39(1):58–62
36. van Beelen MEJ, van Beeck EF, den Hertog P, Beirens TMJ, Raat H. Correlates of unsupervised bathing of infants: a cross-sectional study. *Int J Environ Res Public Health.* 2013;10(3):856–866

37. Rauchschwalbe R, Brenner RA, Smith GS. The role of bathtub seats and rings in infant drowning deaths. *Pediatrics*. 1997;100(4):E1

38. Consumer Product Safety Commission. CPSC approves new federal safety standard for infant bath tubs. 2017. Available at: https://www.cpsc.gov/CPSC-Approves-New-Federal-Safety-Standard-for-Infant-Bath-Tubs. Accessed November 2, 2020

39. Safe Kids Worldwide. Water watcher card. Available at: https://www.safekids.org/other-resource/water-watcher-card. Accessed November 2, 2020

40. Consumer Product Safety Commission. *Pool or Spa Submersion: Estimated Nonfatal Drowning Injuries and Reported Drownings, 2020 Report*. Washington, DC: Consumer Product Safety Commission; 2020. Available at: https://www.cpsc.gov/s3fs-public/2020-Submersion-Report-4-29-20_0.pdf?ghYmK0mkLBzmXo6Rjm96Qkn16JCpM1ir. Accessed November 2, 2020

41. Shenoi RP, Levine N, Jones JL, Frost MH, Koerner CE, Fraser JJ Jr. Spatial analysis of paediatric swimming pool submersions by housing type. *Inj Prev*. 2015;21(4):245–253

42. Consumer Product Safety Commission. *Safety Barrier Guidelines for Residential Pools*. Washington, DC: Consumer Product Safety Commission; 2012. Available at: https://www.cpsc.gov/s3fs-public/362%20Safety%20Barrier%20Guidelines%20for%20Pools.pdf. Accessed November 2, 2020

43. Consumer Product Safety Commission. Pool or spa submersion: estimated nonfatal drowning injuries and reported drownings, 2019 report. 2019. Available at: https://www.cpsc.gov/s3fs-public/Pool_or_Spa_Submersion_Estimated_Nonfatal_Drowning_Injuries_and_Reported_Drownings_May_2019.pdf?mW8FxiPVF0l3UErKzePwJ.JNoCc79yY5. Accessed November 2, 2020

44. ASTM International. *ASTM F2666-16. Standard Specification for Above-ground Portable Pools for Residential Use*. West Conshohocken, PA: American Society for Testing and Materials; 2016. Available at: www.astm.org/Standards/F2666.htm. Accessed November 2, 2020

45. Shields BJ, Pollack-Nelson C, Smith GA. Pediatric submersion events in portable above-ground pools in the United States, 2001-2009. *Pediatrics*. 2011;128(1):45–52

46. Ridenour MV. Climbing performance of children: is the above-ground pool wall a climbing barrier? *Percept Mot Skills*. 2001;92(3 Pt 2):1255–1262

47. Safely P. 2018 CPSC reports: as drowning rates remain consistent, CPSC encourages families to increase water safety efforts. 2018. Available at: https://www.poolsafely.gov/2018-cpsc-reports-as-drowning-rates-remain-consistent-parents-and-caregivers-are-encouraged-to-increase-water-safety-efforts-this-summer/. Accessed November 2, 2020

48. Consumer Product Safety Commission. *2014–2018 Reported Circulation/Suction Entrapment Incidents Associated with Pools, Spas, and Whirlpool Bathtubs, 2019 Report*. Washington, DC: Consumer Product Safety Commission; 2019. Available at: https://cpsc.gov/s3fs-public/2019_Circulation_Entrapment.pdf?lzoaBICIbtP70RRVUJqPK3RI4Ikxyety. Accessed November 2, 2020

49. Consumer Product Safety Commission. *Guidelines for Entrapment Hazards: Making Pools and Spas Safer*. Washington, DC: Consumer Product Safety Commission; 2009. Available at: https://www.cpsc.gov/s3fs-public/361.pdf. Accessed November 2, 2020

50. Quraishi A, Morton S, Cody B, Wilcox R. *Pool and Spa Drowning: A National Study of Drain Entrapment and Pool Safety Measures*. Washington, DC: Safe Kids Worldwide; 2006

51. S. 1771 (110th): Virginia Graeme Baker Pool and Spa Safety Act. 2007. Available at: https://www.govtrack.us/congress/bills/110/s1771. Accessed November 2, 2020

52. Zhang Q. *2013-2017 Reported Circulation/Suction Entrapment Incidents Associated with Pools, Spas, and Whirlpool Bathtubs, 2018 Report*. Washington, DC: Consumer Product Safety Commission; 2018

53. Petrass LA, Blitvich JD, Finch CF. Lack of caregiver supervision: a contributing factor in Australian unintentional child drowning deaths, 2000-2009. *Med J Aust*. 2011;194(5):228–231

54. Mackay JM, Steel A, Dykstra H, Wheeler T, Samuel E, Green A. *Keeping Kids Safe In and Around Water: Exploring Misconceptions that Lead to Drowning*. Washington, DC: Safe Kids Worldwide; 2016. Available at https://www.ncfrp.org/wp-content/uploads/NCRPCD-Docs/Keeping-Kids-Safe-in-and-Around-Water-Report-2016.pdf. Accessed November 2, 2020

55. Bugeja L, Franklin RC. An analysis of stratagems to reduce drowning deaths of young children in private swimming pools and spas in Victoria, Australia. *Int J Inj Contr Saf Promot*. 2013;20(3):282–294

56. Saluja G, Brenner R, Morrongiello BA, Haynie D, Rivera M, Cheng TL. The role of supervision in child injury risk: definition, conceptual and measurement issues. *Inj Control Saf Promot*. 2004;11(1):17–22

57. Cody B, Quraishi A, Dastur M, Mickalide A. *Clear Danger: A National Study of Childhood Drowning and Related Attitudes and Behaviors*. Washington, DC: National Safe Kids Campaign; 2004

58. Morrongiello BA, Sandomierski M, Schwebel DC, Hagel B. Are parents just treading water? The impact of participation in swim lessons on parents' judgments of children's drowning risk, swimming ability, and supervision needs. *Accid Anal Prev*. 2013;50:1169–1175

59. Morrongiello BA, Sandomierski M, Spence JR. Changes over swim lessons in parents' perceptions of children's supervision needs in drowning risk situations: "His swimming has improved so now he can keep himself safe". *Health Psychol*. 2014;33(7):608–615

60. Peterson L, Ewigman B, Kivlahan C. Judgments regarding appropriate child supervision to prevent injury: the role of environmental risk and child age. *Child Dev*. 1993;64(3):934–950

61. Driscoll TR, Harrison JA, Steenkamp M. Review of the role of alcohol in drowning associated with recreational

aquatic activity. *Inj Prev.* 2004;10(2):107–113

62. Smith GS, Keyl PM, Hadley JA, et al. Drinking and recreational boating fatalities: a population-based case-control study. *JAMA.* 2001;286(23):2974–2980
63. Howland J, Smith GS, Mangione T, Hingson R, DeJong W, Bell N. Missing the boat on drinking and boating. *JAMA.* 1993;270(1):91–92
64. Cummings P, Quan L. Trends in unintentional drowning: the role of alcohol and medical care. *JAMA.* 1999;281(23):2198–2202
65. Donson H, Van Niekerk A. Unintentional drowning in urban South Africa: a retrospective investigation, 2001-2005. *Int J Inj Contr Saf Promot.* 2013;20(3):218–226
66. Quistberg DA, Bennett E, Quan L, Ebel BE. Low life jacket use among adult recreational boaters: a qualitative study of risk perception and behavior factors. *Accid Anal Prev.* 2014;62:276–284
67. Gorniak JM, Jenkins AJ, Felo JA, Balraj E. Drug prevalence in drowning deaths in Cuyahoga County, Ohio: a ten-year retrospective study. *Am J Forensic Med Pathol.* 2005;26(3):240–243
68. Bijur PE, Kurzon M, Overpeck MD, Scheidt PC. Parental alcohol use, problem drinking, and children's injuries. *JAMA.* 1992;267(23):3166–3171
69. Damashek A, Williams NA, Sher K, Peterson L. Relation of caregiver alcohol use to unintentional childhood injury. *J Pediatr Psychol.* 2009;34(4):344–353
70. Allasio D, Fischer H. Immersion scald burns and the ability of young children to climb into a bathtub. *Pediatrics.* 2005;115(5):1419–1421
71. Consumer Product Safety Commission. How to plan for the unexpected: preventing child drownings. Available at: https://cpsc.gov/s3fs-public/359.pdf. Accessed November 2, 2020
72. Mackay JM, Samuel E, Green A. *Hidden Hazards: An Exploration of Open Water Drowning and Risks for Children.* Washington, DC: Safe Kids Worldwide; 2018
73. Martin CA, Kelly TH, Rayens MK, et al. Sensation seeking, puberty, and nicotine, alcohol, and marijuana use in adolescence. *J Am Acad Child Adolesc Psychiatry.* 2002;41(12):1495–1502
74. Forbes EE, Dahl RE. Pubertal development and behavior: hormonal activation of social and motivational tendencies. *Brain Cogn.* 2010;72(1):66–72
75. Wu Y, Huang Y, Schwebel DC, Hu G. Unintentional child and adolescent drowning mortality from 2000 to 2013 in 21 countries: analysis of the WHO Mortality Database. *Int J Environ Res Public Health.* 2017;14(8):875
76. Browne ML, Lewis-Michl EL, Stark AD. Watercraft-related drownings among New York State residents, 1988-1994. *Public Health Rep.* 2003;118(5):459–463
77. Petrass LA, Blitvich JD. Preventing adolescent drowning: understanding water safety knowledge, attitudes and swimming ability. The effect of a short water safety intervention. *Accid Anal Prev.* 2014;70:188–194
78. US Coast Guard. *2017 Recreational Boating Statistics.* Washington, DC: US Coast Guard; 2018. Available at: https://www.uscgboating.org/library/accident-statistics/Recreational-Boating-Statistics-2017.pdf. Accessed November 2, 2020
79. Quan L, Bennett E, Cummings P, Trusty MN, Treser CD. Are life vests worn? A multiregional observational study of personal flotation device use in small boats. *Inj Prev.* 1998;4(3):203–205
80. Mangione TW, Chow W, Nguyen J. Trends in life jacket wear among recreational boaters: a dozen years (1999-2010) of US observational data. *J Public Health Policy.* 2012;33(1):59–74
81. Quan L, Mangione T, Bennett E, Chow W. Use of life jackets and other types of flotation for in-water recreation in designated swim areas in Washington State. *Inj Prev.* 2018;24(2):123–128
82. Lhatoo SD, Sander JWAS. Cause-specific mortality in epilepsy. *Epilepsia.* 2005;46(Suppl 11):36–39
83. Kemp AM, Sibert JR. Epilepsy in children and the risk of drowning. *Arch Dis Child.* 1993;68(5):684–685
84. Diekema DS, Quan L, Holt VL. Epilepsy as a risk factor for submersion injury in children. *Pediatrics.* 1993;91(3):612–616
85. Bell GS, Gaitatzis A, Bell CL, Johnson AL, Sander JW. Drowning in people with epilepsy: how great is the risk? *Neurology.* 2008;71(8):578–582
86. Guan J, Li G. Injury mortality in individuals with autism. *Am J Public Health.* 2017;107(5):791–793
87. Shavelle RM, Strauss DJ, Pickett J. Causes of death in autism. *J Autism Dev Disord.* 2001;31(6):569–576
88. Guan J, Li G. Characteristics of unintentional drowning deaths in children with autism spectrum disorder. *Inj Epidemiol.* 2017;4(1):32
89. Alaniz ML, Rosenberg SS, Beard NR, Rosario ER. The effectiveness of aquatic group therapy for improving water safety and social interactions in children with autism spectrum disorder: a pilot program. *J Autism Dev Disord.* 2017;47(12):4006–4017
90. National Autism Association. NAA's Big Red Safety Box. Available at: http://nationalautismassociation.org/big-red-safety-box. Accessed November 2, 2020
91. Bruce B, Kirkland S, Waschbusch D. The relationship between childhood behaviour disorders and unintentional injury events. *Paediatr Child Health.* 2007;12(9):749–754
92. Ruiz-Goikoetxea M, Cortese S, Aznarez-Sanado M, et al. Risk of unintentional injuries in children and adolescents with ADHD and the impact of ADHD medications: A systematic review and meta-analysis. *Neurosci Biobehav Rev.* 2018;84:63–71
93. Ghirardi L, Larsson H, Chang Z, et al. Attention-deficit/hyperactivity disorder medication and unintentional injuries in children and adolescents. *J Am Acad Child Adolesc Psychiatry.* 2020;59(8):944–951
94. Choi G, Kopplin LJ, Tester DJ, Will ML, Haglund CM, Ackerman MJ. Spectrum and frequency of cardiac channel defects in swimming-triggered arrhythmia syndromes. *Circulation.* 2004;110(15):2119–2124
95. Semple-Hess J, Campwala R. Pediatric submersion injuries: emergency care

and resuscitation. *Pediatr Emerg Med Pract.* 2014;11(6):1–21, quiz 21–22

96. Denny SA, Quan L, Gilchrist J, et al; Council on Injury, Violence, and Poison Prevention. Policy statement: Prevention of drowning. *Pediatrics.* 2019;143(5):e20190850
97. Vittone M. Drowning doesn't look like drowning. Available at: https://mariovittone.com/2010/05/154a/. Accessed November 2, 2020
98. Matthews BL, Franklin RC. Examination of a pilot intervention program to change parent supervision behaviour at Australian public swimming pools. *Health Promot J Austr.* 2018;29(2):153–159
99. Fergusson DM, Horwood LJ. Risks of drowning in fenced and unfenced domestic swimming pools. *N Z Med J.* 1984;97(767):777–779
100. Pitt WR, Balanda KP. Childhood drowning and near-drowning in Brisbane: the contribution of domestic pools. *Med J Aust.* 1991;154(10):661–665
101. Thompson DC, Rivara FP. Pool fencing for preventing drowning in children. *Cochrane Database Syst Rev.* 2000;(2):CD001047
102. van Weerdenburg K, Mitchell R, Wallner F. Backyard swimming pool safety inspections: a comparison of management approaches and compliance levels in three local government areas in NSW. *Health Promot J Austr.* 2006;17(1):37–42
103. Franklin RC, Peden AE. Improving pool fencing legislation in Queensland, Australia: attitudes and impact on child drowning fatalities. *Int J Environ Res Public Health.* 2017;14(12):E1450
104. Rabinovich BA, Lerner ND, Huey RW. Young children's ability to climb fences. *Hum Factors.* 1994;36(4):733–744
105. Karlson TA. Injury control and public policy. *Critical Reviews in Environmental Control.* 1992;22(3–4):195–241
106. Deal LW, Gomby DS, Zippiroli L, Behrman RE. Unintentional injuries in childhood: analysis and recommendations. *Future Child.* 2000;10(1):4–22
107. Consumer Product Safety Commission. *CPSC Warns Consumers of Potential Drowning Hazard Posed by Solar Pool Covers Used on Swimming Pools.* Washington, DC: Consumer Product Safety Commission; 1980
108. Whitfield T. *An Evaluation of Swimming Pool Alarms.* Washington, DC: Consumer Product Safety Commission; 2000. Available at https://www.cpsc.gov/s3fs-public/pdfs/alarm.pdf. Accessed November 2, 2020
109. Gilchrist J, Branche CM. Lifeguard effectiveness. In: Tipton M, Wooler A, eds. *The Science of Beach Lifeguarding.* Boca Raton: CRC Press; 2016
110. US Lifesaving Association. Statistics. Available at: http://arc.usla.org/Statistics/public.asp. Accessed November 2, 2020
111. Koon W, Rowhani-Rahbar A, Quan L. The ocean lifeguard drowning prevention paradigm: how and where do lifeguards intervene in the drowning process? *Inj Prev.* 2018;24(4):296–299
112. The Allen Consulting Group. *Valuing an Australian Icon: The Economic and Social Contribution of Surf Lifesaving in Australia.* Melbourne, Australia: The Allen Consulting Group; 2005
113. Mintel Custom Solutions. *The Economic Value of Lifeguarding: A Research Study Exploring the Value of Providing Lifeguarding Service in the UK.* London, United Kingdom: Mintel Custom Solutions; 2007
114. Pelletier AR, Gilchrist J. Fatalities in swimming pools with lifeguards: USA, 2000-2008. *Inj Prev.* 2011;17(4):250–253
115. Tobin JM, Ramos WD, Pu Y, Wernicki PG, Quan L, Rossano JW. Bystander CPR is associated with improved neurologically favourable survival in cardiac arrest following drowning. *Resuscitation.* 2017;115:39–43
116. Girasek DC. Evaluation of a brief intervention designed to increase CPR training among pregnant pool owners. *Health Educ Res.* 2011;26(4):689–697
117. McCarrison R, Ren D, Woomer GR, Cassidy B. Evaluation of a self-instructional CPR program for parents with children enrolled in community swim lessons. *J Pediatr Health Care.* 2017;31(3):314–319
118. Mott TF, Latimer KM. Prevention and treatment of drowning. *Am Fam Physician.* 2016;93(7):576–582
119. Tobin JM, Ramos WD, Greenshields J, et al; CARES Surveillance Group. Outcome of conventional bystander cardiopulmonary resuscitation in cardiac arrest following drowning. *Prehosp Disaster Med.* 2020;35(2):141–147
120. Lavonas EJ, Drennan IR, Gabrielli A, et al. Part 10: special circumstances of resuscitation: 2015 American Heart Association guidelines update for cardiopulmonary resuscitation and emergency cardiovascular care [published correction appears in Circulation. 2016;134(9):e122]. *Circulation.* 2015;132(18 Suppl 2):S501–S518
121. Parker HE, Blanksby BA. Starting age and aquatic skill learning in young children: mastery of prerequisite water confidence and basic aquatic locomotion skills. *Aust J Sci Med Sport.* 1997;29(3):83–87
122. Blanksby BA, Parker HE, Bradley S, Ong V. Children's readiness for learning front crawl swimming. *Aust J Sci Med Sport.* 1995;27(2):34–37
123. American Red Cross, Advisory Council on First Aid, Aquatics, Safety, and Preparedness. *ACFASP Scientific Review: Minimum Age for Swimming Lessons.* Washington, DC: American Red Cross; 2009. Available at: https://www.redcross.org/content/dam/redcross/Health-Safety-Services/scientific-advisory-council/Scientific%20Advisory%20Council%20SCIENTIFIC%20REVIEW%20-%20Minimum%20Age%20for%20Swimming%20Lessons.pdf. Accessed November 2, 2020
124. Brenner RA, Taneja GS, Haynie DL, et al. Association between swimming lessons and drowning in childhood: a case-control study. *Arch Pediatr Adolesc Med.* 2009;163(3):203–210
125. Yang L, Nong QQ, Li CL, Feng QM, Lo SK. Risk factors for childhood drowning in rural regions of a developing country: a case-control study. *Inj Prev.* 2007;13(3):178–182
126. Rahman F, Bose S, Linnan M, et al. Cost-effectiveness of an injury and drowning prevention program in Bangladesh. *Pediatrics.* 2012;130(6):e1621–e1628
127. Gladish K, Washington RL, Bull MJ. Swimming programs for infants and

toddlers. *Pediatrics.* 2002;109(1):168–169

128. Moran K, Stanley T. Parental perceptions of toddler water safety, swimming ability and swimming lessons. *Int J Inj Contr Saf Promot.* 2006;13(3):139–143

129. Quan L, Ramos W, Harvey C, et al. Toward defining water competency: an American Red Cross definition. *Int J Aquat Res Educ.* 2015;9(1): https://doi.org/10.25035/ijare.09.01.03

130. Irwin CC, Irwin RL, Ryan TD, Drayer J. The legacy of fear: is fear impacting fatal and non-fatal drowning of African American children? *J Black Stud.* 2011;42(4):561–576

131. Quan L, Crispin B, Bennett E, Gomez A. Beliefs and practices to prevent drowning among Vietnamese-American adolescents and parents. *Inj Prev.* 2006;12(6):427–429

132. Stempski S, Liu L, Grow HM, et al. Everyone Swims: a community partnership and policy approach to address health disparities in drowning and obesity. *Health Educ Behav.* 2015;42(1 Suppl):106S–114S

133. Goldberg GN, Lightner ES, Morgan W, Kemberling S. Infantile water intoxication after a swimming lesson. *Pediatrics.* 1982;70(4):599–600

134. Yoder JS, Hlavsa MC, Craun GF, et al; Centers for Disease Control and Prevention. Surveillance for waterborne disease and outbreaks associated with recreational water use and other aquatic facility-associated health events–United States, 2005-2006. *MMWR Surveill Summ.* 2008;57(9):1–29

135. Schoefer Y, Zutavern A, Brockow I, et al; LISA study group. Health risks of early swimming pool attendance. *Int J Hyg Environ Health.* 2008;211(3–4):367–373

136. World Aquatic Babies and Children Network. About WABC: guidelines. Available at: www.wabcswim.com. Accessed November 2, 2020

137. American National Red Cross. Swimming lessons for kids. Available at: https://www.redcross.org/take-a-class/swimming/swim-lessons/kids-swim-lessons. Accessed November 2, 2020

138. Bernard A, Carbonnelle S, Dumont X, Nickmilder M. Infant swimming practice, pulmonary epithelium integrity, and the risk of allergic and respiratory diseases later in childhood. *Pediatrics.* 2007;119(6):1095–1103

139. Nystad W, Håberg SE, London SJ, Nafstad P, Magnus P. Baby swimming and respiratory health. *Acta Paediatr.* 2008;97(5):657–662

140. Nickmilder M, Bernard A. Ecological association between childhood asthma and availability of indoor chlorinated swimming pools in Europe. *Occup Environ Med.* 2007;64(1):37–46

141. Font-Ribera L, Villanueva CM, Nieuwenhuijsen MJ, Zock JP, Kogevinas M, Henderson J. Swimming pool attendance, asthma, allergies, and lung function in the Avon Longitudinal Study of Parents and Children cohort. *Am J Respir Crit Care Med.* 2011;183(5):582–588

142. Bernard A, Nickmilder M, Voisin C, Sardella A. Impact of chlorinated swimming pool attendance on the respiratory health of adolescents. *Pediatrics.* 2009;124(4):1110–1118

143. Franklin RC, Pearn JH. Drowning for love: the aquatic victim-instead-of-rescuer syndrome: drowning fatalities involving those attempting to rescue a child. *J Paediatr Child Health.* 2011;47(1–2):44–47

144. Turgut A, Turgut T. A study on rescuer drowning and multiple drowning incidents. *J Safety Res.* 2012;43(2):129–132

145. Zhu Y, Jiang X, Li H, Li F, Chen J. Mortality among drowning rescuers in China, 2013: a review of 225 rescue incidents from the press. *BMC Public Health.* 2015;15:631

146. SwimSafe - Bangladesh. The Alliance for Safe Children. Available at: http://swimsafe.org/swimsafe-projects/bangladesh/. Accessed November 2, 2020

147. Cummings P, Mueller BA, Quan L. Association between wearing a personal floatation device and death by drowning among recreational boaters: a matched cohort analysis of United States Coast Guard data. *Inj Prev.* 2011;17(3):156–159

148. Stempski S, Schiff M, Bennett E, Quan L. A case-control study of boat-related injuries and fatalities in Washington State. *Inj Prev.* 2014;20(4):232–237

149. Chung C, Quan L, Bennett E, Kernic MA, Ebel BE. Informing policy on open water drowning prevention: an observational survey of life jacket use in Washington State. *Inj Prev.* 2014;20(4):238–243

150. Wintemute GJ, Anton A, Andrada E, Ribeira R. Compliance with an ordinance requiring the use of personal flotation devices by children in public waterways. *West J Emerg Med.* 2013;14(2):200–203

151. Bennett E, Cummings P, Quan L, Lewis FM. Evaluation of a drowning prevention campaign in King County, Washington. *Inj Prev.* 1999;5(2):109–113

152. Massachusetts Department of Public Health. *Minimum Requirements for Personal Flotation Devices for Minor Children at Municipal and Recreational Programs and Camps.* Boston, MA: Commonwealth of Massachusetts; 2016. Available at: http://blog.mass.gov/publichealth/wp-content/uploads/sites/11/2016/12/Personal-Flotation-Devices.pdf. Accessed November 2, 2020

153. Boat U.S. Foundation. Life jackets state requirements. Available at: https://www.boatus.org/life-jackets/state-requirements. Accessed November 2, 2020

154. US Coast Guard. How to Choose the Right Life Jacket. Available at: www.uscgboating.org/images/howtochoosetherightlifejacket_brochure.pdf. Accessed November 2, 2020

155. Bugeja L, Cassell E, Brodie LR, Walter SJ. Effectiveness of the 2005 compulsory personal flotation device (PFD) wearing regulations in reducing drowning deaths among recreational boaters in Victoria, Australia. *Inj Prev.* 2014;20(6):387–392

156. US Coast Guard. National life jacket wear study. 2017. Available at: https://uscgboating.org/library/national-live-jacket-wear-study/2017-Life-Jacket-Wear-Rate-Observation-Study-Report.pdf. Accessed November 2, 2020

157. Szpilman D, Webber J, Quan L, et al. Creating a drowning chain of survival. *Resuscitation*. 2014;85(9):1149–1152

158. Szpilman D, Tipton M, Sempsrott J, et al. Drowning timeline: a new systematic model of the drowning process. *Am J Emerg Med*. 2016;34(11):2224–2226

159. Mosayebi Z, Movahedian AH, Mousavi GA. Drowning in children in Iran: outcomes and prognostic factors. *Med J Malaysia*. 2011;66(3):187–190

160. Schilling UM, Bortolin M. Drowning. *Minerva Anestesiol*. 2012;78(1):69–77

161. Quan L, Bierens JJLM, Lis R, Rowhani-Rahbar A, Morley P, Perkins GD. Predicting outcome of drowning at the scene: A systematic review and meta-analyses. *Resuscitation*. 2016;104:63–75

162. Shenoi RP, Allahabadi S, Rubalcava DM, Camp EA. The Pediatric Submersion Score predicts children at low risk for injury following submersions. *Acad Emerg Med*. 2017;24(12):1491–1500

163. Brennan CE, Hong TKF, Wang VJ. Predictors of safe discharge for pediatric drowning patients in the emergency department. *Am J Emerg Med*. 2018;36(9):1619–1623

164. Shenoi RP, Koerner CE, Cruz AT, et al. Factors associated with poor outcome in childhood swimming pool submersions. *Pediatr Emerg Care*. 2016;32(10):669–674

165. Joanknecht L, Argent AC, van Dijk M, van As AB. Childhood drowning in South Africa: local data should inform prevention strategies. *Pediatr Surg Int*. 2015;31(2):123–130

166. Quan L, Mack CD, Schiff MA. Association of water temperature and submersion duration and drowning outcome [published correction appears in *Resuscitation*. 2014;85(9):1304]. *Resuscitation*. 2014;85(6):790–794

167. Suominen PK, Vähätalo R, Sintonen H, Haverinen A, Roine RP. Health-related quality of life after a drowning incident as a child. *Resuscitation*. 2011;82(10):1318–1322

168. Reynolds JC, Michiels EA, Nasiri M, Reeves MJ, Quan L. Observed long-term mortality after 18,000 person-years among survivors in a large regional drowning registry. *Resuscitation*. 2017;110:18–25

Promoting Healthy Sexuality for Children and Adolescents With Disabilities

- *Clinical Report*

CLINICAL REPORT Guidance for the Clinician in Rendering Pediatric Care

American Academy of Pediatrics
DEDICATED TO THE HEALTH OF ALL CHILDREN™

Promoting Healthy Sexuality for Children and Adolescents With Disabilities

Amy Houtrow, MD, PhD, MPH, FAAP,[a] Ellen Roy Elias, MD, FAAP, FACMG,[b] Beth Ellen Davis, MD, MPH, FAAP,[c]
COUNCIL ON CHILDREN WITH DISABILITIES Dennis Z. Kuo, MD, MHS, FAAP Rishi Agrawal, MD, MPH, FAAP
Lynn F. Davidson, MD, FAAP Kathryn A. Ellerbeck, MD, FAAP Jessica E.A. Foster, MD, MPH, FAAP Ellen Fremion, MD, FAAP, FACP
Mary O'Connor Leppert, MD, FAAP Barbara S. Saunders, DO, FAAP Christopher Stille, MD, MPH, FAAP
Jilda Vargus-Adams, MD, MSc, FAAP Larry Yin, MD, MSPH, FAAP Kenneth NorwoodJr,MD, FAAP Cara Coleman, JD, MPH
Marie Y. Mann, MD, MPH, FAAP Edwin Simpser, MD, FAAP Jennifer Poon, MD, FAAP Marshalyn Yeargin-Allsopp, MD, FAAP, and
Alexandra Kuznetsov

This clinical report updates a 2006 report from the American Academy of Pediatrics titled "Sexuality of Children and Adolescents With Developmental Disabilities." The development of a healthy sexuality best occurs through appropriate education, absence of coercion and violence, and developmental acquisition of skills to navigate feelings, desires, relationships, and social pressures. Pediatric health care providers are important resources for anticipatory guidance and education for all children and youth as they understand their changing bodies, feelings, and behaviors. Yet, youth with disabilities and their families report inadequate education and guidance from pediatricians regarding sexual health development. In the decade since the original clinical report was published, there have been many advancements in the understanding and care of children and youth with disabilities, in part because of an increased prevalence and breadth of autism spectrum disorder as well as an increased longevity of individuals with medically complex and severely disabling conditions. During this same time frame, sexual education in US public schools has diminished, and there is emerging evidence that the attitudes and beliefs of all youth (with and without disability) about sex and sexuality are being formed through media rather than formal education or parent and/or health care provider sources. This report aims to provide the pediatric health care provider with resources and tools for clinical practice to address the sexual development of children and youth with disabilities. The report emphasizes strategies to promote competence in achieving a healthy sexuality regardless of physical, cognitive, or socioemotional limitations.

abstract

[a]Division of Pediatric Rehabilitation Medicine, Department of Physical Medicine and Rehabilitation, School of Medicine, University of Pittsburgh, Pittsburgh, Pennsylvania; [b]School of Medicine, University of Colorado and Special Care Clinic, Children's Hospital Colorado, Aurora, Colorado; and [c]School of Medicine, University of Virginia and University of Virginia Children's Hospital, Charlottesville, Virginia

Dr Houtrow reviewed the literature, drafted the manuscript, and critically edited the content; Drs Elias and Davis reviewed the literature, added content to the manuscript, and critically edited the content; and all authors approved the final manuscript as submitted.

To cite: Houtrow A, Elias E R, Davis B E, et al. Promoting Healthy Sexuality for Children and Adolescents With Disabilities. *Pediatrics*. 2021;148(1):e2021052043

INTRODUCTION

As stated by the World Health Organization, "Sexual health is a state of physical, emotional, mental and social well-being in relation to sexuality … Sexual health requires a positive and respectful approach to sexuality and sexual relationships, as well as to the possibility of having pleasurable and safe sexual experiences, free of coercion, discrimination, and violence."[1] One's sexuality is experienced through one's thoughts and desires; attitudes, beliefs, and values; and actions, behaviors, and relationships.[1] Developing healthy sexuality is important for all individuals and depends, in part, on having evidenced-based and evidence-informed information to formulate attitudes and beliefs about sexual orientation, gender identity, relationships, and intimacy.[2–4] It is well known that sexual satisfaction and intimacy are directly related to quality of life,[5] and, thus, pediatric health care providers are encouraged to address the sexual health and education needs of their patients as they grow and develop to promote their patients' competence in achieving a healthy sexuality. Generally speaking, pediatric health care providers are an important resource for sexual education and counseling for children, adolescents, and young adults as well as for parents seeking anticipatory guidance.[6] Pediatric health care providers can help patients and their parents/caregivers understand their changing feelings, their changing bodies, their desires for relationships, and how to avoid risky sexual situations.[6] As is true for everyone, it is important that individuals with disabilities be provided experiences to acquire developmentally appropriate, relevant, and accurate sexual health knowledge to become competent. Youth with disabilities need regular opportunities to develop and use skills for negotiating sexual desire, intimacy, and activity that supports healthy sexuality while limiting negative outcomes of sexual activity (such as sexually transmitted infections [STIs], unintended pregnancy or sexual coercion, violence, abuse, or exploitation) regardless of their intellectual capacity. Culturally responsive pediatric health care should include sexual health as a focus for all children and adolescents, including those with disabilities, and actively involve parents and caregivers, while respecting the youth's autonomy and rights to privacy.[2]

THE SEXUAL HEALTH NEEDS OF CHILDREN AND YOUTH WITH DISABILITIES

Children with disabilities are a growing subset of children with diverse needs that affect their functioning, health, and well-being. More than 10 million children in the United States have health conditions that moderately or consistently affect their daily activities at least some of the time.[7] This means that most pediatric primary care providers routinely care for children and youth with a broad range of developmental and acquired health conditions that affect their ability to function as children typically do or require special services such as Individualized Education Programs at school.[8] Disabilities experienced in childhood may be primarily physical in nature or associated with intellectual and/or social-communication impairments or may involve co-occurring conditions. The associated health condition or etiology of the disability or disabilities, the severity of the disability or disabilities, and what aspects of functioning are affected all influence how sexuality is addressed in the clinical setting.

Developing a healthy sexuality is a complex process for all children and youth, especially those with disabilities. Sexual development is not just physiologic changes of a person's body but is a key part of social competency and should be considered in the context of basic human desires for connectedness and intimacy, beliefs, values, and aspirations. Sociosexual development is an essential part of growing up, and emphasis on this aspect of development is especially important for individuals with disabilities as they navigate changing bodies, expectations, and desires.[9] Individuals with all types of disabilities may have to negotiate varying and unique reproductive capacity and sexual intimacy issues, yet they routinely experience inadequate education and opportunities to develop competence.[10,11] Ample research indicates people with disabilities receive substandard sexual education and reproductive health care.[12–15] Families and/or caregivers of children with disabilities may be reluctant or feel that they are not empowered to acknowledge their child's potential as a sexual individual and may shelter them from the routine presexual social experiences of other children and underestimate their interest in sex and their risk for exploitation.[10,16] Helping families and/or caregivers understand their children's sexual development and how to support it may require additional time and counseling to address expectations of all involved around appropriate independence and autonomy through shared decision-making strategies.[17] In addition, children with disabilities are often limited in social participation and social networks outside of school,[10,18] which offer typical social experiences that form the developmental framework toward understanding one's own individual sexuality, interests, and behaviors. The lack of understanding about how disability affects sexual expression likely influences health care providers' willingness to

address it, as does the more general stigmatization of people with disabilities as nonsexual beings.[19]

I S PP S I
S I I I S
I IS I I I S

Bright Futures: Guidelines for Health Supervision of Infants, Children, and Adolescents, Fourth Edition, provides the foundation for pediatric health care providers to promote healthy sexual development.[20] Care and education should be delivered through a longitudinal, developmentally appropriate, culturally respectful relationship between health care providers and their patients and families, caregivers, and educators.[20] In the last 10 years, sexuality education resources specifically designed for individuals with specific health conditions have emerged (Table 1).[21] Routine health maintenance and chronic health care visits, including health care

TABLE 1 Sexuality Education Resources for Pediatric Health Care Providers

	Resource Information
For parents	
Center for Parent Information & Resources	www.parentcenterhub.org (also in Spanish)
Couwenhoven T. Boyfriends & Girlfriends: *A Guide to Dating for People With Disabilities*. Bethesda, MD: Woodbine House; 2015	—
Healthybodies.org (Vanderbilt) Boys/Girls	https://vkc.vumc.org/healthybodies/files/HealthyBodies-Boys-web.pdf; Includes a free online packet entitled "Healthy Bodies for Boys: A Parent's Guide for Boys with Disabilities" (and a separate one for girls); https://vkc.vumc.org/healthybodies/files/HealthyBodies-Girls-web.pdf
Bright Futures: Guidelines for Health Supervision of Infants, Children, and Adolescents, Fourth Edition	https://brightfutures.aap.org/Pages/default.aspx; Promoting Healthy Sexual Development and Sexuality; Adolescent Visits
Sexuality Resource Center for Parents	Teaching children across the age ranges 0–18; http://www.srcp.org/for_all_parents/development.html
AMAZE	https://amaze.org AMAZE uses digital media to provide young adolescents with medically accurate, age-appropriate, affirming, and honest sex education they can access directly online. AMAZE also strives to assist adults–parents, guardians, educators and health care providers–to communicate effectively and honestly about sex and sexuality with the children and adolescents in their lives. www.amaze.org
Condition-specific resources for pediatric health care providers	
ASD	AAP Autism Toolkit (Handout): Sexuality of Children and Youths with Autism Spectrum Disorder: https://toolkits.solutions.aap.org/autism/handout/504891; Autism Speaks: ATN/AIR-P Puberty and Adolescence Resource: https://www.autismspeaks.org/docs/family_services_docs/parentworkbook.pdf; Kate E. Reynolds books to help learn about puberty: *What's Happening to Ellie? A Book About Puberty for Girls and Young Women With Autism and Related Conditions* (2015); *What's Happening to Tom? A Book About Puberty for Boys and Young Men With Autism and Related Conditions* (2015)
Cerebral palsy	Glader L, Stevenson R. *Children and Youth with Complex Cerebral Palsy: Care and Management*. London, United Kingdom: Mac Keith Press; 2019. (chapters 17 and 18)
Spina bifida	The Spina Bifida Association: https://www.spinabifidaassociation.org/guidelines/; Centers for Disease Control and Prevention: https://www.cdc.gov/ncbddd/spinabifida/adult.html#sexual-health
Down syndrome	Chicoine B, McGuire D. *The Guide to Good Health for Teens and Adults with Down Syndrome*. Bethesda, MD: Woodbine House; 2010; Couwenhoven T. *Teaching Children with Down Syndrome About Their Bodies, Boundaries, and Sexuality: A Guide for Parents and Professionals*. Bethesda, MD: Woodbine House; 2005
Other	US National Library of Medicine, Genetics Home Reference: https://ghr.nlm.nih.gov/condition; An up-to-date genetic review of genetic conditions, easily searchable alphabetically, including rare microdeletions
For schools and educators	
Sexuality and Disabilities: A Guide for Professionals	https://www.routledge.com/Sexuality-and-Intellectual-Disabilities-A-Guide-for-Professionals/Triska/p/book/9781138231023 (2018). This book provides a concise overview of sexuality and gender identity in clients with intellectual disabilities for therapists, social workers, educators, and health care providers
Seattle and King County Sexual Health Education Curriculum	https://www.kingcounty.gov/depts/health/locations/family-planning/education/FLASH.aspx
Advocates for Youth	https://advocatesforyouth.org/wp-content/uploads/storage//advfy/documents/Factsheets/sexual--health-education-for-young-people-with-disabilities-educators.pdf

—, not applicable

transition preparation visits, afford opportunities for the pediatric health care provider to gather information, give guidance, provide education, and be a resource regarding sexuality for children and adolescents with disabilities as they develop their skills and competence.[6,20,22] Pediatric health care providers can introduce issues of psychosexual development to families and caregivers and their children in early childhood and have discussions at health maintenance visits throughout childhood, adolescence, and young adulthood.[2] Doing so, on a routine basis, helps normalize the topic and helps reinforce understanding. The education should go beyond the basics of anatomy and physiology of puberty and reproduction to incorporate education about gender identity, sexual orientation, interpersonal relationships, intimacy, the types of sexual expression, and body image.[23,24] Culturally responsive care recognizes that sexuality is influenced by personal and environmental factors, such as religion or ethnic background.[2] It is essential for developmentally appropriate sexuality education to start early in childhood, with families and/or caregivers and primary care providers helping young children to develop a safe, healthy, and positive attitude toward themselves and others. This healthy and safe attitude includes understanding respect, consent, and relationship building.[25]

ADDRESSING PUBERTAL DEVELOPMENT IN CHILDREN WITH DISABILITIES

Like any child, a child with disabilities may feel anxious and unhappy about how their body is changing during puberty. The timing of onset of puberty (Table 2) in a child with disabilities may be different from that of a typically developing child.[26] Some patients with severe nutritional issues may be late to go through puberty because of failure to thrive and low BMI and may achieve menarche late or have sparse menses that start at an older age than typical. Patients with certain genetic disorders or conditions associated with chromosome abnormalities[27] may require hormonal treatment to enter and proceed through puberty.

Conversely, patients with certain neurologic disorders, including myelomeningocele or hydrocephalus, have a greater chance of early adrenarche and pubarche, and girls may achieve menarche at younger than 10 years (Table 2).[28] Central precocious puberty is defined as the full activation of the hypothalamic-pituitary-gonadal axis before 8 years of age in genetic girls and before 9 years of age in genetic boys.[29,30] Central precocious puberty is more common in children with fragile X syndrome, congenital brain malformations, and a history of birth asphyxia, meningitis, or other acquired brain injury.[31]

Menstrual Manipulation and/or Suppression

Although menstruation is often not a barrier to care and well-being, there are a number of concerns that face the primary caregivers of individuals with disabilities once they achieve menarche.[32] These concerns may include hygiene issues (especially for individuals who cannot use a toilet independently), worsening seizures, worsening cyclical behavioral problems, discomfort for the child or adolescent (including breast tenderness and headaches), difficulty for a caregiver who is not comfortable dealing with menses, and difficulty coping at school.[33,34] Menstrual hygiene issues can be introduced early in puberty, even before menarche, and with caregiver shared decision-making, providers can help identify ways to foster independence and teach individuals with disabilities how to manage their menses or seek appropriate help, such as from the school nurse. It is important for caregivers to understand that amenorrhea is often not achieved immediately but that menstrual manipulation may be used to induce amenorrhea, better regulate cycles, or decrease the amount or duration of menstrual flow and minimize menstrual pain and/or dysmenorrhea.[35] Providers interested in understanding the myriad available options are encouraged to review the clinical report from the American Academy of Pediatrics (AAP) and the North American Society for Pediatric and

TABLE 2 Common Differences of Timing of Puberty in Patients with Disabilities

Early-Onset Puberty	Typical Puberty	Delayed Puberty
Congenital brain malformations	Varies by family, ethnic, and racial groups	Severe nutritional deficiency
Hydrocephalus	Attention-deficit/hyperactivity disorder	Hormonal abnormalities
Neural tube defects; myelomeningocele	Children with ASD with typical growth	Sex chromosome abnormalities
Epilepsy	Other behavioral and mental health issues	Chromosome abnormalities (ie, trisomy 21)
Severe cognitive disabilities	Mild and moderate cognitive disabilities	Complex disabilities
Brain injuries		Psychiatric medications causing high prolactin
Some genetic conditions such as fragile X, neurofibromatosis 1, tuberous sclerosis, and McCune-Albright syndrome		

Adolescent Gynecology, "Menstrual Management for Adolescents With Disabilities."[32] Surgical options for menstrual suppression are rarely indicated. Menstrual suppression before menarche and endometrial ablation are not recommended.[36] Permanent decisions regarding sterilization have ethical, legal, and medical implications, vary by state, and are beyond the scope of this report. There are also important ethical issues to consider such as patient autonomy and independent decision-making, separate from caregiver issues related to menstrual manipulation in general.[37] Having a conversation and physical examination performed in a confidential manner with appropriate chaperoning and consenting and the caregiver excused from the room is an important practice, especially for those patients with physical disabilities alone or cognitive disabilities requiring limited supports (mild intellectual disability). A confidential examination provides an opportunity to assess the individual's sexual health knowledge and risks or history of abuse or coercion.[6,35] Addressing menstruation can also foster a discussion regarding sexual activity, the risk of sexual victimization, and the need to prevent STIs and pregnancy.

STI and Pregnancy Prevention

Although individuals with disabilities may be delayed, compared with their peers, in terms of first sexual encounters, they are more likely to engage in unsafe sex practices, which is especially true for those with mild disabilities.[38,39] Some youth, such as youth with attention-deficit/hyperactivity disorder, are more likely than their peers to engage in sexual activity earlier and also engage in unsafe sex practices.[40,41] All sexually active adolescents are at risk for STIs, including HIV, and, therefore, should be counseled about how to reduce their risks, including the use of barrier protection, in addition to long-acting reversible contraception, as appropriate.[2,6,42–44] Sexual minority youth often do not receive counseling appropriate for their sexuality; therefore, the pediatric health care provider should tailor counseling on the basis of the youth's specific needs when possible.[45] Providers should encourage and facilitate family-child communication about sexual health and confidentially ensure that any sexual activity is consensual for the youth.[6,45] Confidential family planning services and sexual health care should be made available to adolescents in accordance with legal obligations.[2,27,32,46] Effective counseling is characterized by compassion, respect, a nonjudgmental attitude, and using open-ended questions.[47] Shared decision-making strategies can be employed to enhance the autonomy of the individual with disabilities and can help ensure that all voices are heard during the decision-making process.[17]

Human Papillomavirus Vaccine

Vaccination against human papillomavirus (HPV) has become one of the most successful vaccination programs, not only to prevent this STI but also to significantly reduce certain cancers. Because of the efficacy and safety of the HPV vaccine, all pediatric patients, including those with disabilities, should receive a full course of this vaccine.[48,49] Patients with a history of sexual abuse or violence should receive the HPV series starting at 9 years of age.[50]

Counseling Regarding Genetic Reproductive Risks

Many patients with disabilities may have an underlying genetic disorder as their primary diagnosis, which carries a recurrence risk.[51] Often, the diagnosis is made during infancy or early childhood and communicated with the family, but it is common that the diagnosis and recurrence risk may never have been formally discussed with the patient as he or she approaches reproductive age. Part of caring for patients with genetic disorders as they reach an age in which they may become sexually active or pregnant is to make sure that patients receive appropriate genetic counseling (such as with a genetic counselor) to understand contraception options and their reproductive risks.[52] Table 3 lists reproductive risks for some common genetic disorders. Extensive information regarding trisomy 21 is available in the health supervision guidance from the AAP.[53] There are thousands of genetic conditions that may be associated with disabilities for which the pediatric health care provider can find additional condition-specific information by searching https://ghr.nlm.nih.gov/condition. In addition, youth with disabilities may be taking medications that alter sexual function or have teratogenic effects. Screening and counseling regarding medication adverse effects are important aspects of ensuring optimal sexual and reproductive health.

ADDRESSING THE RISKS OF SEXUAL ABUSE AGAINST CHILDREN AND YOUTH WITH DISABILITIES

Children with disabilities of all types are nearly 3 times as likely as those without disabilities to be sexually abused, and the risks are increased further for children with intellectual disabilities.[54] Although overall lifetime sexual violence victimization is low for men, men with disabilities have 3 times higher rates of victimization than men without disabilities do (13.8% vs 3.7%, respectively).[55] Nearly 25% of

TABLE 3 Reproductive Risks in Common Genetic Disorders

Genetic Disorder	Reproductive Risks
Autosomal dominant disorders	
Achondroplasia: most common form of skeletal dysplasia caused by a mutation in FGFR3	A person with achondroplasia whose partner has normal stature has a 50% chance of having a child with achondroplasia. A pregnant woman with achondroplasia may have difficulty carrying the fetus to term.
	If both genetic parents have achondroplasia, there is a 25% chance of having an infant with a lethal disorder who has 2 copies of the FGFR3 mutation.
Deletion of 22q11: common, with wide spectrum of presentation including intellectual disabilities, mental health issues, congenital heart disease, immunodeficiency, and hypoparathyroidism (formerly called DiGeorge syndrome)	A parent with mild learning problems or mental health issues can have a child with more complex birth defects and severe developmental problems.
	Chromosomal abnormalities, such as microdeletions, are passed on in an autosomal dominant pattern and may have variable severity of the phenotype from one generation to the next.
OI: most forms of brittle bone disease are caused by mutations in COL1A1 or COL1A2.	Confirmation of the diagnosis of OI can now be made with DNA analysis in blood.
	Most severe cases of OI arise from de novo mutations, but patients with milder forms of OI have a 50% chance of passing on their mutation in each pregnancy. There are more rare forms of OI caused by autosomal recessive genes with a 25% recurrence risk.
EDS: there are now 14 types of EDS	The hypermobile type is the most common with an estimated incidence of 1:5000. The genes for this type are unknown. This type can be associated with gastrointestinal tract issues, immunologic changes, dysautonomia, pelvic floor dysfunction, prolapse of the rectum and/or uterine prolapse, and chronic pain and disability.
	The vascular form of EDS can be associated with severe, life-threatening issues including arterial rupture, intestinal rupture, and uterine rupture in pregnancy.
Autosomal recessive disorders	A history of consanguinity increases the chances of having a partner who carries mutations in the same gene.
	Genetic boys with cystic fibrosis are sterile.
	Patients of certain ethnic backgrounds have a higher carrier rate of having mutations in autosomal recessive disorders; there are now next-generation sequencing panels that screen for carriers of certain disorders so that patients can receive genetic counseling regarding their recurrence risks.
	Many patients with autosomal recessive disorders have more severe disabilities and are less likely to procreate.
X-linked disorders	Females who are carriers of FMR1, which causes fragile X syndrome, have an increased risk of premature ovarian failure. The maternal grandfather may develop a condition that mimics Parkinson disease, called FRAXTAS.
	The severity of symptoms in female carriers of X-linked disorders may be affected by skewed X-inactivation.
	A female carrying a mutation in an X-linked gene (eg, fragile X syndrome) may be normal or have just a mild phenotype but has a risk of having a male child with more severe issues.
Mitochondrial disorders	Mitochondrial disorders may be caused by mutations in mitochondrial DNA, in which case they are maternally inherited, or may be caused by mutations in autosomal genes, in which case they are usually autosomal recessively inherited.
	Maternally inherited mitochondrial disorders are generally passed on to all children in the sibship, although the severity of issues may vary from one sibling to another.
Multifactorial disorders	
NTDs are common birth defects with an increased recurrence risk within families	Patients with NTDs have an ~5% chance of having a child with an NTD.
	Siblings of patients with NTDs, parents, aunts, uncles, etc, also have an increased risk.
	Folate, 4 mg/kg per day, taken 3 mo before conception and through the first trimester, can decrease (but not eliminate) this risk.
	Certain ethnic groups (including people of English and/or Irish, Hispanic, and Chinese descent) have an increased risk of having a child with an NTD and might also consider taking folate prophylactically, even without a family history.
Other	Some disorders are caused by multiple factors including genes that may not be known, teratogens such as alcohol, or nutritional factors such as low folate. Recently available genetic tests including next-generation sequencing panels have helped make specific diagnoses in patients with rare disorders.

COL1A1, collagen type I alpha 1; COL1A2, collagen type I alpha 2; EDS, Ehlers-Danlos syndrome; FGFR3, fibroblast growth factor receptor 3; FRAXTAS, fragile X-associated tremor/ataxia syndrome; NTD, neural tube defect; OI, osteogenesis imperfecta.

adolescent women, regardless of disability status, report being victims of sexual abuse and/or assault.[56] In a cross-sectional survey of 101 students with disabilities from a large northeastern public university, 22% reported some form of abuse over the last year, and nearly 62% ($n = 63$) had experienced some form of physical or sexual abuse before the age of 17.[57] Of those who were abused in the past year, 40% reported little or no knowledge of abuse-related resources, and only 27% reported the incident.[57] Compared with respondents without disabilities, young women with physical disabilities had a higher odds of being a victim of rape (odds ratio: 1.49; 95% confidence interval: 1.06–2.08).[58] Perpetrators of sexual violence against people with disabilities often know their victims well. Nearly one-third of perpetrators of sexual abuse are family members or acquaintances, and an additional 44% of assailants had a care-provider relationship with their victims.[55]

Children and youth with disabilities are more vulnerable to sexual victimization, likely because of a variety of factors depending on the type of disability, including a decreased ability to resist an attack, a desire to please the other person without a full understanding of the circumstances, dependence on others for aspects of care and decision-making, limited communication skills, and increased tolerance of physical intrusion, among others.[55] For example, some individuals with intellectual disability may lack the decision-making capacity, ability to consent, and skills necessary to develop healthy relationships, which can be associated with sexual exploitation, abuse, or coercion.[59,60] Given the increased risk of sexual abuse, coercion, and assault, the pediatric provider is encouraged to surveil often, in developmentally appropriate ways, and provide resources when a concern is raised.[2,55,61] As is the case for all children, health care providers are mandated reporters, and reporting should occur to the appropriate authorities[61,62] If the youth with disabilities is 18 years or older, reports should be made to adult protective services. In addition, children with disabilities may have been placed in foster care because of sexual abuse; therefore, the pediatric health care provider is encouraged to screen for a history of sexual violence for this population. Specific AAP policies on sexual abuse, coercion, and assault as they relate to children with disabilities can be found in Table 4.

TYPICAL AND PROBLEM SEXUAL BEHAVIORS

There are a wide range of typical and developmentally appropriate child and adolescent sexual behaviors that provide teachable moments for health care providers and families, especially during early development.[63] For example, when a preschooler undresses in the classroom, an adult can comment, "undressing is what we do privately before taking a bath, not in front of our friends at school." Children with developmental disabilities, including autism spectrum disorder (ASD), may extend the ages of typical sexual exploration. Providers need to consider social, cultural, religious, familial, and medical contexts for typical and problem behaviors. It is important to be able to differentiate signs of expected and/or typical versus atypical, aberrant, or problem sexual behaviors in children with disabilities and provide appropriate education and counseling on the topic.

Typical behaviors in early development, which may be seen in older children who have developmental disabilities, include general sexual curiosity, masturbation, an interest in peer or sibling genitals, standing or sitting too close, trying to view adult nudity, and sometimes crude mimicking of movements associated with sexual acts. These are separated from uncommon and rarely typical behaviors, regardless of cognitive ability, such as explicit imitation of sexual acts, asking peers or adults to engage in sexual activities, insertion of objects into genitals, activity with children who are more than 4 years apart, and frequent sexual behaviors that are resistant to distraction.[63,64] Atypical behaviors at any age or developmental level include sexual behaviors that result in distress or pain, are associated with physical aggression or coercion, or become persistent and resistant to redirection. Sorting out behaviors that involve sexual offense from those that are problem behaviors and challenging to self or others can help determine the acuity and degree of intervention.[31] Regardless, challenging sexualized behaviors associated with developmental disabilities or acquired disorders such as brain injury require assessment of the reason for the behavior. Families and/or caregivers and the clinicians can work with schools, behavioral analysts, and/or psychologists to obtain a functional behavior assessment and customize behavioral interventions.[31,65]

Problem or inappropriate sexual behaviors, such as public masturbation and nonconsensual groping, are exhibited more commonly in children and adolescents with disabilities, specifically developmental disabilities, and may be the most problematic in those with ASD.[65] Core deficits in social reciprocity, communication, and sensory

TABLE 4 Relevant AAP Policy Statements, Clinical Reports, and Technical Reports

Title	Date of Publication and/or Reaffirmation
Long-Acting Reversible Contraception: Specific Issues for Adolescents	August 2020
Barrier Protection Use by Adolescents During Sexual Activity (Policy Statement); Barrier Protection Use by Adolescents During Sexual Activity (Technical Report)	August 2020
Emerging Issues in Male Adolescent Sexual and Reproductive Health Care	May 2020
Emergency Contraception	December 2019
Unique Needs of Adolescents	December 2019
Supporting the Health Care Transition From Adolescence to Adulthood in the Medical Home	November 2018
Ensuring Comprehensive Care and Support for Transgender and Gender-Diverse Children and Adolescents	October 2018
Counseling in Pediatric Population at Risk for Infertility and/or Sexual Dysfunction	August 2018
Sexual and Reproductive Health Care Services in the Pediatric Setting	November 2017
Shared Decision-making and Children with Disabilities: Pathways to Consensus	June 2017
Care of the Adolescent After an Acute Sexual Assault	March 2017; erratum June 2017
Sexuality Education for Children and Adolescents	August 2016
Menstrual Management for Adolescents with Disabilities	July 2016
Contraception for Adolescents	October 2014
Screening for Nonviral Sexually Transmitted Infections in Adolescents and Young Adults	July 2014
Condom Use by Adolescents	November 2013
The Evaluation of Children in the Primary Care Setting When Sexual Abuse Is Suspected	August 2013; reaffirmed August 2018
Office-Based Care for Lesbian, Gay, Bisexual, Transgender, and Questioning Youth (Policy Statement); Office-Based Care for Lesbian, Gay, Bisexual, Transgender, and Questioning Youth (Technical Report)	July 2013
Standards for Health Information Technology to Ensure Adolescent Privacy	November 2012; reaffirmed December 2018
Male Adolescent Sexual and Reproductive Health Care	December 2011; reaffirmed May 2015
Protecting Children from Sexual Abuse by Health Care Providers	August 2011; reaffirmed January 2020
The Use of Chaperones During the Physical Examination of the Pediatric Patient	May 2011; reaffirmed November 2017
Gynecologic Examination for Adolescents in the Pediatric Office Setting	September 2010; reaffirmed May 2013
The Evaluation of Sexual Behaviors in Children	September 2009; reaffirmed October 2018

processing likely contribute to poor adherence to sociosexual norms, as well a limited understanding of the consequences of sexual behavior. In a recent survey of both parents and youth, 29% of young adults with ASD experienced challenging sexualized behaviors, most commonly masturbation in public.[66] When parents of children and youth with ASD, Down syndrome, and typical development were interviewed, those with ASD had significantly more trouble in multiple domains of sexual functioning, including social behavior, privacy awareness, sex education, sexual behavior, and parental concerns.[67] Improving sociosexual education can help prevent or minimize many of these behaviors and should begin at a young age.[68] Health care providers, educators, and family members and caregivers can work collaboratively toward extinguishing problem behaviors and use reminders, distractions, or replacement with socially appropriate gestures or places. Specific resources to address problem behaviors can be found in Table 5.

SEXUALITY AND ADOLESCENTS WITH ASD

Adulthood is a highly social construct. Negotiating the transition to adulthood from supervised, structured home and school settings can be challenging for all adolescents, especially for individuals with ASD.[69–71] It is not surprising that the core deficits of ASD, including difficulty with social reciprocity and pragmatic communication, complicate experiences and relationships of youth with ASD, compared with their typical or cognitively delayed peers.[67,72] Although youth and adults with ASD did not significantly differ from their counterparts without ASD in their knowledge of sexual language and interest in sexual experiences,[72,73] more than a dozen studies including direct report by individuals with ASD

TABLE 5 Resources for Problem Behaviors

Problem Behavior	Resources
Excessive or public masturbation	Suggested conversation: "Today, we discussed that masturbation is a normal behavior. Excessive and/or inappropriate masturbation is often difficult to control because it can be a self-reinforcing behavior. We discussed that although inappropriate masturbation, such as public masturbation, may not completely go away, your child can learn to be redirected to perform the behavior in private. The key to approaching this is to ensure that your child both has a personal space and that he or she understands the appropriate place for private behaviors. Recommend using a schedule or timer to set boundaries for these behaviors." Specific protocols for minimizing excessive public masturbation include interrupting the behavior, reminding the person of appropriate time and place, redirection, and allowing masturbation in private. Often, working with a behavior therapist who can offer applied behavior analysis is recommended. Resources: Kate E. Reynolds books: *Things Tom Likes: A Book About Sexuality and Masturbation for Boys and Young Men with Autism and Related Conditions* (2015) and *Things Ellie Likes: A Book About Sexuality and Masturbation for Girls and Young Women with Autism and Related Conditions* (2015).
Inappropriate interactions (stalking), touching, or romantic gestures	Through the Individualized Education Program, request a functional behavior assessment and a behavior intervention plan for positive supports such as a social skills group, scripting, video modeling and feedback, self-management, and rule governed behaviors. Resource: Teaching Moment: Teaching Your Kids Appropriate and Inappropriate Touching (https://www.northshore.org/healthy-you/teaching-your-kids-appropriate-touching/).
Using public restrooms	Resources: Kate E Reynolds books: *Tom Needs to Go: A Book About How to Use Public Toilets Safely for Boys and Young Men with Autism and Related Conditions* (2015) and *Ellie Needs to Go: A Book About How to Use Public Toilets Safely for Girls and Young Women with Autism and Related Conditions* (2015).

indicate lower levels of sexual knowledge (including understanding of privacy norms) decreased social opportunities, and increased social anxiety and vulnerability.[66,74,75] In addition, at a population level, teenagers and young adults with ASD without an intellectual disability have greater diversity in sexual orientation and gender identity, compared with typically developing peers, which they state can be confusing.[76] As understanding of sexual knowledge and health differences between individuals with ASD increases, there are new opportunities to individualize safety and sex education to understand sexual orientation and prevent socially isolating problem sexual behaviors, sexual coercion, and abuse.[74] Typical sex education may not be sufficient for people with ASD, and specific methods and curricula are necessary to match their needs (Table 1).[77] An enhancement of clinical services and additional research is needed to ensure people with ASD have their informational needs met and are able to achieve a healthy sexuality.[78]

SEXUALITY AND ADOLESCENTS WITH SPINA BIFIDA OR A SPINAL CORD INJURY

Individuals with spina bifida or a spinal cord injury have some amount of lower extremity paralysis and also tend to have a neurogenic bowel and bladder as well as loss of nerve signals to their sex organs. The neurologic consequences of spinal cord injury and spina bifida can alter sexual and reproductive experiences for people with these conditions, affect confidence and self-esteem, and hinder relationship building.[12,79–81] Although many youth with spina bifida do not understand their reproductive potential, women with spinal cord injury or spina bifida tend to have normal fertility but require high-risk obstetric care before and during their pregnancies.[12,82] Many women with spinal cord injury or spina bifida, when sexually aroused, do not have full vulvar engorgement or vaginal lubrication, making penetration difficult or painful.[83] Some women with these conditions are able to experience orgasms.[82] Men with spina bifida or spinal cord injury tend to have altered fertility.[84] In addition, the performance of sexual intercourse may be hindered by erectile dysfunction, including an inability to achieve or maintain an erection for

penetration and retrograde, absent, or incomplete ejaculation.[79,85] For both men and women with these conditions, engaging in sexual activity may be complicated by incontinence from neurogenic bowel or bladder.[86,87] Both men and women may be counseled to catheterize their bladders before and after sexual activity.[83] Men who have retrograde ejaculation often need to flush their bladders after sex to remove semen from the bladder.[88] Sexual education and guidance should be tailored to the individual's needs and should consider the cognitive and physical capabilities of the individual.[86] Many people with spina bifida also commonly have learning disabilities and other cognitive problems.[89] People with spina bifida also need to be counseled about the use of nonlatex condoms because of the risk of latex allergies in this population.

SEXUALITY AND HEALTH CARE TRANSITION

Viewing sexuality as a normative part of adolescence in people with disabilities, including ASD, is conceptually new, compared with long-standing myths of universal asexuality and limited sexual experiences.[72,75] The 2018 AAP clinical report, "Supporting the Health Care Transition From Adolescence to Adulthood in the Medical Home," provides a strong framework for primary care providers to longitudinally promote and integrate healthy sexuality for all youth, both with and without disabilities, from understanding pubertal changes and gender identity to experiencing sexual feelings and understanding sexual orientation to ultimately exploring and developing capacity for intimacy and reproduction.[22] This ongoing longitudinal relationship, similar to that for typically developing youth, includes confidential conversations, appropriate genital examinations, openness to sexual and gender diversity and individual and family preferences, and, if needed, sensitive reporting of sexual abuse or violence.[90] As opportunities for employment, postsecondary education, and community living increase for a large portion of the population with disabilities, it is imperative to prepare and support them in their sociosexual self-efficacy, safety, and well-being.

THE PEDIATRIC HEALTH CARE PROVIDER'S ROLE

Pediatric health care providers play a crucial and longitudinal role in the development of healthy sexuality of children and youth with disabilities. The unique relationship with the patient and family over time allows the pediatric health care provider to discuss and promote important social and sexual skills at an individualized pace appropriate for each patient.

- Pediatric health care providers can examine and adjust or reinforce their knowledge, beliefs, and attitudes about sexuality and gender identity to ensure their own behavior reflects inclusivity and autonomy of all their patients, especially children and adolescents with disabilities; all people have the right to develop relationships, exercise choice and autonomy, and receive education to promote a healthy sexuality, regardless of sexual orientation or gender identity. Communication that is open and respectful can help develop trust and foster shared decision-making.
- At the earliest ages, including preschoolers, pediatric health care providers are encouraged to discuss appropriate "private" versus "public" behaviors. Pediatric health care providers can help children with disabilities and their families understand boundaries and the concept of body ownership and consent. Explaining "good touch," "bad touch," and "necessary touch" can help children frame their understanding of appropriate and inappropriate circumstances and situations. Using anatomically correct language for body parts at young ages helps children to understand their bodies in a positive, healthy way and offers children a way to express healthy sexuality.
- By at least 8 or 9 years of age, pediatric health care providers should begin to discuss puberty and may need to do so sooner if the child is at risk for precocious puberty. Discussing puberty, preparing children and families, and offering additional materials (separate from school curriculum; Table 1) to review in a quiet comfortable place such as the home allows for questions, clarification, and anticipatory guidance for supports in hygiene and normalization of experiences.
- As with all adolescents, pediatric health care providers are encouraged to offer youth with disabilities an opportunity to speak with their provider confidentially during a visit. This allows youth to express their thoughts and experiences and ask questions. This is especially important for youth who are discovering their nonbinary gender identity or nonheterosexual sexual orientation. The pediatric health care provider's office should be a safe place to discuss these issues for all youth, including those with disabilities.
- Pediatric health care providers have opportunities with families and caregivers to introduce topics such as healthy sexual development and exploration while limiting risk of harm. Encouraging coeducational supervised group activities to include individuals with disabilities in typical teenager interactions often is best received by families and caregivers as anticipatory guidance by their trusted

provider. This is also a good time to encourage families and caregivers to be a primary source of sexual education for their children. There are many resources available, including those listed in Table 1. Pediatric health care providers can partner with families and caregivers who may feel uncomfortable addressing sexual health through a shared decision-making process that is culturally responsive and elevates the rights of children with disabilities to gain knowledge and understanding regarding their developing sexuality.

- Pediatric health care providers are the best resource to counsel all youth, including youth with disabilities, regarding the prevention of STIs and unwanted pregnancy as well as the benefits of HPV vaccination.
- Pediatric health care providers can help youth with disabilities procure contraceptives in a confidential manner, with adherence to informed consent rules.
- Pediatric health care providers can screen for STIs or ensure that appropriate referrals are in place (eg, gynecology or urology) for routine screening as part of their role in providing care in a medical home.
- Pediatric health care providers are well suited to provide families with resources to help them address problematic or inappropriate sexual behaviors (Table 5).
- Pediatric health care providers can partner with schools to ensure that children with disabilities have access to a developmentally appropriate sexual education that includes knowledge building around sexual victimization, safer sex practices, consent, and respect through their Individualized Education Programs or as part of the typical curriculum.
- Pediatric health care providers may need to offer education to schools regarding the high risk of sexual victimization for children with disabilities, how best to prevent it, and how to identify it if it occurs.
- Pediatric health care providers are vigilant about the knowledge that children and youth with disabilities are at an increased risk for sexual abuse and assault and can help families understand this risk. Asking about unwanted or coercive interactions and monitoring for emotional disturbance that may indicate sexual abuse or coercion can happen at every visit. If concerns arise, ensuring that proper reporting occurs and follow-up care is delivered is a role pediatric health care providers are trained to provide.

Pediatric health care providers are encouraged to approach sexual education and guidance individually for children and youth with disabilities, taking into account their patient's developmental trajectory and understanding the functional limitations of health conditions that can affect the development of healthy sexuality. Numerous other AAP reports can help inform the pediatric health provider on the topic of sexuality (Table 4). Framing healthy sexuality through a "competence lens" helps providers recognize the strengths and challenges for each individual patient. To be competent at something, an individual must have sufficient knowledge and skills to engage in action. Although there may be barriers to the development of skills needed for healthy sexuality in individuals with disabilities, it is important to prioritize ongoing skill development, compensatory strategies, and opportunities for autonomy and self-actualization.

LEAD AUTHORS

Amy Joy Houtrow, MD, PhD, MPH, FAAP
Ellen Roy Elias, MD, FAAP, FACMG
Beth Ellen Davis, MD, MPH, FAAP

COUNCIL ON CHILDREN WITH DISABILITIES EXECUTIVE COMMITTEE, 2020–2021

Dennis Z. Kuo, MD, MHS, FAAP, Chairperson
Rishi Agrawal, MD, MPH, FAAP
Lynn F. Davidson, MD, FAAP
Kathryn A. Ellerbeck, MD, FAAP
Jessica E.A. Foster, MD, MPH, FAAP
Ellen Fremion, MD, FAAP, FACP
Mary O'Connor Leppert, MD, FAAP
Barbara S. Saunders, DO, FAAP
Christopher Stille, MD, MPH, FAAP
Jilda Vargus-Adams, MD, MSc, FAAP
Larry Yin, MD, MSPH, FAAP

PAST COUNCIL ON CHILDREN WITH DISABILITIES EXECUTIVE COMMITTEE MEMBERS

Kenneth Norwood, Jr, MD, FAAP, Immediate Past Chairperson

LIAISONS

Cara Coleman, JD, MPH – *Family Voices*
Marie Y. Mann, MD, MPH, FAAP – *Maternal and Child Health Bureau*
Edwin Simpser, MD, FAAP – *Section on Home Care*
Jennifer Poon, MD, FAAP – *Section on Developmental and Behavioral Pediatrics*
Marshalyn Yeargin-Allsopp, MD, FAAP – *Centers for Disease Control and Prevention*

STAFF

Alexandra Kuznetsov

ABBREVIATIONS

AAP: American Academy of Pediatrics
ASD: autism spectrum disorder
HPV: human papillomavirus
STI: sexually transmitted infection

DOI: https://doi.org/10.1542/peds.2021-052043

Address correspondence to Amy Houtrow, MD, PhD, MPH, FAAP. E-mail: houtrow@upmc.edu

PEDIATRICS (ISSN Numbers: Print, 0031-4005; Online, 1098-4275).

FINANCIAL DISCLOSURE: The authors have indicated they have no financial relationships relevant to this article to disclose.

FUNDING: No external funding.

POTENTIAL CONFLICT OF INTEREST: The authors have indicated they have no potential conflicts of interest to disclose.

REFERENCES

1. World Health Organization. Defining sexual health. Available at: www.who.int/reproductivehealth/topics/sexual_health/sh_definitions/en/. Accessed September 30, 2020
2. Breuner CC, Mattson G; COMMITTEE ON ADOLESCENCE; COMMITTEE ON PSYCHOSOCIAL ASPECTS OF CHILD AND FAMILY HEALTH. Sexuality education for children and adolescents. *Pediatrics*. 2016;138(2):e20161348
3. Swartzendruber A, Zenilman JM. A national strategy to improve sexual health. *JAMA*. 2010;304(9):1005–1006
4. American College of Obstetricians and Gynecologists. Comprehensive sexuality education. Available at: https://www.acog.org/-/media/project/acog/acogorg/clinical/files/committee-opinion/articles/2016/11/comprehensive-sexuality-education.pdf. Accessed July 15, 2020
5. Lee S, Fenge LA, Collins B. Promoting sexual well-being in social work education and practice. *Soc Work Educ*. 2018;37(3):315–327
6. Marcell AV, Burstein GR; COMMITTEE ON ADOLESCENCE. Sexual and reproductive health care services in the pediatric setting. *Pediatrics*. 2017;140(5):e20200627
7. Child and Adolescent Health Measurement Initiative. Data search results. Available at: www.childhealthdata.org/browse/survey/results?q=4668&r=1. Accessed September 30, 2020
8. Hagerman TK, Houtrow AJ. Variability in prevalence estimates of disability among children in the National Survey of Children's Health. *JAMA Pediatr*. 2021;175(3):307–310
9. Rosenbaum P, Gorter JW. The 'F-words' in childhood disability: I swear this is how we should think! *Child Care Health Dev*. 2012;38(4):457–463
10. DiGiulio G. Sexuality and people living with physical or developmental disabilities: a review of key issues. *Can J Hum Sex*. 2003;12(1):53–68
11. Horner-Johnson W, Moe EL, Stoner RC, et al. Contraceptive knowledge and use among women with intellectual, physical, or sensory disabilities: a systematic review. *Disabil Health J*. 2019;12(2):139–154
12. Sawin KJ, Buran CF, Brei TJ, Fastenau PS. Sexuality issues in adolescents with a chronic neurological condition. *J Perinat Educ*. 2002;11(1):22–34
13. Finlay WM, Rohleder P, Taylor N, Culfear H. 'Understanding' as a practical issue in sexual health education for people with intellectual disabilities: a study using two qualitative methods. *Health Psychol*. 2015;34(4):328–338
14. Schaafsma D, Kok G, Stoffelen JMT, Curfs LMG. People with intellectual disabilities talk about sexuality: implications for the development of sex education. *Sex Disabil*. 2017;35(1):21–38
15. Barnard-Brak L, Schmidt M, Chesnut S, Wei T, Richman D. Predictors of access to sex education for children with intellectual disabilities in public schools. *Intellect Dev Disabil*. 2014;52(2):85–97
16. Swango-Wilson A. Meaningful sex education programs for individuals with intellectual/developmental disabilities. *Sex Disabil*. 2011;29(2):113–118
17. Adams RC, Levy SE; COUNCIL ON CHILDREN WITH DISABILITIES. Shared decision-making and children with disabilities: pathways to consensus. *Pediatrics*. 2017;139(6):e20170956
18. Houtrow A, Jones J, Ghandour R, Strickland B, Newacheck P. Participation of children with special health care needs in school and the community. *Acad Pediatr*. 2012;12(4):326–334
19. Milligan MS, Neufeldt AH. The myth of asexuality: a survey of social and empirical evidence. *Sex Disabil*. 2001;19(2):91–109
20. Hagan JF, Shaw JS, Duncan PM, eds. *Bright Futures: Guidelines for Health Supervision of Infants, Children, and Adolescents*. 4th ed. Elk Grove Village, IL: American Academy of Pediatrics; 2017
21. Center for Parent Information & Resources. Sexuality education for students with disabilities. Available at: https://www.parentcenterhub.org/sexed/. Accessed September 30, 2020
22. White PH, Cooley WC; TRANSITIONS CLINICAL REPORT AUTHORING GROUP; AMERICAN ACADEMY OF PEDIATRICS; AMERICAN ACADEMY OF FAMILY PHYSICIANS; AMERICAN COLLEGE OF PHYSICIANS. Supporting the health care transition from adolescence to adulthood in the medical home. *Pediatrics*. 2018;142(5):182–200
23. Rafferty J; COMMITTEE ON PSYCHOSOCIAL ASPECTS OF CHILD AND FAMILY HEALTH; COMMITTEE ON ADOLESCENCE; SECTION ON LESBIAN, GAY, BISEXUAL, AND TRANSGENDER HEALTH AND WELLNESS. Ensuring comprehensive care and support for transgender and gender-diverse children and adolescents. *Pediatrics*. 2018;142(4):e20182162
24. Wolfe PS, Wertalik JL, Domire Monaco S, Gardner S, Ruiz S. Review of sociosexuality curricular content for individuals with developmental disabilities. *Focus Autism Other Dev Disabl*. 2019;34(3):153–162
25. Ailey SH, Marks BA, Crisp C, Hahn JE. Promoting sexuality across the life span for individuals with intellectual

and developmental disabilities. *Nurs Clin North Am.* 2003;38(2):229 252

26. Michaud P-A, Ambresin AE. Consultation for disordered puberty: what do adolescent medicine patients teach us? *Endocr Dev.* 2016;29:240 255
27. American College of Obstetricians and Gynecologists. Committee opinion No. 710: counseling adolescents about contraception. *Obstet Gynecol.* 2017;130(2):e74 e80
28. Cholley F, Trivin C, Sainte-Rose C, Souberbielle JC, Cinalli G, Brauner R. Disorders of growth and puberty in children with non-tumoral hydrocephalus. *J Pediatr Endocrinol Metab.* 2001;14(3):319 327
29. Kaplowitz P, Bloch C; Section on Endocrinology, American Academy of Pediatrics. Evaluation and referral of children with signs of early puberty. *Pediatrics.* 2016;137(1):e20153732
30. Kaplowitz PB, Mehra R. Clinical characteristics of children referred for signs of early puberty before age 3. *J Pediatr Endocrinol Metab.* 2015;28(9 10): 1139 1144
31. McLay L, Carnett A, Tyler-Merrick G, van der Meer L. A systematic review of interventions for inappropriate sexual behavior of children and adolescents with developmental disabilities. *Rev J Autism Dev Disord.* 2015;2(4):357 373
32. Quint EH, O'Brien RF; COMMITTEE ON ADOLESCENCE; North American Society for Pediatric and Adolescent Gynecology. Menstrual management for adolescents with disabilities. *Pediatrics.* 2016;138(1):e20160295
33. Grover SR. Gynaecological issues in adolescents with disability. *J Paediatr Child Health.* 2011;47(9):610 613
34. Tracy J, Grover S, Macgibbon S. Menstrual issues for women with intellectual disability. *Aust Prescr.* 2016;39(2):54 57
35. Quint EH. Menstrual and reproductive issues in adolescents with physical and developmental disabilities. *Obstet Gynecol.* 2014;124(2, pt 1):367 375
36. American College of Obstetricians and Gynecologists' Committee on Adolescent Health Care. Committee opinion No. 668: menstral manipulation for adolescents with physical and developmental disabilities. *Obstet Gynecol.* 2016;128(2):e20 e25
37. Acharya K, Lantos JD. Considering decision-making and sexuality in menstrual suppression of teens and young adults with intellectual disabilities. *AMA J Ethics.* 2016;18(4):365 372
38. Baines S, Emerson E, Robertson J, Hatton C. Sexual activity and sexual health among young adults with and without mild/moderate intellectual disability. *BMC Public Health.* 2018;18(1):667
39. Abells D, Kirkham YA, Ornstein MP. Review of gynecologic and reproductive care for women with developmental disabilities. *Curr Opin Obstet Gynecol.* 2016;28(5):350 358
40. Spiegel T, Pollak Y. Corrigendum: attention deficit/hyperactivity disorder and increased engagement in sexual risk-taking behavior: the role of benefit perception. *Front Psychol.* 2019;10:2152
41. Schoenfelder EN, Kollins SH. Topical review: ADHD and health-risk behaviors: toward prevention and health promotion. *J Pediatr Psychol.* 2016;41(7):735 740
42. LeFevre ML; US Preventive Services Task Force. Behavioral counseling interventions to prevent sexually transmitted infections: U.S. Preventive Services Task Force recommendation statement. *Ann Intern Med.* 2014;161(12):894 901
43. Grubb LK; COMMITTEE ON ADOLESCENCE. Barrier protection use by adolescents during sexual activity. *Pediatrics.* 2020;146(2):e2020007237
44. Menon S; COMMITTEE ON ADOLESCENCE. Long-acting reversible contraception: specific issues for adolescents. *Pediatrics.* 2020;146(2):e2020007252
45. Alderman EM, Breuner CC; COMMITTEE ON ADOLESCENCE. Unique needs of the adolescent. *Pediatrics.* 2019;144(6):e20193150
46. Gavin L, Moskosky S, Carter M, et al; Centers for Disease Control and Prevention (CDC). Providing quality family planning services: recommendations of CDC and the U.S. Office of Population Affairs. *MMWR Recomm Rep.* 2014;63(RR-04):1 54
47. Workowski KA, Bolan GA; Centers for Disease Control and Prevention. Sexually transmitted diseases treatment guidelines, 2015. *MMWR Recomm Rep.* 2015;64(RR-03):1 137
48. Blake DR, Middleman AB. Human papillomavirus vaccine update. *Pediatr Clin North Am.* 2017;64(2):321 329
49. COMMITTEE ON INFECTIOUS DISEASES. Recommended childhood and adolescent immunization schedule: United States, 2020. *Pediatrics.* 2020;145(3):e20193995
50. Centers for Disease Control and Prevention. Recommended child and adolescent immunization schedule for ages 18 years or younger, United States, 2021. Available at: https://www.cdc.gov/vaccines/schedules/hcp/imz/child-adolescent.html notes. Accessed July 15, 2020
51. American College of Obstetricians and Gynecologists. ACOG committee opinion No. 768 summary: genetic syndromes and gynecologic implications in adolescents. *Obstet Gynecol.* 2019;133(3):598 599
52. Stein Q, Loman R, Zuck T. Genetic counseling in pediatrics. *Pediatr Rev.* 2018;39(7):323 331
53. Bull MJ; Committee on Genetics. Health supervision for children with Down syndrome [published correction appears in *Pediatrics.* 2011;128(6):1212]. *Pediatrics.* 2011;128(2):393 406
54. Smith N, Harrell S. Sexual abuse of children with disabilities: a national snapshot. *Child Law Practice Today.* July 1, 2013. Available at: https://www.americanbar.org/groups/public interest/child law/resources/child law practiceonline/child law practice/vol 32/july-2013/sexual-abuse-of-children-with-disabilities a-national-snapshot0/. Accessed September 30, 2020
55. Crawford-Jakubiak JE, Alderman EM, Leventhal JM; COMMITTEE ON CHILD ABUSE AND NEGLECT; COMMITTEE ON ADOLESCENCE. Care of the adolescent after an acute sexual assault. [published correction appears in *Pediatrics.* 2017;139(6):e20170958]. *Pediatrics.* 2017;139(3):e20164243
56. Finkelhor D, Shattuck A, Turner HA, Hamby SL. The lifetime prevalence of child sexual abuse and sexual assault assessed in late adolescence. *J Adolesc Health.* 2014;55(3):329 333
57. Findley PA, Plummer SB, McMahon S. Exploring the experiences of abuse of college students with disabilities. *J Interpers Violence.* 2016;31(17):2801 2823

58. Haydon AA, McRee AL, Tucker Halpern C. Unwanted sex among young adults in the United States: the role of physical disability and cognitive performance. *J Interpers Violence.* 2011;26(17):3476 3493

59. McDaniels B, Fleming A. Sexuality education and intellectual disability: time to address the challenge. *Sex Disabil.* 2016;34(2):215 225

60. Murphy GH, O'Callaghan A. Capacity of adults with intellectual disabilities to consent to sexual relationships. *Psychol Med.* 2004;34(7):1347 1357

61. Jenny C, Crawford-Jakubiak JE; Committee on Child Abuse and Neglect; American Academy of Pediatrics. The evaluation of children in the primary care setting when sexual abuse is suspected. *Pediatrics.* 2013;132(2):e558 e567

62. Christian CW; Committee on Child Abuse and Neglect, American Academy of Pediatrics. The evaluation of suspected child physical abuse. *Pediatrics.* 2015;135(5):e1337 e1354

63. Kellogg ND; Committee on Child Abuse and Neglect, American Academy of Pediatrics. Clinical report the evaluation of sexual behaviors in children. *Pediatrics.* 2009;124(3):992 998

64. Kenny MC, Abreu RL. Training mental health professionals in child sexual abuse: curricular guidelines. *J Child Sex Abuse.* 2015;24(5):572 591

65. Clay CJ, Bloom SE, Lambert JM. Behavioral interventions for inappropriate sexual behavior in individuals with developmental disabilities and acquired brain injury: a review. *Am J Intellect Dev Disabil.* 2018;123(3):254 282

66. Fernandes LC, Gillberg CI, Cederlund M, Hagberg B, Gillberg C, Billstedt E. Aspects of sexuality in adolescents and adults diagnosed with autism spectrum disorders in childhood. *J Autism Dev Disord.* 2016; 46(9):3155 3165

67. Ginevra MC, Nota L, Stokes MA. The differential effects of Autism and Down's syndrome on sexual behavior. *Autism Res.* 2016;9(1):131 140

68. Beddows N, Brooks R. Inappropriate sexual behaviour in adolescents with autism spectrum disorder: what education is recommended and why. *Early Interv Psychiatry.* 2016;10(4):282 289

69. Bennett AE, Miller JS, Stollon N, Prasad R, Blum NJ. Autism spectrum disorder and transition-aged youth. *Curr Psychiatry Rep.* 2018;20(11):103

70. van Schalkwyk GI, Volkmar FR. Autism spectrum disorders: challenges and opportunities for transition to adulthood. *Child Adolesc Psychiatr Clin N Am.* 2017;26(2):329 339

71. Roux A, Shattuck P, Rast J, Anderson K. *National Autism Indicators Report: Developmental Disability Services and Outcomes in Adulthood.* Philadelphia, PA: Drexel University; 2017

72. Dewinter J, Vermeiren R, Vanwesenbeeck I, Nieuwenhuizen CV. Parental awareness of sexual experience in adolescent boys with autism spectrum disorder. *J Autism Dev Disord.* 2016;46(2):713 719

73. Gilmour L, Schalomon P, Smith V. Sexuality in a community based sample of adults with autism spectrum disorder. *Res Autism Spectr Disord.* 2012;6(1):313 318

74. Hancock GIP, Stokes MA, Mesibov GB. Socio-sexual functioning in autism spectrum disorder: a systematic review and meta-analyses of existing literature. *Autism Res.* 2017;10(11):1823 1833

75. Kellaher DC. Sexual behavior and autism spectrum disorders: an update and discussion. *Curr Psychiatry Rep.* 2015;17(4):562

76. Turner D, Briken P, Schöttle D. Autism-spectrum disorders in adolescence and adulthood: focus on sexuality. *Curr Opin Psychiatry.* 2017;30(6):409 416

77. Hannah LA, Stagg SD. Experiences of sex education and sexual awareness in young adults with autism spectrum disorder. *J Autism Dev Disord.* 2016;46(12):3678 3687

78. Lehan Mackin M, Loew N, Gonzalez A, Tykol H, Christensen T. Parent perceptions of sexual education needs for their children with autism. *J Pediatr Nurs.* 2016;31(6):608 618

79. Gatti C, Del Rossi C, Ferrari A, Casolari E, Casadio G, Scire G. Predictors of successful sexual partnering of adults with spina bifida. *J Urol.* 2009;182(4 suppl): 1911 1916

80. Lassmann J, Garibay Gonzalez F, Melchionni JB, Pasquariello PS Jr, Snyder HM III. Sexual function in adult patients with spina bifida and its impact on quality of life. *J Urol.* 2007;178(4, pt 2): 1611 1614

81. Lee NG, Andrews E, Rosoklija I, et al. The effect of spinal cord level on sexual function in the spina bifida population. *J Pediatr Urol.* 2015; 11(3):142.e1 142.e6

82. de Vylder A, van Driel MF, Staal AL, Weijmar Schultz WC, Nijman JM. Myelomeningocele and female sexuality: an issue? *Eur Urol.* 2004;46(4):421 426, discussion 426 427

83. Hess MJ, Hough S. Impact of spinal cord injury on sexuality: broad-based clinical practice intervention and practical application. *J Spinal Cord Med.* 2012;35(4):211 218

84. Deng N, Thirumavalavan N, Beilan JA, et al. Sexual dysfunction and infertility in the male spina bifida patient. *Transl Androl Urol.* 2018;7(6):941 949

85. Bong GW, Rovner ES. Sexual health in adult men with spina bifida. *ScientificWorldJournal.* 2007;7:1466 1469

86. Verhoef M, Barf HA, Vroege JA, et al. Sex education, relationships, and sexuality in young adults with spina bifida. *Arch Phys Med Rehabil.* 2005;86(5):979 987

87. Cardenas DD, Topolski TD, White CJ, McLaughlin JF, Walker WO. Sexual functioning in adolescents and young adults with spina bifida. *Arch Phys Med Rehabil.* 2008;89(1):31 35

88. Barazani Y, Stahl PJ, Nagler HM, Stember DS. Management of ejaculatory disorders in infertile men. *Asian J Androl.* 2012;14(4):525 529

89. Fletcher JM, Copeland K, Frederick JA, et al. Spinal lesion level in spina bifida: a source of neural and cognitive heterogeneity. *J Neurosurg.* 2005;102(3 suppl):268 279

90. Grubb LK, Powers M; COMMITTEE ON ADOLESCENCE. Emerging issues in male adolescent sexual and reproductive health care. *Pediatrics.* 2020;145(5):e20200627

Promoting Human Milk and Breastfeeding for the Very Low Birth Weight Infant

• *Clinical Report*

CLINICAL REPORT Guidance for the Clinician in Rendering Pediatric Care

American Academy of Pediatrics
DEDICATED TO THE HEALTH OF ALL CHILDREN™

Promoting Human Milk and Breastfeeding for the Very Low Birth Weight Infant

Margaret G. Parker, MD, MPH,[a] Lisa M. Stellwagen, MD,[b,c] Lawrence Noble, MD,[d,e] Jae H. Kim, MD, PhD,[f] Brenda B. Poindexter, MD,[g] Karen M. Puopolo, MD, PhD,[h] SECTION ON BREASTFEEDING, COMMITTEE ON NUTRITION, COMMITTEE ON FETUS AND NEWBORN

Provision of mother's own milk for hospitalized very low birth weight (VLBW) (≤1500 g) infants in the NICU provides short- and long-term health benefits. Mother's own milk, appropriately fortified, is the optimal nutrition source for VLBW infants. Every mother should receive information about the critical importance of mother's own milk to the health of a VLBW infant. Pasteurized human donor milk is recommended when mother's own milk is not available or sufficient. Neonatal health care providers can support lactation in the NICU and potentially reduce disparities in the provision of mother's own milk by providing institutional supports for early and frequent milk expression and by promoting skin-to-skin contact and direct breastfeeding, when appropriate. Promotion of human milk and breastfeeding for VLBW infants requires multidisciplinary and system-wide adoption of lactation support practices.

STATEMENT OF PROBLEM

Provision of mother's own milk for hospitalized very low birth weight (VLBW) (≤1500 g) infants in the NICU provides short- and long-term health benefits. Mothers of very preterm infants face many challenges in the provision of breast milk. The goal of this clinical report is to provide neonatal clinicians up-to-date information regarding NICU lactation support for mothers of VLBW infants.

abstract

[a]*Department of Pediatrics, Boston Medical Center, School of Medicine, Boston University, Boston, Massachusetts;* [b]*University of California Health Milk Bank, San Diego, California;* [c]*Department of Pediatrics, University of California, San Diego, Health, San Diego, California;* [d]*Department of Pediatrics, Icahn School of Medicine at Mount Sinai, New York, New York;* [e]*New York City Health + Hospitals/Elmhurst, Elmhurst, New York;* [f]*Division of Neonatology, Perinatal Institute, Cincinnati Children's Hospital Medical Center and College of Medicine, University of Cincinnati, Cincinnati, Ohio;* [g]*Children's Healthcare of Atlanta and School of Medicine, Emory University, Atlanta, Georgia; and* [h]*Department of Pediatrics, Perelman School of Medicine, University of Pennsylvania, and Children's Hospital of Philadelphia, Philadelphia, Pennsylvania*

Drs Parker, Stellwagen, and Puopolo drafted the original manuscript; and all authors provided intellectual insight and reviewed, edited, and approved the final manuscript as submitted.

To cite: Parker MG, Stellwagen LM, Noble L, et al; AAP Section on Breastfeeding, Committee on Nutrition, Committee on Fetus and Newborn. Promoting Human Milk and Breastfeeding for the Very Low Birth Weight Infant. *Pediatrics*. 2021;148(5):e2021054272

BACKGROUND INFORMATION

Epidemiology

National data from more than 800 NICUs that participate in the Vermont xford Network Quality Collaborative showed that provision of human milk at discharge among VLBW infants has increased from 44 in 008 to 5 in 017, but disparities persist according to maternal race and ethnicity and US census region.[1] Human milk provision is lowest among non-Hispanic Black and American Indian/Alaska Native populations and within the southern region of the United States (Fig 1). Currently, there is no mechanism for national surveillance of hospital-based practices known to support breastfeeding among VLBW infants, although such surveillance has been conducted intermittently at the state ' or individual NICU level.[4–7] Hereafter, breast milk terminology is used according to definitions in Table 1.

Health Outcomes

Mother's own milk contains macronutrients and micronutrients as well as active biological components, including immunoglobulins, cytokines, growth factors, hormones, antimicrobial agents, immune cells, stem cells, and prebiotic oligosaccharides.[8] A substantial portion of the breast milk microbiome comprises probiotic bacteria.[9] Mother's own milk has been associated with multiple health benefits for VLBW infants, including lower incidences of necrotizing enterocolitis (NEC), late-onset sepsis, chronic lung disease, retinopathy of prematurity, and neurodevelopmental impairment (Tables and). Generally, higher doses of mother's own milk are associated with increased health benefits; however, exposures of human milk are highly variable among studies (Table) and there is a paucity of data comparing infants exclusively fed mother's own milk, pasteurized donor milk, or preterm formula.

Pasteurized donor milk is recommended for VLBW infants when mother's own milk is not available[10]; however, pasteurization, freeze-thaw cycles, multiple container changes, and prolonged storage times required for donor milk processing reduce bioactivity.[11] When provided as an exclusive diet or in combination with mother's own milk feeding, pasteurized donor milk is protective against NEC but does not appear to confer the additional health benefits that have been reported with mother's own milk, such as reduction in late-onset sepsis or improvements in neurodevelopment.[1] Pasteurized donor milk may be considered a "bridge" until a full supply of mother's own milk is available.

Although the benefits of a human milk-based diet for preterm infants are established, studies examining the impact of an exclusive human milk diet on the risk of NEC versus a diet with any bovine components (preterm formula or bovine-derived human milk fortifier HMF) have had mixed results (Table). Several randomized control trials (RCTs) and observational studies reported reductions in NEC when very preterm infants received an exclusive human milk diet versus a diet with any bovine formula or bovine-derived HMF.[1 –16] These data are countered by the largest RCT of an exclusive human milk diet of 1 7 infants with birth weight <1 50 g who received bovine- versus human-derived HMF as a supplement to mother's own milk or pasteurized donor milk, which found no difference between groups in feeding tolerance or NEC.[17] Studies comparing human-derived HMF with hydrolyzed bovine protein HMF are not available at the time of this report.

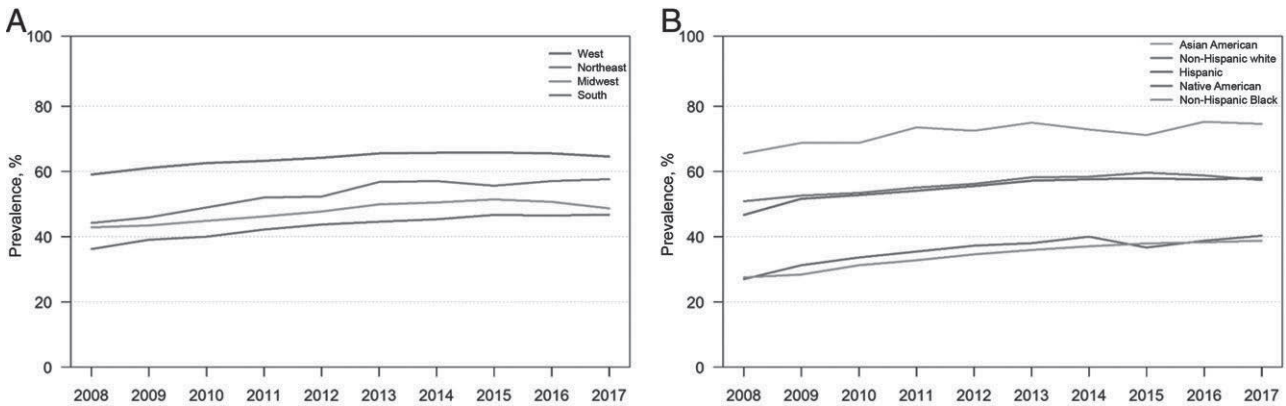


FIGURE 1 Any human milk at discharge among VLBW infants in the United States, 2008–2017. A, Any human milk at discharge among VLBW infants according to US region. B, any human milk at discharge according to maternal race/ethnicity. Adapted with permission from Parker et al.[1]

TABLE 1 Breast Milk Terms

Term	Definition
Mother's own milk	Milk from an infant's own mother
Pasteurized donor milk	Breast milk donated to a milk bank and pasteurized to eliminate pathogens
Informally shared milk	Unpasteurized milk from another infant's mother
Human milk	Mother's own milk or pasteurized donor milk
Bovine-derived HMF	Cow's milk protein based nutritional fortifier for human milk
Human-derived HMF	Human milk protein based nutritional fortifier for human milk
Exclusive human milk diet	Mother's own milk or pasteurized donor milk with a human-derived HMF

LACTATION CARE FOR THE VLBW INFANT

Institutional Lactation Supports

Mothers of very preterm infants are more likely to initiate lactation compared with mothers of term infants,[18] yet many of these mothers do not meet their intended feeding goals.[19] Mothers of VLBW infants face several challenges, including (1) preexisting and pregnancy-related medical morbidities that may contribute to delayed lactogenesis and/or reduced milk production[20–22]; (2) prolonged mother–infant separation; (3) dependence on pumping to maintain milk production, rather than direct breastfeeding; and (4) competing demands on their time that impede frequent milk expression and NICU visitation, such as requirements to return to work and care for other children and family members, among other factors.[23,24] Multidisciplinary NICU teams can play a critical role in ongoing lactation support by providing education, institutional supports for milk provision, and medical practices that support lactation.[4,5,25,26]

Lactation Education and Consultation

Family education has been shown to increase breastfeeding intent and reduce maternal anxiety.[27–30] Staff lactation education increases staff knowledge about breastfeeding and changes attitudes toward the use of human milk among preterm infants.[31] Readily available lactation consultants with NICU expertise improves maternal support in lacation.[25,32] However, bedside nurses also provide significant lactation education and education reinforcement.[4] Family education may include information on the health benefits of mother's own milk for VLBW infants, the need for early and frequent milk expression, the role of skin-to-skin contact (SSC), nonnutritive suckling and direct breastfeeding when physiologically appropriate, and technical information on proper milk handling, storage, and transport. NICU staff need familiarity with the technical skills of hand expression, pumping, and stepwise progression from enteral tube to oral feedings at the breast.[25,32] Family-centered care models promote family integration in medical care and improve duration of lactation.[33,34]

Milk Expression: Timing, Frequency, and Modality

Initiating milk expression soon after birth is important to stimulate milk production and provide early feedings with beneficial effects on the VLBW infant[35]; however, the optimal timing is unclear. A multisite observational study of 1157 mother-VLBW dyads found that first milk expression within 8 hours after birth predicted the highest likelihood of lactation until hospital discharge.[36] An RCT of 180 mothers who first expressed milk 1 to 60 minutes, 61 to 180 minutes, and 181 to 360 minutes after birth found no difference in lactation at 6 weeks or mother's milk feeding at discharge but found a greater volume of milk production over the first 6 weeks within the group expressing milk at 181 to 360 minutes.[35] It remains unclear whether hand expression or use of a breast pump is best for initial milk expression. One study of 11 mothers reported that hand expression in the first 48 hours was superior,[36] but a larger RCT of hand expression versus pumping for the first 7 days after birth reported that pumping was superior.[37]

Frequent milk expression is associated with a longer duration of milk production and greater milk volumes throughout the NICU hospitalization in observational studies[38–43]; however, the optimal frequency of milk expression is difficult to ascertain because studies differ in pumping frequency cut-points ($\geq$4 to 7 times per day).[38–44] Frequent milk expression is needed to maintain ongoing milk supply. Milk production $\geq$500 mL per day by day 14 after birth has been shown to predict a longer duration of milk production during the NICU hospitalization among mothers of VLBW infants.[42,43] Mothers should pump with an effective and efficient double electric breast pump at home and in the hospital when possible because these pumps are superior to manual pumps.[37,45,46] It is useful

TABLE 2 Dose-Response Studies Examining Health Benefits of Human Milk for VLBW Infants

		Outcomes					
Study	Exposure	NEC	Late-Onset Sepsis	Chronic Lung Disease	Retinopathy of Prematurity	Neurodevelopment	Hospital Growth
O'Connor et al, 2003 ($n = 463$)[127]	Mostly HM versus some HM versus mostly PF	—	—	—	—	Favors HM	Favors PF
Furman et al, 2003 ($n = 119$)[128]	1–24, 25–49, and ≥50 mL/kg of MM versus PF	—	Favors MM	—	—	—	—
Feldman et al, 2003 ($n = 86$)[129]	<25%, 25% to 75%, and >75% MM	—	—	—	—	Favors MM	—
Vohr et al, 2006 ($n = 1035$),[130] 2007 ($n = 773$)[131]	10 mL per day increments of MM	—	—	—	—	Favors MM	—
Meinzen-Derr et al, 2009 ($n = 1272$)[132]	10% of total diet increments of HM	Favors HM	—	—	—	—	—
Colaizy et al, 2012 ($n = 171$)[133]	>75% HM versus <75% HM	—	—	—	—	—	Favors less HM
Patel et al, 2013 ($n = 175$)[134]	Continuous mL/kg per day increments of HM	—	Favors HM	—	—	—	—
Belfort et al, 2016 ($n = 180$)[135]	Continuous days of >50% diet of MM	—	—	—	—	Favors MM	—
Assad et al, 2016 ($n = 293$)[16]	Exclusive HM versus MM + bovine HMF versus MM + PF + bovine HMF	Favors exclusive HM	—	Favors exclusive HM	Favors exclusive HM	—	—
Chowning et al, 2016 ($n = 550$)[136]	<50% days HM versus ≥50% days HM	Favors HM	—	—	—	—	Favors less HM
Hair et al, 2016 ($n = 1587$)[13]	Exclusive HM versus MM + PF + bovine HMF	Favors exclusive HM	Favors exclusive HM	Favors exclusive HM	Favors exclusive HM	—	—
Jacobi-Pollishook et al, 2016 ($n = 611$)[137]	25 mL/kg per day increments of MM	—	—	—	—	No difference	—
Patel et al, 2017 ($n = 254$)[138]	10% of total diet increments of MM	—	—	Favors MM	—	—	—
Sisk et al, 2017 ($n = 551$)[138]	≥50% MM versus ≥50% DM versus ≥50% PF	Favors HM	—	—	—	—	—
Madore et al, 2017 ($n = 81$)[139]	100% MM versus >50% DM versus >50% PF	—	—	—	—	Favors PF and MM	Favors PF and MM
Patra et al, 2017 ($n = 430$)[140]	10 mL per day increments of MM	—	—	—	—	Favors MM	—
Brownell et al, 2018 ($n = 314$)[77]	10% of total diet increments of MM versus DM versus PF	—	—	—	—	—	Favors PF and MM
Belfort et al, 2019 ($n = 263\,367$)[141]	HM versus mixed HM and formula versus formula	—	—	—	—	—	Favors formula
Hoban et al, 2019 ($n = 321$)[142]	10% of total diet increments of DM and PF versus 100% MM diet	—	—	—	—	—	Favors PF versus MM; DM versus MM no difference
Miller et al, 2018,[143] meta-analysis of dose-response observational studies (risk ratio [95% confidence interval])	Varied	Favors HM (0.53 [0.42–0.67])	Favors HM (0.7 [0.56–0.90])	Favors HM (0.84 [0.73–0.96])	Favors HM (0.82 [0.70–0.96])	No difference in subcategories of childhood neurodevelopment	Not assessed

DM, donor milk; HM, human milk (combination of mother's milk and donor milk); MM, mother's milk; PF, preterm formula; —, not applicable.

for mothers to be trained in pump use by hospital staff before they are discharged, helping them navigate common technical issues such as suction strength, pain with pumping, and proper flange fit. Mothers may be encouraged to pump at the infants' bedside with accommodations to protect privacy, because greater milk volumes have been reported when mothers pump in close contact with their infants[47]; however, the design of certain centers may mean that a central lactation room is more comfortable for some women. A single-center observational study showed increased milk volume among mothers of infants born at <31 weeks' gestation after training in hand expression while pumping (ie, "hands on pumping"), but this finding has not been examined in an RCT.[39] Mothers need training in appropriate techniques for milk storage and transport and to be provided with rigid, food-grade

TABLE 3 RCTs Examining Health Benefits of Human Milk for VLBW Infants

			Outcomes						
Study	Intervention	Control	NEC	Late-Onset Sepsis	Feeding Tolerance	Chronic Lung Disease	Retinopathy of Prematurity	Neurodevelopment	Hospital Growth
RCT of PF versus DM as a supplement to MM									
Schanler et al, 2005 ($n = 243$)[144]	MM + PF and MM + DM	MM	No difference	Favors MM	—	—	—	—	Varied[a]
RCTs of exclusive human milk versus not									
Cristofalo et al, 2013 ($n = 43$)[14]	DM + human HMF	PF + bovine HMF (powder)	Favors DM + human HMF	No difference	Favors DM + human HMF	—	No difference	—	Favors PF + bovine HMF
Sullivan et al, 2010 ($n = 207$)[15]	Exclusive HM (MM + DM + human HMF)	MM + PF + bovine HMF (powder)	Favors exclusive HM	No difference	No difference	No difference	No difference	—	No difference
Corpeleijn et al, 2016 ($n = 373$)[145]	MM + DM[b]	MM + PF[b]	No difference	No difference	—	No difference	No difference	—	—
O'Connor et al, 2016 ($n = 363$)[146]	MM + DM + bovine HMF (powder)	MM + PF + bovine HMF (powder)	Favors MM + DM + bovine HMF	No difference	—	No difference	No difference	No difference	No difference
RCTs of exclusive human milk examining fortifier types									
Moya[c,d] et al, 2012 ($n = 150$)[84]	MM + DM + bovine HMF (powder)	MM + DM + bovine HMF (liquid)	—	—	—	—	—	—	Favors bovine liquid HMF
Kim[c,e] et al, 2015 ($n = 147$)[82]	MM + DM + bovine HMF (powder)	MM + DM + bovine HMF (liquid)	—	—	No difference	—	—	—	No difference
O'Connor et al, 2018 ($n = 127$)[17]	MM + DM + human HMF	MM + DM + bovine HMF (powder)	No difference	No difference	No difference	No difference	Favors human HMF	—	No difference

DM, donor milk; MM, mother's milk; —, not applicable.

[a] Regarding wt gain, MM only was favorable over MM + DM; Regarding length gain, combined MM + PF and MM + was favorable over MM only.

[b] Intervention delivered in first 10 d of hospitalization before fortifier introduction.

[c] In this trial, intact protein was used for the powder fortifier and hydrolyzed protein was used for the liquid fortifier.

[d] In this trial, the powder HMF had 2.6 g per 100 mL and the liquid HMF had 3.2 g per 100 mL.

[e] In this trial, the powder HMF had 3 g per 100 mL and the liquid HMF had 3.6 g per 100 mL.

human milk collection containers.[32,48] Individualized plans for milk production after maternal hospital discharge may be developed with staff and lactation consultants.

NICU Practices Supporting Lactation

Recent reviews of studies examining SSC among mother-VLBW infant dyads found a positive effect of SSC on duration of mother's own milk production[49] as well as other important neonatal outcomes.[50] Early SSC has been associated with changes to the oral infant microbiome,[51] which may have implications for immune health. A previous American Academy of Pediatrics report provides guidance for SSC.[52] Family members can be encouraged to engage in SSC as often as possible and for as long as desired, depending on the infant's clinical condition. SSC can be safely performed among ventilated infants, infants receiving continuous positive airway pressure, and infants with securely placed central catheters. Facilitation of SSC may require the help of multiple hospital providers, including respiratory therapists. Continuous cardiovascular monitoring and monitoring for correct head positioning to maintain airway patency is needed.

Oral colostrum care consists of placing small amounts of colostrum on the infant buccal mucosa, often in the first hours after birth before beginning enteral feeding. Most mothers are able to provide colostrum for this purpose, even if the mother herself is significantly ill. Research in this area is emerging; a recent Cochrane meta-analysis of 6 small studies reported that oral colostrum care was associated with reduced days to enteral feedings (mean difference: −2.58 [95% confidence interval: −4.01 to −1.14]) but was not associated with reduction of NEC, late-onset sepsis, or mortality.[53] No adverse effects have been reported.[53] Research has not yet examined the impact of oral colostrum care in mother's own milk provision or family engagement later in the NICU hospitalization.

Transition to Direct Breastfeeding

Observational studies demonstrate that initial oral feedings at the breast, more frequent breastfeeding episodes, and earlier gestational age at the time of first breastfeeding attempt are associated with longer duration of breastfeeding during the hospital and postdischarge time periods.[54–58] Despite these potential benefits, significant barriers impede breastfeeding in the NICU, such as prolonged immature oromotor coordination, mother-infant separation, and the need for fortification of mother's own milk to optimize growth. Mothers can be encouraged to begin oral feeding at the breast as soon as the infant shows physiologic readiness (ie, feeding cues), and the infant's level of respiratory support allows for oral feeding. Oral feedings at the breast have been studied as early as 31 to 33 weeks' postmenstrual age.[54,55,57–59] Direct breastfeeding can occur as often as the infant's condition and mother's presence allows. Pre- and post-breastfeeding weight measurements may be used to monitor milk transfer.[60,61]

Multidisciplinary Team–Based Approaches

Multidisciplinary teams, including nursing, lactation, physicians, dietitians, and feeding therapists may best support lactating mothers.[4] Structured local and statewide quality improvement initiatives focused on adoption of hospital lactation support practices by multidisciplinary teams have successfully increased lactation rates.[3] Facilitators of effective multidisciplinary NICU lactation support teams include the following: consistent communication to families and among hospital staff members, physician buy-in, integration of lactation support practices into daily workflow, and ongoing data-driven feedback.[4,62]

Health Equity

Racial and ethnic disparities in the provision of mother's milk and pasteurized donor milk for VLBW infants are well-described; human milk use is lower among VLBW infants with non-Hispanic Black mothers, compared with those with non-Hispanic White mothers.[1,43,63,64] In addition to adherence to evidenced-based breastfeeding support practices described above for all mothers, several additional approaches have been shown to reduce Black and White disparities in breastfeeding in the NICU setting, including peer-counselor programs and support groups,[65,66] assistance with breast pump acquisition,[67] and transportation for mothers to visit the hospital.[28,30,64]

Growth and Fortification Needs for Human Milk–Fed VLBW Infants

The nutritional objective for hospitalized preterm infants is to match the fetal accretion of nutrients; nonetheless, poor growth continues to affect the majority of hospitalized VLBW infants.[68,69] Nutritional requirements cannot be met with human milk alone in the volumes of milk that are generally tolerated by VLBW infants because requirements exceed those of healthy term newborn infants in protein, energy, fatty acids, minerals, and micronutrients.[70] Multinutrient fortifiers are, therefore, added to human milk–fed to hospitalized VLBW infants.[71] It may be helpful to provide mothers with information on the use of HMFs, emphasizing the critical role of human milk despite

the need for fortification to optimize growth and development.

The macronutrient composition of preterm, term, and pasteurized donor milk is variable (Fig 2),[72–76] as are the needs of individual infants, and therefore, routine growth and nutrition monitoring is needed. Generally, the milk of mothers of preterm infants has higher protein content than the milk of mothers of term infants until about 10 to 12 weeks after birth[75] but still contains less than what is recommended for preterm infants (Fig 2).[70] The macronutrient content of pasteurized donor milk is often lower than that of milk provided by mothers of preterm infants,[74] such that infants supplemented with pasteurized donor milk, even with the addition of fortifiers, have a greater risk of growth failure.[77] Holder pasteurization used for donor milk processing results in a loss of lipase activity,[78] which reduces fat digestibility, which further adds to the risk of poor growth. Retort processing, another pasteurization method used to make shelf-stable donor milk, has been shown to significantly reduce lysozyme and secretory immunoglobulin A.[79] Overall, pasteurized donor milk is nutritionally suboptimal to a mother's own milk, reinforcing the importance of supporting mothers in maximal lactation.

Bovine- and human-derived HMFs are commercially available and vary in macronutrient content and degree to which proteins are hydrolyzed.[80–82] Bovine HMFs exist in powdered and liquid forms. In the United States, there has been a transition to use of liquid fortifier because of reports of bacterial contamination of infant formula powder and transmission of *Cronobacter (Enterobacter) sakazakii* during the hospital time period.[83] The liquid forms are supplied in sterile, single-use aliquots. Newer bovine HMFs provide hydrolyzed protein at higher protein concentrations than previous powder HMFs with intact proteins, which has been associated with improved growth.[80,84] Bovine liquid HMFs may be acidified as part of the sterilization process. A trial comparing acidified to nonacidified liquid HMFs showed similar growth but increased transient metabolic acidosis among VLBW infants receiving acidified liquid HMFs.[85] Optimal timing of fortification remains unclear, but several recent RCTs of fortification at feeding volumes less than 80 mL/kg per day showed no associations with feeding intolerance or NEC.[15,86,87] Adjustable fortification algorithms based on markers such as serum urea nitrogen may improve growth.[88,89] Rapid point-of-care milk analyzers that measure the macronutrient content of milk to facilitate individualized fortification strategies are emerging and have become available for clinical use.[90]

HUMAN MILK SAFETY

Milk Preparation and Storage

NICUs should optimally have institutional protocols and parent education addressing breast pump and pump kit cleaning as well as milk storage, handling, and transportation practices.[48,91,92] Guidelines for milk storage are provided in Table 4.[92–96] Fresh milk feedings maximize bioactive properties that are decreased with freezing.[97–99] Errors in administration of milk (feeding milk to an infant from an unrelated mother) are well-documented, and NICUs are best served by clear site-specific protocols for decreasing the risk of such errors. Two-provider verification as well as the use of systems similar to electronic medication administration bar coding are possible practices for preventing milk misadministration.[100,101] The Centers for Disease Control and Prevention provides guidance for instances when milk

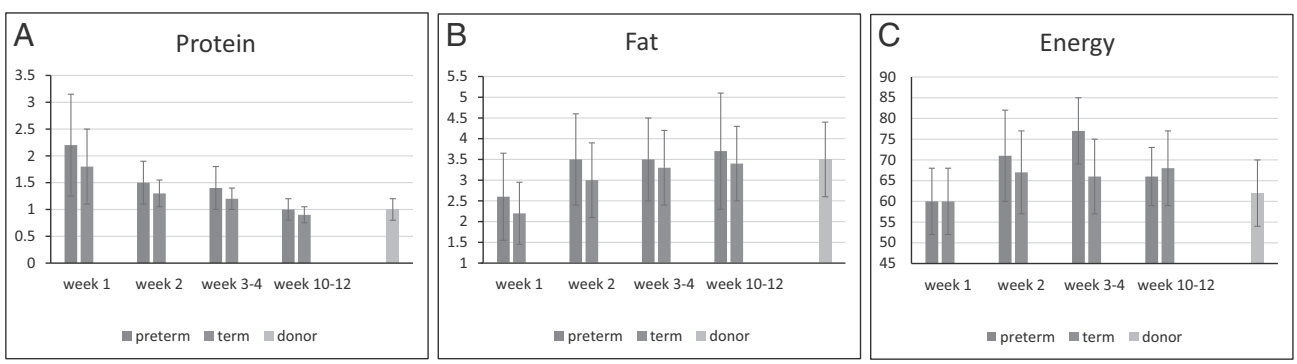


FIGURE 2 Comparison of macronutrient content of preterm, term, and pasteurized donor milk. Error bars indicated 1 SD. A, Protein content (g per 100 mL). B, Fat (g per 100 mL). C, Energy content (kcal per 100 mL). Preterm and term milk results modified from Gidrewicz et al.[75] Donor milk results modified from the mature donor milk category (milk from mothers obtained 4 to 52 weeks after birth) from John et al.[76]

misadministration has occurred (https://www.cdc.gov/breastfeeding/recommendations/other_mothers_milk.htm).[102] Temperature-controlled milk warmers can be used to facilitate safe warming practices.[48]

Informal Milk Sharing

Informal milk sharing is the noncommercial sharing of human milk between mothers for the purpose of infant feeding. This practice is increasing in the United States.[103] Health care providers may choose to discourage families from direct milk sharing and the purchase of human milk from Internet-based sources. Both practices are associated with risks of bacterial or viral contamination of nonpasteurized milk and the possibility of exposure to medications and other substances.[10,104] Informal milk sharing may involve suboptimal milk handling and storage practices that may increase the likelihood of bacterial contamination.[103] Despite counseling, some mothers of VLBW infants will continue to plan on informal milk sharing; mothers are encouraged to discuss this openly with the infant's care team. Some institutions require parents to sign informed consent for hospital use of informally shared milk to document knowledge of the associated risks.

Contraindications

Contraindications to breastfeeding are described in detail in previous American Academy of Pediatrics publications related to breastfeeding.[104–107] Providers may use LactMed, a Web-based information source published by the National Library of Medicine and National Institutes of Health,[108] or other valid published sources of guidance in counseling mothers in provision of mother's own milk when receiving medications. Generally, studies examining effects of maternal medications in mother's own milk have not been performed among VLBW infants; thus, providers must weigh the risks of exposure to maternal medications with the benefits of the mother's own milk in clinical decision-making.

Cytomegalovirus

Cytomegalovirus (CMV) is a ubiquitous double-stranded DNA virus with which 60% to 70% of American women are infected before pregnancy.[109] Most CMV immunoglobulin G–positive women shed the virus in breast milk during lactation. Mother's own milk is the primary source of CMV transmission among term newborn infants, and nearly all term infants who acquire CMV during breastfeeding are infected without signs of illness.[110] In contrast, postnatally acquired cytomegalovirus (pCMV) infection in preterm infants can be associated with a sepsis-like illness, increased morbidity, and, rarely, mortality.[111–113] Manifestations of pCMV infection can include apnea, pneumonitis, leukopenia, thrombocytopenia, hepatitis, cholestasis, and colitis.[114] Health care providers caring for VLBW infants fed mother's own milk and presenting with signs suggestive of late-onset sepsis may consider CMV testing as well as evaluation for bacterial infection. The freeze-thawing cycle has been shown to reduce, but not eliminate, the viral load of CMV in mother's own milk[115] and is associated with loss of bioactive components.[97–99] A recent meta-analysis estimated that rates of postnatally acquired CMV infection from consumption of mother's own milk was 19% (11% to 32%) for asymptomatic CMV infection and 4% (2% to 7%) for CMV sepsis-like syndrome.[112] Although the overall rate of acquiring pCMV is decreased among infants fed frozen mother's own milk (13% [7% to 24%]), freezing is not associated with a decreased risk of CMV sepsis-like syndrome (5% [2% to 12%]), suggesting that minimal viral exposure is required to infect the extremely low birth weight infants at the highest risk for symptomatic pCMV sepsis-like syndrome.[112] Two studies have found higher rates of bronchopulmonary dysplasia among VLBW infants with pCMV infection.[114,116] The long-term neurodevelopmental effect of breast milk–acquired pCMV among VLBW infants is unclear, with some studies finding no effect on neurodevelopment and several others attributing varying degrees of cognitive delay to pCMV infection.[117–124] Additional studies are needed to determine the relative impact of breast milk–acquired pCMV infection, given the many

TABLE 4 Maximum Human Milk NICU Storage Recommendations

Environment	Temperature	Freshly Expressed Mother's Milk	Frozen Mother's Milk	Frozen Pasteurized Donor Milk
Room temperature	60° 85°F or 16° 29°C	4 h	4 h[a]	4 h[a]
Refrigerator	39°F or 4°C	96 h	48 h[a,b]	48 h[a]
Freezer (2 door refrigerator and freezer)	0°F or −18°C	9 mo	9 mo	6 8 mo[c]
Deep freezer	0°F or −18°C	12 mo	12 mo	6 12 mo[c]
Laboratory freezer	−94°F or −70°C	12 mo	12 mo	6 12 mo[c]

[a] After thawing.
[b] Per expert opinion.
[c] Varies by milk bank; check expiration date.

benefits of mother's own milk among VLBW infants, particularly for decreasing the risk of NEC. At the current time, evidence is insufficient to support withholding mother's own milk because of the risk of pCMV.

Discharge Planning

Postdischarge plans must be individualized to consider the mother's goals for breastfeeding, bottle-feeding with expressed milk, and/or formula as well as the infant's growth status and anticipated need for postdischarge milk fortification. It is optimal for health insurers to provide coverage for lactation support to mothers who continue to provide breast milk after the VLBW infant is discharged from the hospital. More than one-half of VLBW infants have extrauterine growth failure (weight for gestational age: less than 10th percentile) at discharge.[68] Postdischarge fortification may be considered among these infants. However, current evidence supporting the use of postdischarge fortification among VLBW infants fed mother's own milk is limited. In one small RCT ($n = 39$), researchers examined fortification of half of mother's own milk feedings for 12 weeks versus no fortification and found improved growth outcomes and bone mineral content in the fortification group,[125] and another larger Danish RCT found no growth benefit among very preterm infants who received less fortification (1 fortified mother's own milk feeding per day) versus no fortification.[126] Neither study showed differences in neurodevelopment. The duration and dose of postdischarge fortification to optimize postdischarge growth and neurodevelopment among former VLBW infants fed human milk requires further study. When developing postdischarge feeding plans, the NICU team should optimally balance the need for fortification (on the basis of existing evidence and the individual infant's nutritional and growth status) with the mother's breastfeeding goals. The logistic challenges of expressing and fortifying milk in the home environment should also be considered. It is helpful to communicate postdischarge lactation and nutrition plans to the infant's outpatient pediatric providers.

Summary

Mother's own milk is the normative standard for VLBW infant nutrition and is associated with multiple health benefits. Neonatal staff and health care providers caring for VLBW infants and their mothers play a critical role in advocating and supporting mothers in NICU lactation.

Key Points

1. Human milk is the optimal nutrition for VLBW infants and decreases the risk of significant complications of prematurity, most notably, NEC. Pasteurized donor milk feeding is recommended when mother's own milk is not available, is insufficient, or is contraindicated.
2. Culturally appropriate information on lactation and the health benefits of human milk should be provided to families of VLBW infants.
3. NICU care for VLBW infants includes determination and support of maternal lactation goals. Lactation consultation with expertise in the needs of preterm infants is an integral part of VLBW NICU care.
4. Racial and ethnic disparities in the provision of mother's own milk and pasteurized donor milk for VLBW infants exist and may be best addressed with center-specific efforts to identify and mitigate local disparities.
5. Effective and efficient double electric breast pumps for mothers of VLBW infants will maximally support mothers in milk expression at the hospital and at home.
6. Because of the need for early and frequent milk expression to maintain milk supply, technical assistance in early milk expression should be available to mothers within 6 to 8 hours of birth of any VLBW infant.
7. Mothers should be encouraged to express their milk as often as needed to maintain a milk supply for their infant(s), ideally every 3 to 4 hours.
8. Written protocols and maternal education addressing milk collection, storage, and transport will optimize infant feeding safety.
9. Centers may encourage and support families in SSC, nonnutritive suckling, and direct breastfeeding, when appropriate to the infant's medical condition.
10. Human milk frequently requires fortification to meet the nutritional needs of VLBW infants. Centers may provide mothers with information on the rationale for and the content of HMFs.
11. CMV infection can be acquired through mother's own milk feeding. Current evidence is insufficient to support withholding mother's own milk solely on the basis of this risk.
12. NICU discharge planning optimally includes defined feeding plans that consider and address the mother's breastfeeding goals in conjunction with the infant's need for milk fortification.

Lead Authors

Margaret G. Parker, MD, MPH, FAAP
Lisa M. Stellwagen, MD, FAAP
Lawrence Noble, MD, FAAP
Jae H. Kim, MD, PhD, FAAP
Brenda B. Poindexter, MD, FAAP
Karen M. Puopolo, MD, PhD

ABBREVIATIONS

CMV: cytomegalovirus
HMF: human milk fortifier
NEC: necrotizing enterocolitis
pCMV: postnatally acquired cytomegalovirus
RCT: randomized control trial
SSC: skin-to-skin contact
VLBW: very low birth weight

DOI: https://doi.org/10.1542/peds.2021-054272

Address correspondence to: Margaret G. Parker, MD, MPH. Email: margaret.parker@bmc.org

PEDIATRICS (ISSN Numbers: Print, 0031-4005; Online, 1098-4275).

FINANCIAL DISCLOSURE: The authors have indicated they have no financial relationships relevant to this article to disclose.

FUNDING: No external funding.

POTENTIAL CONFLICT OF INTEREST: The authors have indicated they have no potential conflicts of interest to disclose.

REFERENCES

1. Parker MG, Greenberg LT, Edwards EM, Ehret D, Belfort MB, Horbar JD. National trends in the provision of human milk at hospital discharge among very low-birth-weight infants. *JAMA Pediatr.* 2019;173(10): 961 968
2. Parker MG, Burnham LA, Melvin P, et al. Addressing disparities in mother's milk for VLBW infants through statewide quality improvement. *Pediatrics.* 2019;144(1):e20183809
3. Lee HC, Kurtin PS, Wight NE, et al. A quality improvement project to increase breast milk use in very low birth weight infants. *Pediatrics.* 2012;130(6):e1679 e1687
4. Bixby C, Baker-Fox C, Deming C, Dhar V, Steele C. A multidisciplinary quality improvement approach increases breastmilk availability at discharge from the neonatal intensive care unit for the very-low-birth weight infant. *Breastfeed Med.* 2016;11(2):75 79
5. Meier PP, Patel AL, Bigger HR, Rossman B, Engstrom JL. Supporting breastfeeding in the neonatal intensive care unit: Rush Mother's Milk Club as a case study of evidence-based care. *Pediatr Clin North Am.* 2013;60(1): 209 226
6. Spatz DL, Froh EB, Schwarz J, et al. Pump early, pump often: a continuous quality improvement project. *J Perinat Educ.* 2015;24(3):160 170
7. Alshaikh B, Kostecky L, Blachly N, Yee W. Effect of a quality improvement project to use exclusive mother's own milk on rate of necrotizing enterocolitis in preterm infants. *Breastfeed Med.* 2015;10(7):355 361
8. Ballard O, Morrow AL. Human milk composition: nutrients and bioactive factors. *Pediatr Clin North Am.* 2013; 60(1):49 74
9. Gomez-Gallego C, Garcia-Mantrana I, Salminen S, Collado MC. The human milk microbiome and factors influencing its composition and activity. *Semin Fetal Neonatal Med.* 2016;21(6):400 405
10. Committee on Nutrition; Section on Breastfeeding; Committee on Fetus

and Newborn. Donor human milk for the high-risk infant: preparation, safety, and usage options in the United States. *Pediatrics.* 2017;139(1): e20163440

11. Perrin MT, Belfort MB, Hagadorn JI, et al. The nutritional composition and energy content of donor human milk: a systematic review. *Adv Nutr.* 2020; 11(4):960–970
12. Quigley M, Embleton ND, McGuire W. Formula versus donor breast milk for feeding preterm or low birth weight infants. *Cochrane Database Syst Rev.* 2019;(7):CD002971
13. Hair AB, Peluso AM, Hawthorne KM, et al. Beyond necrotizing enterocolitis prevention: improving outcomes with an exclusive human milk-based diet. *Breastfeed Med.* 2016;11(2):70–74
14. Cristofalo EA, Schanler RJ, Blanco CL, et al. Randomized trial of exclusive human milk versus preterm formula diets in extremely premature infants. *J Pediatr.* 2013;163(6):1592–1595.e1
15. Sullivan S, Schanler RJ, Kim JH, et al. An exclusively human milk-based diet is associated with a lower rate of necrotizing enterocolitis than a diet of human milk and bovine milk-based products. *J Pediatr.* 2010;156(4): 562–567.e1
16. Assad M, Elliott MJ, Abraham JH. Decreased cost and improved feeding tolerance in VLBW infants fed an exclusive human milk diet. *J Perinatol.* 2016;36(3):216–220
17. O'Connor DL, Kiss A, Tomlinson C, et al; OptiMoM Feeding Group. Nutrient enrichment of human milk with human and bovine milk-based fortifiers for infants born weighing <1250 g: a randomized clinical trial. *Am J Clin Nutr.* 2018;108(1):108–116
18. Colaizy TT, Saftlas AF, Morriss FH Jr. Maternal intention to breast-feed and breast-feeding outcomes in term and preterm infants: Pregnancy Risk Assessment Monitoring System (PRAMS), 2000-2003. *Public Health Nutr.* 2012;15(4):702–710
19. Hoban R, Bigger H, Patel AL, Rossman B, Fogg LF, Meier P. Goals for human milk feeding in mothers of very low birth weight infants: how do goals change and are they achieved during the NICU hospitalization? *Breastfeed Med.* 2015;10(6):305–311
20. Henderson JJ, Hartmann PE, Newnham JP, Simmer K. Effect of preterm birth and antenatal corticosteroid treatment on lactogenesis II in women. *Pediatrics.* 2008;121(1):e92–e100
21. Chapman DJ, Pérez-Escamilla R. Identification of risk factors for delayed onset of lactation. *J Am Diet Assoc.* 1999;99(4):450–454
22. Matias SL, Dewey KG, Quesenberry CP Jr, Gunderson EP. Maternal prepregnancy obesity and insulin treatment during pregnancy are independently associated with delayed lactogenesis in women with recent gestational diabetes mellitus. *Am J Clin Nutr.* 2014; 99(1):115–121
23. Parker MG, Lopera AM, Kalluri NS, Kistin CJ. "I felt like I was a part of trying to keep my baby alive": perspectives of Hispanic and non-Hispanic black mothers in providing milk for their very preterm infants. *Breastfeed Med.* 2018;13(10):657–665
24. Sisk P, Quandt S, Parson N, Tucker J. Breast milk expression and maintenance in mothers of very low birth weight infants: supports and barriers. *J Hum Lact.* 2010;26(4):368–375
25. Gharib S, Fletcher M, Tucker R, Vohr B, Lechner BE. Effect of dedicated lactation support services on breastfeeding outcomes in extremely-low-birth-weight neonates. *J Hum Lact.* 2018;34(4):728–736
26. Hallowell SG, Spatz DL, Hanlon AL, Rogowski JA, Lake ET. Characteristics of the NICU work environment associated with breastfeeding support. *Adv Neonatal Care.* 2014;14(4):290–300
27. Sisk PM, Lovelady CA, Dillard RG, Gruber KJ. Lactation counseling for mothers of very low birth weight infants: effect on maternal anxiety and infant intake of human milk. *Pediatrics.* 2006;117(1). Available at: www.pediatrics.org/cgi/content/full/117/1/e67
28. Meier PP, Engstrom JL, Mingolelli SS, Miracle DJ, Kiesling S. The Rush Mothers' Milk Club: breastfeeding interventions for mothers with very-low-birth-weight infants. *J Obstet Gynecol Neonatal Nurs.* 2004;33(2):164–174
29. Miracle DJ, Meier PP, Bennett PA. Mothers' decisions to change from formula to mothers' milk for very-low-birth-weight infants. *J Obstet Gynecol Neonatal Nurs.* 2004;33(6):692–703
30. Briere C-E, McGrath J, Cong X, Cusson R. An integrative review of factors that influence breastfeeding duration for premature infants after NICU hospitalization. *J Obstet Gynecol Neonatal Nurs.* 2014;43(3):272–281
31. Bernaix LW, Schmidt CA, Arrizola M, Iovinelli D, Medina-Poelinez C. Success of a lactation education program on NICU nurses' knowledge and attitudes. *J Obstet Gynecol Neonatal Nurs.* 2008; 37(4):436–445
32. Kilpatrick SJ, Papile L, Macones GA, Watterberg KL, eds. *Guidelines for Perinatal Care.* 8th ed. Itasca, IL: American Academy of Pediatrics, Committee on Fetus and Newborn, and Washington, DC: American College of Obstetricians and Gynecologists; 2017
33. O'Brien K, Lui K, Tarnow-Mordi W, Lee SK. Breastfeeding data in the Family Integrated Care trial. *Lancet Child Adolesc Health.* 2018;2(4):e5
34. O'Brien K, Robson K, Bracht M, et al; FICare Study Group and FICare Parent Advisory Board. Effectiveness of family integrated care in neonatal intensive care units on infant and parent outcomes: a multicentre, multinational, cluster-randomised controlled trial. *Lancet Child Adolesc Health.* 2018;2(4): 245–254
35. Parker LA, Sullivan S, Kruger C, Mueller M. Timing of milk expression following delivery in mothers delivering preterm very low birth weight infants: a randomized trial. *J Perinatol.* 2020;40(8): 1236–1245
36. Ohyama M, Watabe H, Hayasaka Y. Manual expression and electric breast pumping in the first 48 h after delivery. *Pediatr Int.* 2010;52(1):39–43
37. Lussier MM, Brownell EA, Proulx TA, et al. Daily breastmilk volume in mothers of very low birth weight neonates: a repeated-measures randomized trial of hand expression versus electric breast pump expression. *Breastfeed Med.* 2015;10(6):312–317
38. Furman L, Minich N, Hack M. Correlates of lactation in mothers of very

low birth weight infants. *Pediatrics.* 2002;109(4):e57

39. Morton J, Hall JY, Wong RJ, Thairu L, Benitz WE, Rhine WD. Combining hand techniques with electric pumping increases milk production in mothers of preterm infants. *J Perinatol.* 2009; 29(11):757 764
40. Hill PD, Aldag JC, Chatterton RT. Initiation and frequency of pumping and milk production in mothers of nonnursing preterm infants. *J Hum Lact.* 2001;17(1):9 13
41. deCarvalho M, Anderson DM, Giangreco A, Pittard WB III. Frequency of milk expression and milk production by mothers of nonnursing premature neonates. *Am J Dis Child.* 1985;139(5): 483 485
42. Hoban R, Bigger H, Schoeny M, Engstrom J, Meier P, Patel AL. Milk volume at 2 weeks predicts mother's own milk feeding at neonatal intensive care unit discharge for very low birthweight infants. *Breastfeed Med.* 2018;13(2): 135 141
43. Patel AL, Schoeny ME, Hoban R, et al. Mediators of racial and ethnic disparity in mother's own milk feeding in very low birth weight infants. *Pediatr Res.* 2019;85(5):662 670
44. Hill PD, Aldag JC, Chatterton RT, Zinaman M. Primary and secondary mediators' influence on milk output in lactating mothers of preterm and term infants. *J Hum Lact.* 2005;21(2): 138 150
45. Meier PP, Engstrom JL, Hurst NM, et al. A comparison of the efficiency, efficacy, comfort, and convenience of two hospital-grade electric breast pumps for mothers of very low birthweight infants. *Breastfeed Med.* 2008;3(3): 141 150
46. Becker GE, Cooney F, Smith HA. Methods of milk expression for lactating women. *Cochrane Database Syst Rev.* 2011;(12):CD006170
47. Acuña-Muga J, Ureta-Velasco N, de la Cruz-Bértolo J, et al. Volume of milk obtained in relation to location and circumstances of expression in mothers of very low birth weight infants. *J Hum Lact.* 2014;30(1):41 46
48. Steele C, Collins E, eds; Pediatric Nutrition Dietetic Practice Group. *Infant and Pediatric Feedings: Guidelines for Preparation of Human Milk and Formula in Health Care Facilities.* 3rd ed. Chicago, IL: Academy of Nutrition and Dietetics; 2018
49. Sharma D, Farahbakhsh N, Sharma S, Sharma P, Sharma A. Role of kangaroo mother care in growth and breast feeding rates in very low birth weight (VLBW) neonates: a systematic review. *J Matern Fetal Neonatal Med.* 2019; 32(1):129 142
50. Boundy EO, Dastjerdi R, Spiegelman D, et al. Kangaroo mother care and neonatal outcomes: a meta-analysis. *Pediatrics.* 2016;137(1):e20152238
51. Hendricks-Muñoz KD, Xu J, Parikh HI, et al. Skin-to-skin care and the development of the preterm infant oral microbiome. *Am J Perinatol.* 2015; 32(13):1205 1216
52. Baley J; COMMITTEE ON FETUS AND NEWBORN. Skin-to-skin care for term and preterm infants in the neonatal ICU. *Pediatrics.* 2015;136(3):596 599
53. Nasuf AWA, Ojha S, Dorling J. Oropharyngeal colostrum in preventing mortality and morbidity in preterm infants. *Cochrane Database Syst Rev.* 2018; (9):CD011921
54. Briere CE, McGrath JM, Cong X, Brownell E, Cusson R. Direct-breastfeeding in the neonatal intensive care unit and breastfeeding duration for premature infants. *Appl Nurs Res.* 2016;32:47 51
55. Casavant SG, McGrath JM, Burke G, Briere C-E. Caregiving factors affecting breastfeeding duration within a neonatal intensive care unit. *Adv Neonatal Care.* 2015;15(6):421 428
56. Pineda R. Direct breast-feeding in the neonatal intensive care unit: is it important? *J Perinatol.* 2011;31(8): 540 545
57. Pinchevski-Kadir S, Shust-Barequet S, Zajicek M, et al. Direct feeding at the breast is associated with breast milk feeding duration among preterm infants. *Nutrients.* 2017;9(11):1202
58. Maastrup R, Hansen BM, Kronborg H, et al. Breastfeeding progression in preterm infants is influenced by factors in infants, mothers and clinical practice: the results of a national cohort study with high breastfeeding initiation rates. *PLoS One.* 2014;9(9): e108208
59. Pineda RG. Predictors of breastfeeding and breastmilk feeding among very low birth weight infants. *Breastfeed Med.* 2011;6(1):15 19
60. Meier PP, Engstrom JL, Fleming BA, Streeter PL, Lawrence PB. Estimating milk intake of hospitalized preterm infants who breastfeed. *J Hum Lact.* 1996;12(1):21 26
61. Rankin MW, Jimenez EY, Caraco M, Collinson M, Lostetter L, DuPont TL. Validation of test weighing protocol to estimate enteral feeding volumes in preterm infants. *J Pediatr.* 2016;178: 108 112
62. Lee HC, Martin-Anderson S, Lyndon A, Dudley RA. Perspectives on promoting breastmilk feedings for premature infants during a quality improvement project. *Breastfeed Med.* 2013;8(2): 176 180
63. Boundy EO, Perrine CG, Nelson JM, Hamner HC. Disparities in hospital-reported breast milk use in neonatal intensive care units - United States, 2015. *MMWR Morb Mortal Wkly Rep.* 2017;66(48):1313 1317
64. Patel AL, Johnson TJ, Meier PP. Racial and socioeconomic disparities in breast milk feedings in US neonatal intensive care units. *Pediatr Res.* 2021;89(2):344 352
65. Merewood A, Chamberlain LB, Cook JT, Philipp BL, Malone K, Bauchner H. The effect of peer counselors on breastfeeding rates in the neonatal intensive care unit: results of a randomized controlled trial. *Arch Pediatr Adolesc Med.* 2006;160(7):681 685
66. Meier PP, Engstrom JL, Rossman B. Breastfeeding peer counselors as direct lactation care providers in the neonatal intensive care unit. *J Hum Lact.* 2013;29(3):313 322
67. Chamberlain LB, McMahon M, Philipp BL, Merewood A. Breast pump access in the inner city: a hospital-based initiative to provide breast pumps for low-income women. *J Hum Lact.* 2006; 22(1):94 98
68. Horbar JD, Ehrenkranz RA, Badger GJ, et al. Weight growth velocity and postnatal growth failure in infants 501 to

1500 grams: 2000-2013. *Pediatrics*. 2015;136(1):e84 e92

69. Goldberg DL, Becker PJ, Brigham K, et al. Identifying malnutrition in preterm and neonatal populations: recommended indicators. *J Acad Nutr Diet*. 2018;118(9):1571 1582
70. Kleinman RE, Greer FR, eds; American Academy of Pediatrics Committee on Nutrition. *Pediatric Nutrition*. 8th ed. Itasca, IL: American Academy of Pediatrics; 2019
71. Brown JVE, Embleton ND, Harding JE, McGuire W. Multi-nutrient fortification of human milk for preterm infants. *Cochrane Database Syst Rev*. 2016;(5): CD000343
72. Sauer CW, Boutin MA, Kim JH. Wide variability in caloric density of expressed human milk can lead to major underestimation or overestimation of nutrient content. *J Hum Lact*. 2017;33(2):341 350
73. Zachariassen G, Fenger-Gron J, Hviid MV, Halken S. The content of macronutrients in milk from mothers of very preterm infants is highly variable. *Dan Med J*. 2013;60(6):A4631
74. Cooper AR, Barnett D, Gentles E, Cairns L, Simpson JH. Macronutrient content of donor human breast milk. *Arch Dis Child Fetal Neonatal Ed*. 2013;98(6): F539 F541
75. Gidrewicz DA, Fenton TR. A systematic review and meta-analysis of the nutrient content of preterm and term breast milk. *BMC Pediatr*. 2014;14:216
76. John A, Sun R, Maillart L, Schaefer A, Hamilton Spence E, Perrin MT. Macronutrient variability in human milk from donors to a milk bank: implications for feeding preterm infants. *PLoS One*. 2019;14(1):e0210610
77. Brownell EA, Matson AP, Smith KC, et al. Dose-response relationship between donor human milk, mother's own milk, preterm formula, and neonatal growth outcomes. *J Pediatr Gastroenterol Nutr*. 2018;67(1):90 96
78. Henderson TR, Fay TN, Hamosh M. Effect of pasteurization on long chain polyunsaturated fatty acid levels and enzyme activities of human milk. *J Pediatr*. 1998;132(5):876 878
79. Lima HK, Wagner-Gillespie M, Perrin MT, Fogleman AD. Bacteria and bioactivity in holder pasteurized and shelf-stable human milk products. *Curr Dev Nutr*. 2017;1(8):e001438
80. Liu T-T, Dang D, Lv X-M, Wang T-F, Du J-F, Wu H. Human milk fortifier with high versus standard protein content for promoting growth of preterm infants: a meta-analysis. *J Int Med Res*. 2015; 43(3):279 289
81. Miller J, Makrides M, Gibson RA, et al. Effect of increasing protein content of human milk fortifier on growth in preterm infants born at <31 wk gestation: a randomized controlled trial. *Am J Clin Nutr*. 2012;95(3):648 655
82. Kim JH, Chan G, Schanler R, et al. Growth and tolerance of preterm infants fed a new extensively hydrolyzed liquid human milk fortifier. *J Pediatr Gastroenterol Nutr*. 2015; 61(6):665 671
83. Baker RD. Infant formula safety. *Pediatrics*. 2002;110(4):833 835
84. Moya F, Sisk PM, Walsh KR, Berseth CL. A new liquid human milk fortifier and linear growth in preterm infants. *Pediatrics*. 2012;130(4) Available at: www.pediatrics.org/cgi/content/full/130/4/e928
85. Cordova EG, Soldateli B, Rosner B, et al. Growth and clinical outcomes of very low-birth weight infants receiving acidified vs nonacidified liquid human milk fortifiers [published online ahead of print August 25, 2020]. *Nutr Clin Pract*. doi: 10.1002/ncp.10569
86. Shah SD, Dereddy N, Jones TL, Dhanireddy R, Talati AJ. Early versus delayed human milk fortification in very low birth weight infants-a randomized controlled trial. *J Pediatr*. 2016;174:126 131.e1
87. Alizadeh Taheri P, Sajjadian N, Asgharyan Fargi M, Shariat M. Is early breast milk fortification more effective in preterm infants?: a clinical trial. *J Perinat Med*. 2017;45(8):953 957
88. Arslanoglu S, Moro GE, Ziegler EE. Adjustable fortification of human milk fed to preterm infants: does it make a difference? *J Perinatol*. 2006;26(10): 614 621
89. Kadõoğlu Şimşek G, Alyamaç Dizdar E, Arayõcõ S, et al. Comparison of the effect of three different fortification methods on growth of very low birth weight infants. *Breastfeed Med*. 2019; 14(1):63 68
90. Rochow N, Fusch G, Choi A, et al. Target fortification of breast milk with fat, protein, and carbohydrates for preterm infants. *J Pediatr*. 2013; 163(4):1001 1007
91. Centers for Disease Control and Prevention. Proper storage and preparation of breast milk. Available at: https://www.cdc.gov/breastfeeding/recommendations/handling_breastmilk.htm. Accessed April 7, 2021
92. Human Milk Banking Association of North America. *Best Practice for Expressing, Storing and Handling Human Milk in Hospitals, Homes, and Child Care Settings*. 4th ed. Fort Worth, TX: Human Milk Banking Association of North America; 2019
93. Schlotterer HR, Perrin MT. Effects of refrigerated and frozen storage on holder-pasteurized donor human milk: a systematic review. *Breastfeed Med*. 2018;13(7):465 472
94. Vickers AM, Starks-Solis S, Hill DR, Newburg DS. Pasteurized donor human milk maintains microbiological purity for 4 days at 4°C. *J Hum Lact*. 2015;31(3):401 405
95. Eglash A, Simon L; Academy of Breastfeeding Medicine. ABM clinical protocol #8: human milk storage information for home use for full-term infants, revised 2017. *Breastfeed Med*. 2017; 12(7):390 395
96. Ahrabi AF, Handa D, Codipilly CN, et al. Effects of extended freezer storage on the integrity of human milk. *J Pediatr*. 2016;177:140 143
97. Raoof NA, Adamkin DH, Radmacher PG, Telang S. Comparison of lactoferrin activity in fresh and stored human milk. *J Perinatol*. 2016;36(3):207 209
98. Lev HM, Ovental A, Mandel D, Mimouni FB, Marom R, Lubetzky R. Major losses of fat, carbohydrates and energy content of preterm human milk frozen at -80°C. *J Perinatol*. 2014;34(5):396 398
99. Miranda M, Muriach M, Almansa I, et al. Oxidative status of human milk and its variations during cold storage. *Biofactors*. 2004;20(3):129 137
100. Steele C, Bixby C. Centralized breastmilk handling and bar code scanning

improve safety and reduce breastmilk administration errors. *Breastfeed Med.* 2014;9(9):426–429

101. Oza-Frank R, Kachoria R, Dail J, Green J, Walls K, McClead RE Jr. A quality improvement project to decrease human milk errors in the NICU. *Pediatrics.* 2017;139(2):e20154451
102. Centers for Disease Control and Prevention. What to do if an infant or child is mistakenly fed another woman's expressed breast milk. Available at: https://www.cdc.gov/breastfeeding/recommendations/other_mothers_milk.htm. Accessed April 7, 2021
103. Reyes-Foster BM, Carter SK, Hinojosa MS. Human milk handling and storage practices among peer milk-sharing mothers. *J Hum Lact.* 2017;33(1):173–180
104. Meek YJ, Noble L; American Academy of Pediatrics Section on Breastfeeding. Policy statement: breastfeeding and the use of human milk. *Pediatrics.* 2021: in press
105. Ryan SA, Ammerman SD, O'Connor ME; Committee on Substance Use and Prevention; Section on Breastfeeding. Marijuana use during pregnancy and breastfeeding: implications for neonatal and childhood outcomes. *Pediatrics.* 2018;142(3):e20181889
106. Committee on Pediatric Aids. Infant feeding and transmission of human immunodeficiency virus in the United States. *Pediatrics.* 2013;131(2):391–396
107. Sachs HC; Committee on Drugs. The transfer of drugs and therapeutics into human breast milk: an update on selected topics. *Pediatrics.* 2013;132(3). Available at: www.pediatrics.org/cgi/content/full/132/3/e796
108. National Library of Medicine National Institutes of Health. Drugs and lactation database (LactMed). Available at: https://www.ncbi.nlm.nih.gov/books/NBK501922/. Accessed April 7, 2021
109. Staras SAS, Dollard SC, Radford KW, Flanders WD, Pass RF, Cannon MJ. Seroprevalence of cytomegalovirus infection in the United States, 1988-1994. *Clin Infect Dis.* 2006;43(9):1143–1151
110. Stagno S, Reynolds DW, Pass RF, Alford CA. Breast milk and the risk of cytomegalovirus infection. *N Engl J Med.* 1980;302(19):1073–1076
111. Capretti MG, Lanari M, Lazzarotto T, et al. Very low birth weight infants born to cytomegalovirus-seropositive mothers fed with their mother's milk: a prospective study. *J Pediatr.* 2009;154(6):842–848
112. Lanzieri TM, Dollard SC, Josephson CD, Schmid DS, Bialek SR. Breast milk-acquired cytomegalovirus infection and disease in VLBW and premature infants. *Pediatrics.* 2013;131(6). Available at: www.pediatrics.org/cgi/content/full/131/6/e1937
113. Hamele M, Flanagan R, Loomis CA, Stevens T, Fairchok MP. Severe morbidity and mortality with breast milk associated cytomegalovirus infection. *Pediatr Infect Dis J.* 2010;29(1):84–86
114. Mukhopadhyay S, Meyer SA, Permar SR, Puopolo KM. Symptomatic postnatal cytomegalovirus testing among very low-birth weight infants: indications and outcomes. *Am J Perinatol.* 2016;33(9):894–902
115. Hosseini M, Esmaili HA, Abdoli Oskouei S, et al. Evaluation of the freeze-thawing method in reducing viral load of cytomegalovirus in breast milk of mothers of preterm infants. *Breastfeed Med.* 2016;11:557–560
116. Kelly MS, Benjamin DK, Puopolo KM, et al. Postnatal cytomegalovirus infection and the risk for bronchopulmonary dysplasia. *JAMA Pediatr.* 2015;169(12):e153785
117. Jim WT, Shu CH, Chiu NC, et al. High cytomegalovirus load and prolonged virus excretion in breast milk increase risk for viral acquisition by very low birth weight infants. *Pediatr Infect Dis J.* 2009;28(10):891–894
118. Vollmer B, Seibold-Weiger K, Schmitz-Salue C, et al. Postnatally acquired cytomegalovirus infection via breast milk: effects on hearing and development in preterm infants. *Pediatr Infect Dis J.* 2004;23(4):322–327
119. Bevot A, Hamprecht K, Krägeloh-Mann I, Brosch S, Goelz R, Vollmer B. Long-term outcome in preterm children with human cytomegalovirus infection transmitted via breast milk. *Acta Paediatr.* 2012;101(4):e167–e172
120. Goelz R, Meisner C, Bevot A, Hamprecht K, Kraegeloh-Mann I, Poets CF. Long-term cognitive and neurological outcome of preterm infants with postnatally acquired CMV infection through breast milk. *Arch Dis Child Fetal Neonatal Ed.* 2013;98(5):F430–F433
121. Nijman J, Gunkel J, de Vries LS, et al. Reduced occipital fractional anisotropy on cerebral diffusion tensor imaging in preterm infants with postnatally acquired cytomegalovirus infection. *Neonatology.* 2013;104(2):143–150
122. Dorn M, Lidzba K, Bevot A, Goelz R, Hauser T-K, Wilke M. Long-term neurobiological consequences of early postnatal hCMV-infection in former preterms: a functional MRI study. *Hum Brain Mapp.* 2014;35(6):2594–2606
123. Brecht KF, Goelz R, Bevot A, Krägeloh-Mann I, Wilke M, Lidzba K. Postnatal human cytomegalovirus infection in preterm infants has long-term neuropsychological sequelae. *J Pediatr.* 2015;166(4):834–839.e1
124. Gunkel J, de Vries LS, Jongmans M, et al. Outcome of preterm infants with postnatal cytomegalovirus infection. *Pediatrics.* 2018;141(2):e20170635
125. O'Connor DL, Khan S, Weishuhn K, et al; Postdischarge Feeding Study Group. Growth and nutrient intakes of human milk-fed preterm infants provided with extra energy and nutrients after hospital discharge. *Pediatrics.* 2008;121(4):766–776
126. Zachariassen G, Faerk J, Grytter C, et al. Nutrient enrichment of mother's milk and growth of very preterm infants after hospital discharge. *Pediatrics.* 2011;127(4). Available at: www.pediatrics.org/cgi/content/full/127/4/e995
127. O'Connor DL, Jacobs J, Hall R, et al. Growth and development of premature infants fed predominantly human milk, predominantly premature infant formula, or a combination of human milk and premature formula. *J Pediatr Gastroenterol Nutr.* 2003;37(4):437–446
128. Furman L, Taylor G, Minich N, Hack M. The effect of maternal milk on neonatal morbidity of very low-birth-weight infants. *Arch Pediatr Adolesc Med.* 2003;157(1):66–71

129. Feldman R, Eidelman AI. Direct and indirect effects of breast milk on the neurobehavioral and cognitive development of premature infants. *Dev Psychobiol*. 2003;43(2):109 119

130. Vohr BR, Poindexter BB, Dusick AM, et al; NICHD Neonatal Research Network. Beneficial effects of breast milk in the neonatal intensive care unit on the developmental outcome of extremely low birth weight infants at 18 months of age. *Pediatrics*. 2006; 118(1). Available at: www.pediatrics.org/cgi/content/full/118/1/e115

131. Vohr BR, Poindexter BB, Dusick AM, et al; National Institute of Child Health and Human Development National Research Network. Persistent beneficial effects of breast milk ingested in the neonatal intensive care unit on outcomes of extremely low birth weight infants at 30 months of age. *Pediatrics*. 2007;120(4). Available at: www.pediatrics.org/cgi/content/full/120/4/e953

132. Meinzen-Derr J, Poindexter B, Wrage L, Morrow AL, Stoll B, Donovan EF. Role of human milk in extremely low birth weight infants' risk of necrotizing enterocolitis or death. *J Perinatol*. 2009;29(1):57 62

133. Colaizy TT, Carlson S, Saftlas AF, Morriss FH Jr. Growth in VLBW infants fed predominantly fortified maternal and donor human milk diets: a retrospective cohort study. *BMC Pediatr*. 2012; 12:124

134. Patel AL, Johnson TJ, Engstrom JL, et al. Impact of early human milk on sepsis and health-care costs in very low birth weight infants. *J Perinatol*. 2013;33(7):514 519

135. Belfort MB, Anderson PJ, Nowak VA, et al. Breast milk feeding, brain development, and neurocognitive outcomes: a 7-year longitudinal study in infants born at less than 30 weeks' gestation. *J Pediatr*. 2016;177:133 139.e1

136. Chowning R, Radmacher P, Lewis S, Serke L, Pettit N, Adamkin DH. A retrospective analysis of the effect of human milk on prevention of necrotizing enterocolitis and postnatal growth. *J Perinatol*. 2016;36(3):221 224

137. Jacobi-Polishook T, Collins CT, Sullivan TR, et al. Human milk intake in preterm infants and neurodevelopment at 18 months corrected age. *Pediatr Res*. 2016;80(4):486 492

138. Sisk PM, Lambeth TM, Rojas MA, et al. Necrotizing enterocolitis and growth in preterm infants fed predominantly maternal milk, pasteurized donor milk, or preterm formula: a retrospective study. *Am J Perinatol*. 2017;34(7):676 683

139. Madore LS, Bora S, Erdei C, Jumani T, Dengos AR, Sen S. Effects of donor breastmilk feeding on growth and early neurodevelopmental outcomes in preterm infants: an observational study. *Clin Ther*. 2017;39(6):1210 1220

140. Patra K, Hamilton M, Johnson TJ, et al. NICU human milk dose and 20-month neurodevelopmental outcome in very low birth weight infants. *Neonatology*. 2017;112(4):330 336

141. Belfort MB, Edwards EM, Greenberg LT, Parker MG, Ehret DY, Horbar JD. Diet, weight gain, and head growth in hospitalized US very preterm infants: a 10-year observational study. *Am J Clin Nutr*. 2019;109(5):1373 1379

142. Hoban R, Schoeny ME, Esquerra-Zwiers A, et al. Impact of donor milk on short- and long-term growth of very low birth weight infants. *Nutrients*. 2019; 11(2):241

143. Miller J, Tonkin E, Damarell RA, et al. A systematic review and meta-analysis of human milk feeding and morbidity in very low birth weight infants. *Nutrients*. 2018;10(6):707

144. Schanler RJ, Lau C, Hurst NM, Smith EO. Randomized trial of donor human milk versus preterm formula as substitutes for mothers' own milk in the feeding of extremely premature infants. *Pediatrics*. 2005;116(2):400 406

145. Corpeleijn WE, de Waard M, Christmann V, et al. Effect of donor milk on severe infections and mortality in very low-birth-weight infants: the Early Nutrition Study Randomized Clinical Trial. *JAMA Pediatr*. 2016;170(7):654 661

146. O'Connor DL, Gibbins S, Kiss A, et al; GTA DoMINO Feeding Group. Effect of supplemental donor human milk compared with preterm formula on neurodevelopment of very low-birth-weight infants at 18 months: a randomized clinical trial. *JAMA*. 2016;316(18):1897 1905

Promoting the Participation of Children and Adolescents With Disabilities in Sports, Recreation, and Physical Activity

• *Clinical Report*

CLINICAL REPORT Guidance for the Clinician in Rendering Pediatric Care

American Academy of Pediatrics
DEDICATED TO THE HEALTH OF ALL CHILDREN™

Promoting the Participation of Children and Adolescents With Disabilities in Sports, Recreation, and Physical Activity

Paul S. Carbone, MD, FAAP,[a] Peter J. Smith, MD, MA, FAAP,[b] Charron Lewis, MD, FAAP,[c] Claire LeBlanc, MD, FAAP,[d]
COUNCIL ON CHILDREN WITH DISABILITIES, COUNCIL ON SPORTS MEDICINE AND FITNESS

The benefits of physical activity are likely universal for all children, including children and adolescents with disabilities (CWD). The participation of CWD in physical activity, including adaptive or therapeutic sports and recreation, promotes inclusion, minimizes deconditioning, optimizes physical functioning, improves mental health as well as academic achievement, and enhances overall well-being. Despite these benefits, CWD face barriers to participation and have lower levels of fitness, reduced rates of participation, and a higher prevalence of overweight and obesity compared with typically developing peers. Pediatricians and caregivers may overestimate the risks or overlook the benefits of physical activity in CWD, which further limits participation. Preparticipation evaluations often include assessment of health status, functional capacity, individual activity preferences, availability of appropriate programs, and safety precautions. Given the complexity, the preparticipation evaluation for CWD may not occur in the context of a single office visit but rather over a period of time with input from the child's multidisciplinary team (physicians, coaches, physical education teachers, school nurses, adaptive recreation specialists, physical and occupational therapists, and others). Some CWD may desire to participate in organized sports to experience the challenge of competition, and others may prefer recreational activities for enjoyment. To reach the goal of inclusion in appropriate physical activities for all children with disabilities, child, family, financial, and societal barriers to participation need to be identified and addressed. Health care providers can facilitate participation by encouraging physical activity among CWD and their families during visits. Health care providers can create "physical activity prescriptions" for CWD on the basis of the child's preferred activities, functional status, need for adaptation of the activity and the recreational opportunities available in the community. This clinical report discusses the

abstract

[a]Department of Pediatrics, The University of Utah, Salt Lake City, Utah; [b]Section on Developmental and Behavioral Pediatrics, The University of Chicago, Chicago, Illinois; [c]Division of Developmental-Behavioral Pediatrics and Psychology, Rainbow Babies and Children's Hospital, Cleveland, Ohio; and [d]Department of Pediatrics, McGill University, Montreal, Quebec, Canada

All authors participated in conception, design, drafting, and critical revision of the clinical report and approved the final manuscript as submitted.

DOI: https://doi.org/10.1542/peds.2021-054664

To cite: Carbone PS, Smith PJ, Lewis C, et al.; AAP Council on Children With Disabilities, Council on Sports Medicine and Fitness Promoting the Participation of Children and Adolescents With Disabilities in Sports, Recreation, and Physical Activity. *Pediatrics*. 2021;148(6):e2021054664

importance of participation in sports, recreation, and physical activity for CWD and offers practical suggestions to health care providers.

GLOSSARY OF TERMS

- Children and youth with special health care needs (CYSHCN) are "children who have or are at increased risk for a chronic physical, developmental, behavioral or emotional condition and who also require health and related services of a type or amount beyond that required by children generally."[1] In the United States, 19% of children have a special health care need.[2] CYSHCN are a diverse group of children, ranging from children with chronic conditions, to those with medical complexity, to children with cognitive, behavioral, or emotional conditions. The term CYSHCN includes children with disabilities (CWD) and children with medical complexity, whom are described below and shown in Fig 1.
- CWD are defined under the Individuals with Disabilities Education Act (IDEA) as children with intellectual disabilities, hearing impairments (including deafness), speech or language impairments, visual impairments (including blindness), serious emotional disturbance, orthopedic impairments, autism spectrum disorder, traumatic brain injury, other health impairments, or specific learning disabilities and who, by reason thereof, need special education and related services.[3] Although not part of the IDEA definition, the World Health Organization International Classification of Functioning, Disability and Health (ICF) framework provides an important alternative framework for disability because of its emphasis on body function, pursuit of meaningful activities, and community participation as primary determinates of the health of individuals rather than emphasis on any particular diagnosis or deficit (Fig 2).[4]
- Children with medical complexity have multiple significant chronic health problems resulting in functional limitations, high health care service needs, and often the need for or use of medical technology.[5] An example of a child with medical complexity is one with a genetic syndrome with an associated congenital heart defect, difficulty swallowing, cerebral palsy, and a urologic condition. This child would typically require the care of a primary care physician; multiple pediatric medical subspecialists or pediatric surgical specialists, home nurses, and rehabilitative and habilitative therapists; community-based services; extensive pharmaceutical therapies; special attention to his or her nutritional needs and growth; and durable medical equipment to maintain health, maximize development, and promote function.
- Participation, defined by the ICF, is the nature and extent of a person's involvement in desired activities, such as recreation, leisure activities, and community life. The ICF also emphasizes the interconnection of contextual factors, environmental and personal, that can have profound influences on participation. For example, finding out what recreational activities are enjoyable and fun for CWD (personal factors) and supporting families (environmental factors) can foster increased community participation and bolster overall health.[6,7]
- Physical activity refers to any body movement produced by skeletal muscles that requires energy expenditure.[8]
- Exercise is planned, structured, and repetitive physical activity that aims to improve or maintain one or more component of physical fitness.[8] Exercise may be subdivided into aerobic (cardiovascular endurance), flexibility (increase muscle and joint range of motion), anaerobic (resistance training), and high-impact weight-bearing exercise (that promotes bone health).[8]

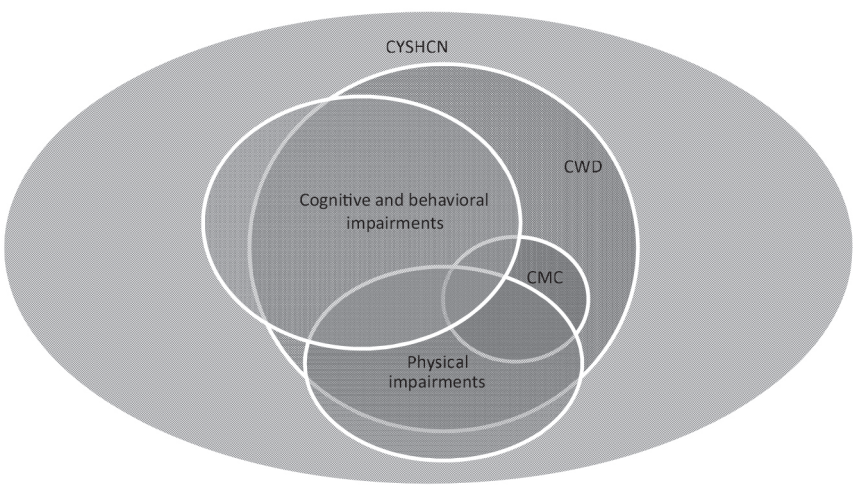


FIGURE 1 Diverse subgroups within CYSHCN. CMC, children with medical complexity.

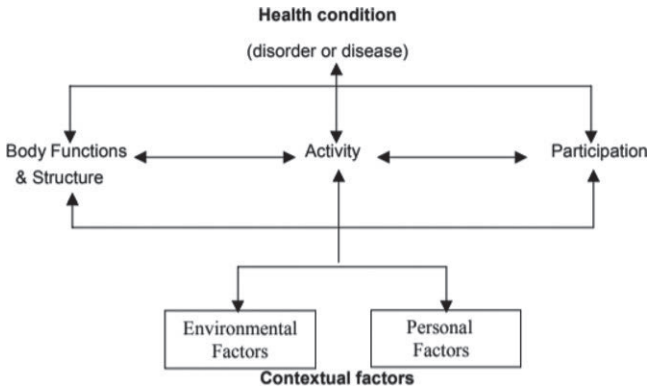


FIGURE 2 The World Health Organization International Classification of Functioning, Disability and Health. Reprinted with permission from World Health Organization. *Towards a Common Language for Functioning, Disability and Health.* Geneva, Switzerland: World Health Organization; 2002:9.

- PAVS, physical activity vital sign.
- AAI, atlantoaxial instability.

INTRODUCTION

International efforts to promote the well-being of CWD through participation in exercise, sports, recreation, and physical activities began with the first competitive sporting event for individuals with disabilities in 1948, followed by the first Paralympics competition in 1960. Special Olympics was established in 1968 and is now the largest recreational program for children and adults with intellectual disabilities, with 5.5 million athletes in 1930 countries.[9] Despite the success of these programs, opportunities for CWD to participate in physical activity, exercise, or competitive sports remain limited, and they are less likely to participate compared with their peers without disabilities.[10–12] In the absence of such opportunities and the encouragement to participate, many CWD engage in more sedentary and solitary activities, leading to a higher prevalence of overweight and obesity, lower levels of cardiorespiratory fitness, and increasing social isolation.[13–19] Taking part in physical activity through recreation and sport provides CWD the opportunity to achieve better physical and mental health, develop skills and competencies, express creativity, form friendships, and improve quality of life.[20–23] Thus, the American Academy of Pediatrics *Bright Futures: Guidelines for Health Supervision of Infants, Children, and Adolescents, Fourth Edition*, includes promotion of physical activity as a key health promotion theme and includes recommendations for health care providers to help CYSHCN and their families identify appropriate and enjoyable activities and implement adaptations based on need and ability.[24]

This clinical report discusses the importance of physical activity for CWD, reviews potential barriers to inclusion, and offers practical solutions for clinicians to facilitate participation. Of note, the terms CYSHCN, CWD, and children with medical complexity are overlapping (Fig 1). This clinical report focuses on the needs of CWD, but many of the comments and recommendations apply also to the larger group of CYSHCN. However, not all points or problems apply equally to the diverse subgroups of CWD. For example, some recommendations may apply more to children with physical impairments or children with cognitive or behavioral impairments. Furthermore, the subgroups within CWD are also overlapping and can shift over time, such as the case in which a child with primary motor impairments as a young child might be more impacted by cognitive or behavioral impairments as an adolescent (Fig 1). Regardless of the subgroup, CYSHCN and all children with different abilities are at risk for being "left out," which can adversely affect wellness, community integration, and full actualization of their individuality. Although it is hoped that children with and without disabilities engage in physical activity together, there will be times when CWD and their families opt for adaptive programs that are focused specifically on their needs. It must also be noted that there is a heterogeneity of adaptive recreation and sports programs, varying both by the type of primary impairment they are focused on and by the competitive levels of the programs. For example, Paralympians are high-performance competitive athletes who generally self-identify as primarily having physical or visual impairments, whereas Special Olympians are often individuals with intellectual and developmental disabilities who compete in many different sports at various competitive levels.[9,25] There are also sports programs for people with hearing impairments, with the most elite being the Deaflympics.[26] Although adaptive recreation programs have existed for more than 50 years, recently there has been accelerated growth in the number of programs, especially those with a primary purpose of fostering physical activity in a noncompetitive, fun environment. Whatever the activity or the level of competition, health care providers can engage in shared decision-making with CWD and their families with the goal of pursuing appropriate opportunities for physical activity.[27]

BENEFITS OF PARTICIPATION IN PHYSICAL ACTIVITIES

The benefits of physical activity are likely universal for all children, including those with disabilities. CWD are underrepresented in exercise intervention research, resulting in a limited understanding of how research involving children without disabilities can be translated into guidance for physical activity programs for CWD. The limited research conducted to date points to at least short-term benefits for CWD, such as improvements in aerobic capacity, muscular strength, physical and cognitive function, body weight and composition, social skills, relationships, and psychological well-being.[28–30] Although many studies of exercise interventions for children with physical disabilities have small sample sizes and lack randomization, they support safe participation and improvements in fitness and well-being.[31] Several studies rated from moderate- to high-quality show that children and youth with physical disabilities who participate in physical activity programs improve their locomotor performance and skills, object control, social skills, peer interactions, and self-confidence.[29] One randomized trial of an 8-month weight-bearing physical activity program for children with cerebral palsy showed improvements in bone mineral density.[32] In some CWD, exercise interventions may even be able to slow disease progression. For example, in 2 randomized trials of assisted bicycle and upper extremity training, functional motor deterioration slowed in boys with Duchenne muscular dystrophy.[33,34] Ambulatory children with spina bifida can also increase their walking speed and cardiorespiratory fitness with treadmill training programs.[35] Thus, *Bright Futures: Guidelines for Health Supervision of Infants, Children, and Adolescents, Fourth Edition*, includes recommendations for health care providers to help CYSHCN and their families identify appropriate and enjoyable physical activities and implement adaptations on the basis of their needs and abilities.

Physical activity also has benefits for children with primarily cognitive and behavioral disabilities. Children with autism spectrum disorder (hereafter referred to as autism), who are more likely to be diagnosed with overweight or obesity, have this risk attenuated with regular physical activity and sports participation.[36] Short periods of walking or running before educational sessions also help children with autism increase the proportion of correct academic responses and work tasks completed in school settings.[37,38] Other exercise interventions for children with autism, such as horseback riding, martial arts, swimming, yoga, or dance, can result in better social responsiveness and decreased irritability, stereotypical behavior, and hyperactivity.[39–43] Although stimulant medication is the mainstay in addressing core symptoms for children with attention-deficit/hyperactivity disorder, aerobic exercise offers a safe and widely beneficial adjunct in decreasing hyperactivity and improving attention and executive function.[44] Youth with intellectual disability who are overweight or obese benefit from participating in an integrative training program, with improved cardiorespiratory fitness, balance, muscle strength, and endurance as well as lower BMI.[45] Adolescents and adults with Down syndrome who receive individualized progressive resistance training over 10 weeks have increased muscular strength and become more physically active.[46]

Beyond the physiologic benefits, regular physical activity, recreation, and sports participation are associated with both psychosocial well-being and quality of life of CWD as well as with improving academic achievements.[21] For example, participants in Special Olympics show heightened self-esteem, perceived physical competence, and peer acceptance when compared with nonparticipants.[47] Physically active individuals with cerebral palsy experience higher quality of life and happiness compared with those who are less active.[20] Children with autism who have higher levels of participation in organized activities, including sports, have better social-emotional adjustment as well as reduced loneliness and depression.[48,49] Children with muscular dystrophies who participate in physical activities, such as swimming, benefit by cultivation of friendships, increased self-confidence, and enjoyment.[50] Children with hearing impairment who participated in a 3-month ice skating program were found by their parents to have improvements in self-esteem, behavior, and sleep quality.[51]

Despite the physical, behavioral, cognitive, and psychosocial benefits of physical activity for CWD, the incorporation of physical activity is often prioritized below other interventions in treatment planning.[49] Yet, as the above examples illustrate, inclusion of physical activity into treatment plans allows CWD real-world and enjoyable opportunities to work on motor, communication, and social skill goals identified in traditional therapies, such as physical, speech, and occupational therapy.

BARRIERS TO PARTICIPATION

Despite the potential benefits, CWD participate in sports, recreation, and physical activity less than children without disabilities, and they experience barriers to participation that go beyond the functional limitations associated with their disabilities (Table 1).[52–57] Without

TABLE 1 Benefits, Barriers, and Considerations for Participation in Sports by CWD

Benefits of participation
Improved wellness
Increased community integration
Improved muscle strength
Improved fundamental movement skills
Enhanced psychosocial well-being
Increased cardiorespiratory fitness
Decreased morbidity (ie, pressure ulcers, infections, overweight and obesity, etc)
Improved bone health
Improved motor coordination
Improved attention and focus
Decreased maladaptive behaviors
Barriers to participation
False belief: no programs for this population
False belief: participation is unsafe or too risky
False belief: rules of sports too hard to learn or cannot be adapted to accommodate CWD
Low physical literacy
Lack of transportation to and from activities
Lack of needed supervision or expertise
Extra cost and time commitment
Facilitators to participation
Preparticipation evaluations to maximize safety with appropriate accommodations
Organized sports that are focused on fun over competition
Clinicians, physical education teachers, and coaches who create physical activity prescriptions and recognize individual needs
Adaptations such as longer rest periods, lower coach to athlete ratios, copious positive feedback, and close monitoring for symptoms of fatigue or injury

Reproduced with permission from: American Academy of Pediatrics. Athletes with a disability. In: Bernhardt DT, Roberts WO, eds. *PPE: Preparticipation Physical Evaluation.* 5th ed. Itasca, IL: American Academy of Pediatrics; 2019:185

addressing barriers to physical activity, CWD often fill leisure time with sedentary screen-based activities.[18,58] Frequently identified barriers to participation of CWD in sports and physical activity are the child's functional limitations, negative self-perceptions, high cost, lack of accessible facilities, lack of nearby facilities or programs, and lack of providers with adaptive recreation expertise.[10,59–62] In addition, many individuals with disabilities are still, to a large extent, socially segregated and experience negative societal stereotypes and low performance expectations, providing them with limited opportunities for participation in group-based physical activities.[57,60,63] Some CWD may be discouraged to participate by an implicit societal bias that favors competitiveness and winning over participation for the sake of fun, enjoyment, and inclusion. When CWD do attempt to participate in sports, they are also more likely to be bullied by their peers[64,65]; this is especially true for CWD with obesity, who may experience additional weight-bias stigmatization. Primary care providers who have longitudinal and trusting relationships with CWD and their families can be positive role models and use nonjudgmental language and motivational interviewing to identify short-term goals and strategies related to eating and physical activity.[66] With negative experiences and lack of opportunities, support, or encouragement, some CWD may become disinterested or discouraged to participate. Older children and adolescents with disabilities may lose self-confidence to participate as skill gaps between them and their typically developing peers widen and sports become more competitive. Through required physical education services of a child's Individualized Education Program (IEP), schools can develop goals to address deficits in fundamental movement skills to foster physical literacy. However, most CWD take general physical education classes, and although physical education teachers may make accommodations for some, budget constraints and lack of training are cited as barriers to participation.[67,68] Pediatricians, other professionals, and parents may also overestimate the risk of injury during physical activity, although involvement in sports has been shown to be reasonably safe for CWD; one recent study found a lower risk of injury in CWD after controlling for personal and environmental factors.[60,69–71] Nevertheless, parents of CWD are justified in desiring high-quality, accessible, and safe adaptive recreation programs, yet they report marked variation in recreational activity availability, long waiting lists for adaptive programs, absence of suitable transport to these facilities, a reduced number of skilled instructors to run these programs, and poor advertisement of programs in the community.[60,61] Likewise, pediatricians may be unaware of adaptive recreation opportunities within the community or of the family's interest in pursuing these opportunities.[72]

Overall, misconceptions and attitudinal barriers at the level of the individual, family, and community need to be addressed to integrate children of all abilities into recreational and physical activities. Pediatricians can help families and children balance the benefits of participation with the potential risks, recognizing that historically, being "too safe" and assuming that CWD "can't do that," has been a persistent barrier to participation.

FACILITATORS TO PARTICIPATION

The combined efforts of well-informed health care providers, parents, educators, coaches, and others are needed to ensure and promote the participation of all children in sports, recreation, and physical activity (Table 1). Health care providers can facilitate

participation by asking about current levels of activity and using tools, such as a physical activity vital sign (PAVS) in the electronic health record, to start the conversation about physical activity during visits.[23] The PAVS consists of 2 screening questions that are used to assess how many days per week the individual engages in physical activity that is moderate (causes the child or youth to sweat a little and breathe harder, such as bike riding or playground activities) to vigorous (causes the child or youth to sweat and be out of breath, such as running or swimming) and how many minutes this level of physical activity is maintained. Use of the PAVS has been associated with a greater likelihood of physician exercise counseling and improved metabolic outcomes in adults.[73] Clinicians can then create "physical activity prescriptions" for CWD with goals for participation and referrals to specific programs or resources that are based on baseline physical activity, preferred activities, functional limitations that may require adaptation of the activity and preparticipatory planning, and the evidence base of the physical activity regarding risks and benefits.[23] Providers can explore the child and family's beliefs and attitudes about physical activity through motivational interviewing and arrive at a treatment plan through shared decision-making (Appendix 1).[27,74] Lastly, by their own commitment to physical activity, health care providers can serve as role models for CWD and their families. For example, pediatricians with self-reported higher levels of fitness are more likely to discuss physical activity during health supervision visits.[75]

To facilitate participation, providers can refer CWD to specialized adaptive programs staffed by recreational, physical, or occupational therapists that create a safe and fun recreational environment while allowing coordination with the primary care provider if medical concerns occur.[76] Specifically, health care providers and care coordinators within practices can partner with local adaptive recreational programs that address traditional barriers to participation (time, cost, transportation) and share this information with families. For example, many city and county parks and recreation departments offer low-cost adaptive recreation opportunities for CWD, and some adaptive recreational programs offer scholarships and provide transportation to and from activities. Therapists and coaches at specialized adaptive recreation programs facilitate participation for CWD by having lower participant to coach or instructor ratios (fewer than 4 participants for each coach), using positive feedback, and individualizing activities to the preferences of each participant.[77]

Lastly, providers can work with local and state public health agencies to promote physical activity to create and strengthen recreational programs for CWD. The Title V Maternal and Child Health Services Block Grant Program has a National Performance Measure on physical activity, with only 25% of CYSHCN with more complex health needs meeting the measure of being physically active at least 60 minutes per day.[78] At the federal level, the Centers for Disease Control and Prevention funds and supports 2 national centers on disability: Special Olympics and the National Center on Health, Physical Activity and Disability. These centers identify and expand physical activity programs, provide training for professionals, and provide data to establish best practices.[79]

Parents, caregivers, and peers are important facilitators of physical activity for CWD. Parents who believe in the benefits of physical activity report higher levels of activity in their CWD.[70] In one study, CWD whose parents were physically active at least 3 hours per week were 4.2 times as likely to be physically active compared with those whose parents were less active.[80] Therefore, an important message from pediatric health care providers to parents of CWD is to prioritize their own physical activity and to include CWD in family recreational activities.[81] Additionally, CWD are too often left behind regarding organized sports participation despite the clear benefit of participation for CWD. Parents can advocate for and support organized sports that encourage inclusion and focus on fun instead of winning, such as Special Olympics, because these are important influencers of sustained participation by CWD.[65] In addition, peer-mediated interventions to facilitate play skills and foster inclusion and acceptance of CWD by modeling behaviors can be an effective counterbalance to the barrier of systematic exclusion that has (in the past) resulted in opportunities for bullying behaviors.[82,83]

The American Heart Association has called for schools to play a central role in ensuring all students participate in enough physical activity to develop healthy lifestyles.[84] With only 24% of CWD engaging in 60 minutes of physical activity daily, schools can help a greater proportion reach this level of activity.[85] The Centers for Disease Control and Prevention recommends that a substantial percentage of students' overall physical activity should be obtained through school physical education. The right of CWD to participate in physical activity and sports in school is rooted in several federal laws. The

IDEA mandates free, appropriate public education in the least restrictive environment, and Section 504 of the Rehabilitation Act of 1973 requires that no individual shall be excluded because of disability in programs that receive federal funds.[86] Physical education is a federally mandated component of special education services, including the promotion of physical fitness, fundamental movement skills, and skills in individual and group games and sports.[67] However, many school districts allow exemption from physical education requirements for students with cognitive and other disabilities.[87] Physical education curricula for CWD can promote enjoyment of movement and skill development that can be incorporated before, during, and after school hours.[88] Pediatric providers and parents can partner with the educational team to include physical activity goals in progress metrics within a child's IEP to facilitate participation in physical activity at school.[86] Physical activity can be accurately measured for CWD through subjective and objective measures.[89] Adaptive physical education teachers can address physical activity goals by modifying recreational programs to accommodate the motor skills, muscle strength, and fitness of each child. Strategies physical education teachers use to accommodate CWD may include simplified instruction, additional skill modeling, peer teaching, equipment modification, and coordinating activities with a special education teacher.[68] Beyond physical education, the Comprehensive School Physical Activity Program developed by the Centers for Disease Control and Prevention and the Society of Health and Physical Educators, is a framework to capture all opportunities for school-based physical activity for CWD.[90] School nurses can coordinate with pediatricians in developing and implementing health care plans that promote safe participation in physical activity.[91] School-based physical activity programs, such as recess or physical education, that are focused on fun and enjoyment are strongly associated with daily physical activity in CWD.[88]

PREPARTICIPATION CONSIDERATIONS

It is important that all CWD participate in activity-related recreational programs while minimizing risks of illness or injury. Well-designed programs can target fundamental movement skills (throwing, catching, kicking, jumping, running, hopping, balance), flexibility, cardiorespiratory endurance, and muscular strength while maximizing enjoyment and safety. Rather than being excluded from sports participation, all children can be empowered to take part with a can-do attitude, enjoying the dignity of taking acceptable risk during participation just as individuals without disabilities are allowed to do. It is also important to involve parents and caregivers early and often in discussions of the importance of participation in sports, recreation, and physical activity for CWD.

A first step toward regular physical activity of all children, including CWD, is achieving physical literacy, which is the "the ability, confidence, and desire to be physically active for life."[92] For children with typical development, fundamental movement skills emerge in early childhood after the attainment of gross and fine motor milestones in infancy. Later in childhood, provided the child has opportunities to engage regularly in active play and physical activity throughout the day, additional competences are gained in coordination, balance, running, kicking, throwing, and catching.[23] The attainment of these fundamental movement skills influences physical literacy, is a strong predictor of future physical activity levels of children, and is linked to improvement in cardiovascular fitness scores and BMI.[93] Thus, CWD who have decreased gross motor function or other developmental delays may lack fundamental movement skills, may have low physical literacy, and are subsequently at risk for developing a low preference for physical activity during childhood and later in life.[23,94] Physical literacy assessments by health care providers are essential to allow early identification of any deficits.[95] Physical literacy assessments for all children begin in early childhood and encompass surveillance and screening for motor delay and exploring the child and family's knowledge, motivation, and feelings related to physical activity and movement.[23,96,97] Figure 3 provides an adaptation of the ICF framework for pediatricians to use in assessing physical literacy and promoting physical activity in CWD.[7] For CWD who have motor delays, referrals to exercise-related specialists (physical therapist, physical medicine and rehabilitation physician, recreation therapist, sports medicine physician) for structured programming may help to maximize the child's potential in developing fundamental movement skills, which in turn may foster confidence and desire to participate in sports and recreation.[98,99] Furthermore, young CWD can be given the same opportunities as other children to participate in free play and recess to develop fundamental movement skills and to foster the notion that physical activity is fun.[100,101] One such program to include students with autism with typically developing peers during recess activities led to improvements in peer engagement.[102]

How Much Physical Activity to Recommend?

All children, including CWD, are encouraged to strive to follow

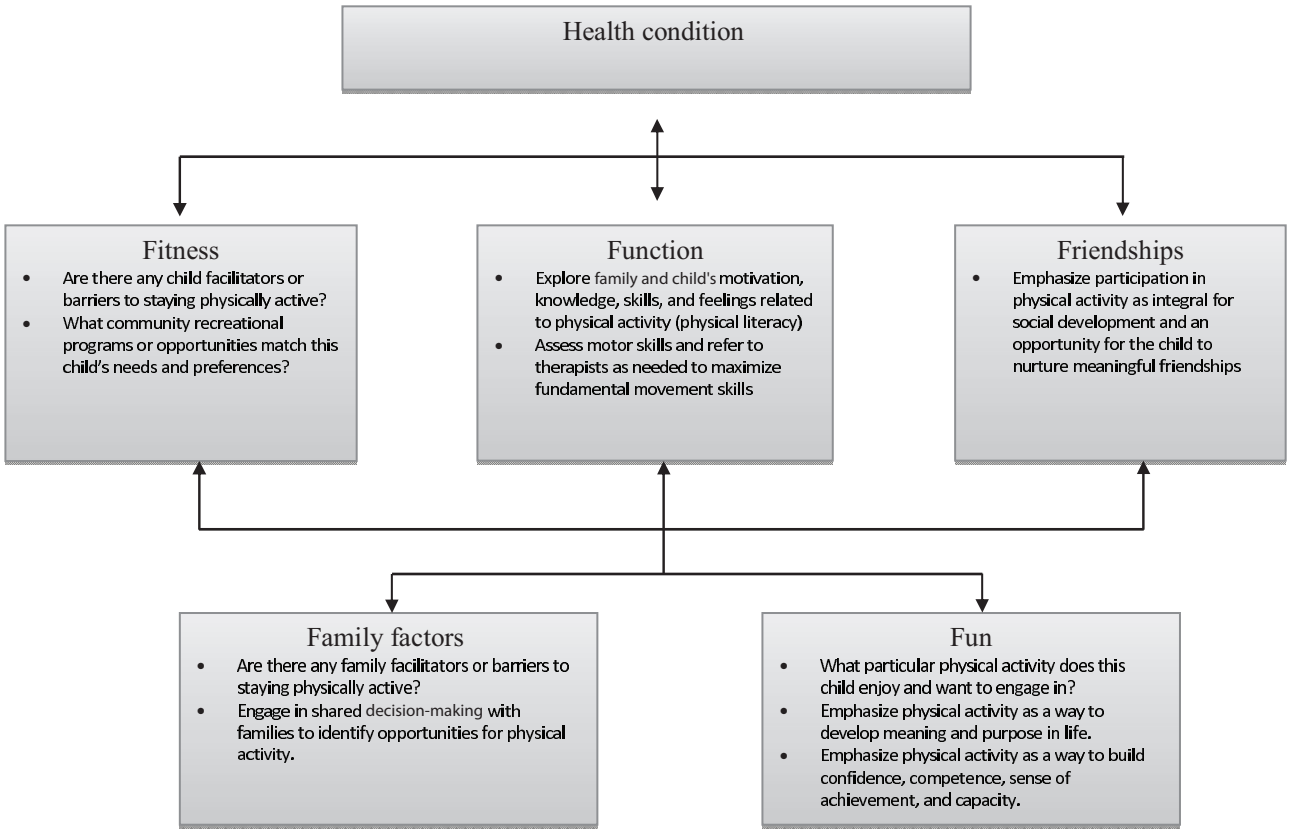


FIGURE 3 Adaptation of the International Classification of Function as a framework of assessing physical literacy and promoting participation of CWD in sports, recreation, and physical activity.[7] Adapted from World Health Organization. *Towards a Common Language for Functioning, Disability and Health*. Geneva, Switzerland: World Health Organization; 2002:9.

guidelines established by the 2018 Physical Activity Guidelines Advisory Committee, which recommends that children and adolescents (6–17 years) take part in at least 60 minutes of moderate to vigorous physical activity daily as well as in bone and muscle strengthening activities at least 3 days a week.[103] Parents of infants are encouraged to keep them active several times a day through interactive floor-based play, and parents of preschool-aged children (3–5 years) are encouraged to have their children accumulate at least 3 hours of light- to moderate-intensity activity throughout the day to develop movement skills.[23,104–106] For CWD, some modifications may be required to the frequency, intensity, and/or duration of physical activity. Goals need to be realistic, with an emphasis on encouraging children and families to do whatever they can through a gradual exploration of increases in time, intensity, and duration.[104] By asking CWD and their families about usual weekly duration and intensity of physical activity, health care providers can adapt physical activity guidelines to accommodate for neuromuscular deficits and cardiorespiratory profiles associated with specific conditions.

The Preparticipation Evaluation: Special Concerns for CWD

Families of CWD will sometimes schedule mandatory preparticipation physical evaluations or recommended health supervision visits. In either case, these visits allow opportunities for families and providers to discuss medical and psychosocial issues that are relevant for participation in physical activity. The concepts of self-determination and shared decision-making have emerged as important themes in the care of CWD.[27] Discussions with children and families may start with a query about the child's current level of physical activity and the importance the family and child place on being physically active. Families of CWD may experience high levels of day-to-day stress and may consider time for physical activity a lower priority. Using behavioral techniques, such as motivational interviewing, providers can explore the family's beliefs and develop achievable physical activity goals. Once the wishes of the child and family are known, conditions that may interfere with participation or predispose the child to injury can be collaboratively discussed between the child, family, provider, and other treatment team members.

The child's current health status and functional ability, demands of the sport (including level of competition), and whether the sport can be modified with protective or adaptive equipment to allow for safer participation are important considerations. Given the complexity, the preparticipation evaluation for CWD may not occur in the context of a single office visit but rather over a period of time with the assistance of care coordination from the primary care medical home to obtain input from the child's multidisciplinary team, which may include subspecialists such as physical medicine and rehabilitation or sports medicine physicians; school nurses, coaches, and physical education teachers; and recreation, physical, and occupational therapists. Ideally, members of the multidisciplinary team can periodically reassess CWD to update treatment plans, including recommendations about sport participation, adaptations, and any restrictions deemed necessary.

The goal of the preparticipation evaluation is to review the desired activities of the child and family and the current state of disability-specific and co-occurring conditions to provide an appropriate menu of activities and potential accommodations or precautions that may be needed. Tables 2 and 3 show elements of a preparticipation history and physical examination that can be used for CWD. For example, children with physical disabilities, such as cerebral palsy, may have decreased flexibility with joint contractures, muscle strength imbalances, and lack of motor control, coordination, and equilibrium, which may increase the risk of lower extremity overuse injuries, strains, and sprains. If a child with cerebral palsy wishes to play baseball and there are limitations in skills (catching, throwing, and using a bat), it may be advisable to consider ways to adapt the sport or the child's participation to prevent injury to the athlete or other participants.[107] Children with neurologic conditions who use wheelchairs for ambulation are at higher risk of upper extremity overuse injuries, peripheral nerve entrapment (eg, carpal tunnel syndrome), and pressure sores affecting the sacrum and ischial tuberosities.[108] The preparticipation evaluation presents an opportunity to screen for skin ulcerations and, when present, initiate appropriate treatment before sports participation.[109,110] Inspecting the adaptive or medical equipment used by CWD participating in sport so that braces are appropriately fitted and sports wheelchairs are in proper working order promotes optimum performance and injury prevention. Families can be encouraged to bring all equipment used during physical activity to the preparticipation visit so that these assessments can be conducted. If needed, referrals to exercise-related subspecialists (physical therapist, physical medicine and rehabilitation physician, recreation therapist, sports medicine physician) can be made for equipment adjustments or other equipment concerns.

The preparticipation evaluation also allows for the provision of anticipatory guidance that promotes safe participation for children with physical disabilities. For example, athletes with spinal cord pathology above the sixth thoracic level may develop autonomic dysreflexia, which is excessive and uncontrolled sympathetic nervous system output. This condition, which can be life-threatening, may be triggered by bladder infections, sunburns, and other stimuli or may be self-induced by an act such as occluding a bladder catheter in an attempt to improve sport performance (also known as "boosting"). Autonomic dysreflexia may present with symptoms and signs such as headache, high blood pressure, or bradycardia, and these symptoms prompt immediate removal of the precipitating factor and prompt medical care.[107] Children with spinal cord injuries and cerebral palsy are also at risk for abnormal thermoregulation and exertional heat illness resulting from impaired sweating and control of peripheral blood flow as well the use of certain medications (such as those with anticholinergic properties).[107,111] As is the current practice for most adaptive and therapeutic sports organizations, coaches can modify the activity as needed, provide frequent breaks of appropriate duration, have ready access to fluids, and use appropriate clothing and equipment, which can mitigate this risk.[107,111,112]

Children with developmental disabilities also benefit from preparticipation planning and anticipatory guidance. For example, children with autism may have apraxia and motor coordination deficits, increasing the risk for injuries.[113] This risk can be managed by adaptations to the activity or the equipment or with additional neuromotor training to develop kinesthetic awareness.[114] Children with intellectual disability may have lower muscle strength, balance, flexibility, and endurance and may benefit from exercise that is of lower intensity as well as preparatory conditioning, such as resistance training, to reduce the risk of injury.[108] Children with Down syndrome are at slight increased risk of symptomatic atlantoaxial instability (AAI). Neurologic manifestations of AAI with cervical cord myelopathy include significant neck pain, radicular pain, weakness, spasticity or change in tone, gait difficulties, hyperreflexia, and change in bowel or bladder function or other signs or symptoms of myelopathy. In the

TABLE 2 Elements of a History During Preparticipation Evaluation for CWD

History	Comments
Is there a history of seizures?	Children with uncontrolled seizures or implantable devises (eg, ventriculoperitoneal shunt, vagal nerve stimulator) may benefit from consultation with a neurologist or neurosurgeon, respectively, to assist with medical eligibility. Although there is no universal exclusion for participation in contact sports for children with epilepsy, some families may choose to avoid sports in which seizure activity would pose risk to self or others (eg, archery, riflery, weightlifting, and sports that involve heights). There are considerations related to prevention of drowning in children with epilepsy who swim.[118] In addition, some antiepilepsy drugs can impair normal sweating.
Is there a history or concern for hearing or vision loss?	Boxing and full-contact martial arts are not recommended for functionally one-eyed athletes.[119] Visually asymptomatic CWD are encouraged to have a vision screening based on the *Bright Futures* periodicity table. Those with ocular signs or symptoms are recommended to have a complete examination by a pediatric ophthalmologist.[120]
Is there a history or concern for cardiopulmonary disease?	Children with stage 2 hypertension are recommended to refrain from high-static sports (weightlifting, gymnastics). Children with congenital heart disease, structural heart disease, and dysrhythmias are encouraged to have consultation with a cardiologist.[119]
Is there history of symptomatic AAI?	Children with symptomatic AAI may report or demonstrate fatigue, gait abnormalities, neck pain, limited neck range of motion, changes in coordination, spasticity, hyperreflexia, clonus, or extensor-plantar reflex. Parents can be advised that participation in contact sports, such as football, soccer, and gymnastics, places children at risk for spinal cord injury.[115]
Is there a history of heat stroke or heat exhaustion?	Thermoregulation in children with spinal cord injuries can be impaired because of skeletal muscle paralysis (impaired shivering and reduced ability to produce heat) and a loss of autonomic nervous system control (impaired sweating and vasodilation to dissipate heat). Athletes who have a history of heat illness are more at risk to develop the condition again.
Is there a history of fractures or dislocations?	Ligamentous laxity and joint hypermobility are more common in some disabilities, such as Down syndrome and Ehlers-Danlos syndrome. Children with obesity, those with osteogenesis imperfecta, and athletes in wheelchairs may have reduced bone mineral density with increased fracture risk.
Are there adaptive devices used during sports participation?	Health care providers are encouraged to be aware of the child's need for adaptive equipment. Athletes using wheelchairs are at increased risk for shoulder and wrist injuries and upper extremity peripheral nerve entrapment syndrome.
Is there a need for bladder catheterization?	Athletes with spinal cord injuries or other neurologic conditions may have neurogenic bladder and need an indwelling catheter or require intermittent catheterization.
Is there a history of pressure sores or ulcers?	Children who use wheelchairs are prone to pressure ulcers over the sacrum and ischial tuberosities.
What medications is the child taking?	Medications used for pain and bladder dysfunction can interfere with the normal sweating response; medications that alter QT intervals also may require special assessments.
Is there a history of autonomic dysreflexia?	Autonomic dysreflexia is acute onset of excessive, unregulated sympathetic output that can occur in children with spinal cord injuries at or above the sixth thoracic spinal cord level. This condition may occur spontaneously or may be self-induced (boosting) in an attempt to improve performance.[121]

Adapted from American Academy of Pediatrics. Athletes with a disability. In: Bernhardt DT, Roberts WO, eds. *PPE: Preparticipation Physical Evaluation.* 5th ed. Itasca, IL: American Academy of Pediatrics; 2019:182–183.

absence of myelopathic signs and symptoms during the preparticipation evaluation, routine radiographic evaluation of the cervical spine is not recommended.

Children and youth with Down syndrome can be encouraged to participate in activities they enjoy, although contact sports, such as football, soccer, and gymnastics, may place them at increased risk of spinal cord injury.[115]

As the above examples illustrate, for each child and youth with a

TABLE 3 Elements of a Physical Examination During Preparticipation Evaluation for CWD

Physical Examination Components	Items to Screen
Ocular	Decreased visual acuity
	Ocular health
	Strabismus
	Abnormalities in ocular appearance
Cardiovascular	Cardiovascular heart disease
	Hypertension
Neurologic	Peripheral neuropathies
	Inadequate motor control
	Inadequate coordination and balance
	Clonus
	Impaired hand-eye coordination
	Sensory dysfunction
	AAI
	Hyperreflexia
	Ataxia
	Muscle weakness
	Spasticity
	Upper motor neuron and posterior column signs and symptoms
Dermatologic	Abrasions
	Lacerations
	Blisters
	Pressure ulcers
	Rashes
Musculoskeletal	Limited neck range of motion
	AAI
	Torticollis
	Decreased flexibility, often with contractures; decreased strength; and muscle strength imbalance
	Wrist and elbow extensor tendinitis in athletes using wheelchairs
	Rotator cuff tendinitis and impingement in athletes using wheelchairs
	Pelvic dysfunction caused by lower extremity prosthetic device causing unequal leg lengths

Reproduced with permission from: American Academy of Pediatrics. Athletes with a disability. In: Bernhardt DT, Roberts WO, eds. *PPE: Preparticipation Physical Evaluation.* 5th ed. Itasca, IL: American Academy of Pediatrics; 2019:185

disability, pediatricians can review condition-specific information, current medications, and other individualized aspects of the history to offer recommendations that promote safe participation. Concerns or questions that arise during the preparticipation visit can be addressed through consultation with a sports medicine or physical medicine and rehabilitation physician, who can provide additional guidance. Although a comprehensive review of preparticipation considerations is beyond the scope of this report, health care providers are encouraged to refer to the publication *PPE: Preparticipation Physical Evaluation, Fifth Edition*, which has a chapter titled "Athletes with Disability." A supplemental history form for athletes with a disability and a Special Olympics medical form are available for download at https://www.aap.org/en-us/advocacy-and-policy/aap-health-initiatives/Pages/PPE.aspx or in Supplemental Fig 4.[116]

RECOMMENDATIONS

Pediatricians can promote participation of children and adolescents with disabilities in sports, recreation, and physical activity in the following ways:

1. Assess motor development, physical literacy, and physical activity levels at all health supervision visits with CWD.
    a. Adding a PAVS to visits can help start conversations about physical activity with CWD and their families.

Communicate the physical, beha-vioral, cognitive, and social-emotional benefits of participation in sports, recreation, and physical activity to CWD and their caregivers (Table 1).

- a. Promotion of physical activity is a *Bright Futures* key health promotion theme to be aware of in each stage of child development.[24]

Health care providers can make a difference when they agree to "take the pledge" to talk to their patients about physical activity (https://www.nchpad.org/pledge/doctalk).
Encourage parents to be physically active and encourage inclusion of CWD in family recreational activities.
Recognize, identify, and address barriers to participation at the individual, family, community, and societal levels to increase the opportunities for CWD to be physically active (Table 1).

- a. Refer CWD to local adaptive and therapeutic recreation programs that decrease the barriers to participation. If there is limited access to local programs, home-based programs with adapted exercises and movements can be recommended. Free-to-access videos are available through the National Center on Health, Physical Activity and Disability (https://www.nchpad.org/Videos).

Pediatricians can partner with families, schools, and community organizations in advocating for safe, affordable, accessible, and inclusive recreational programs for CWD to reduce disparities in participation in physical activity;
Encourage participation by discu-ssing physical activity goals with CWD and their families and

partnering with interdisciplinary team members to develop physical activity prescriptions that can be incorporated within an after-visit summary within the electronic medical record. If a handwritten paper note is preferred, a free physical activity prescription pad is available through the Americans with Disabilities Fund at http://foundationforpmr.org/old/physicians/diagnostic-population/rx-for-exercise-pediatrics-new/.

a. Participation in recreation, sports, and physical activity has inherent risk for all. Rather than exclusion from sports participation, pediatricians can encourage CWD to adopt a can-do attitude, enjoying the dignity of taking acceptable risk during participation just as individuals without disabilities are allowed to do.

While striving to meet the 2018 Physical Activity Guidelines Advisory Committee recommendations for physical activity, some CWD will require modifications to the frequency, intensity, and/or duration of physical activity. Realistic goals can be based on gradual increases in baseline duration and intensity of physical activity.

Perform preparticipation evaluations for CWD, in collaboration with the child, family, pediatric specialists, and therapists, leading to opportunities to participate in sports and recreational activities with appropriate adaptation to minimize risk of injury (Tables 2 and 3).

a. Encourage families to bring ada-ptive equipment used during physical activity to visits to assess need for adjustments or referrals.

PPE: Preparticipation Physical Evaluation, Fifth Edition, serves as a resource for medical providers to keep athletes safe and healthy while participating in sports and includes condition-specific preparticipation considerations for athletes with disabilities.

The use of a preparticipation form can promote the documentation of relevant medical issues that can be shared with therapeutic recreation programs, schools, and coaches (Supplemental Fig 4; https://www.aap.org/en-us/advocacy-and-policy/aap-health-initiatives/Pages/PPE.aspx).

Partner with children, parents, and educational teams to include physical activity goals and modifications in a student's IEP and advocate for school-based physical activity programs for CWD.

Be aware of and actively refer to local school and community-based organizations that offer appropriate physical activity programs and sports for CWD.

a. Local and state disability organizations, such as family-to-family health information centers and Family Voices, may have up-to-date lists of adaptive recreation programs (https://familyvoices.org/).

Web sites of national organizations, such as Special Olympics, the National Center on Health, Physical Activity and Disability, and Move United, can provide information on local activities (see Resources for Health Care Providers and Families).

Advocate at the local, state, and national levels for policies that that promote inclusion of CWD in sports, recreation, and physical activity and for surveillance systems that include CWD to track participation and access.[117]

SUMMARY AND CONCLUSIONS

Participation in free play, sports, recreational programs, and physical activity improves health, well-being, and quality of life for CWD and their families. Although more research is needed to confirm specific outcomes and benefits, particularly among individuals with higher levels of disability, clinicians should not hesitate to promote physical activity for CWD. Well-informed decisions regarding each child's participation are made through consideration of individual activity preferences, overall health status, motor skills, balance, muscle strength, bone strength, fitness level, and the availability of adaptive programs. Child, family, and societal barriers to participation continue to exist and need to be directly identified and addressed through advocacy at the local, state, and federal levels. Pediatric health care providers are urged to promote healthy, active living for CWD through physical activity, exercise, recreation, and organized sport by creating specific physical activity prescriptions suited to the child's interests and ability. The benefits are substantial not only for the children who participate but also for communities that welcome them.

RESOURCES FOR HEALTH CARE PROVIDERS AND FAMILIES

- National centers on health promotion for people with disabilities: National Center on Health, Physical Activity and Disability (http://www.nchpad.org) and Special Olympics (https://www.specialolympics.org);
- Paralympics (https://www.paralympic.org);
- US Association of Blind Athletes (usaba.org);
- Miracle League (http://www.themiracleleague.net);
- Move United (https://www.moveunited.org);
- Achilles International (achillesinternational.org);
- National Wheelchair Basketball Association (nwba.org);
- Easter Seals (http://www.easterseals.com/our-programs/camping-recreation/recreation-and-sports.html);

- *PPE: Preparticipation Physical Evaluation, Fifth Edition* (https://www.aap.org/en-us/advocacy-and-policy/aap-health-initiatives/Pages/PPE.aspx);
- America the Beautiful access pass for federal recreation sites (https://www.nps.gov/planyourvisit/passes.htm); and
- Medical Home Portal, Recreational Activities page (https://www.medicalhomeportal.org/living-with-child/other-needs/recreation-activities).

APPENDIX: SAMPLE PROCESSES IN CREATING PHYSICAL ACTIVITY PRESCRIPTIONS FOR CWD

Example 1

During a health supervision visit for a 10-year-old girl with autism spectrum disorder, the clinician notes her BMI is greater than the 95th percentile. On the PAVS, the mother reports 1 day of physical activity per week for 20 minutes. When asked, the child indicates she likes playing basketball, but her mother reports that previous attempts at several team sports, including basketball, have been negative experiences. Her mother explains that the skills required, the pace of play, and the increasingly competitive aspect of the team exceeded her capability, resulting in her becoming discouraged and quitting. She has since become more involved in sedentary activities, such as video games and television viewing. Through a previous collaboration with the state parent-to-parent network, the care coordinator for the practice maintains a list of local adaptive recreational programs. The clinician informs the family of a low-cost adaptive basketball program for CWD offered by the nearby parks and recreation department. Through motivational interviewing, the child and parent agree to walk the family dog to the park 3 times per week, where she can practice basketball in addition to the twice weekly basketball activities offered through the adaptive recreation program. Her after-visit summary includes a physical activity prescription with the contact information for the program and the goals of basketball 3 times per week and walking to the park 3 times per week. At follow-up in 3 months, the child proudly shows the clinician the team photograph of her adaptive basketball team. Her PAVS has improved to 4 days of activity per week for 40 minutes. Her mother reports meeting families of other CWD through the program, which has resulted in friendships and the child wanting to enroll in other sports offered.

Example 2

A 12-year-old boy with hemiplegic cerebral palsy, intellectual disability, and attention-deficit/hyperactivity disorder is seen in follow-up. Despite taking stimulant medication, he continues to display impulsive and oppositional behaviors, especially at home. He is tripping and falling and complaining of more pain, leading to less physical activity. He previously had an ankle foot orthosis but stopped wearing it after excessive skin irritation and pain. His PAVS filled out by his mother shows 2 days of activity per week for 30 minutes. His examination shows increased right upper and lower extremity tone and hyperreflexia. His right hamstrings and gastrocnemius muscles are tight, and his right ankle does not dorsiflex past 0°. Through motivational interviewing, he expresses a desire to participate in martial arts, which his mother states he initially enjoyed before quitting because of pain. His after-visit summary includes a physical activity prescription for martial arts after consultation for further preparticipation planning with several specialists. He is referred for a physical medicine and rehabilitation consultation with the request for assistance in preparticipation planning for martial arts. In the physical medicine and rehabilitation clinic, his spasticity is treated with intramuscular botulinum toxin injections, and he is fitted with a new ankle foot orthosis. He is referred to physical therapy and has weekly sessions to address goals of improving core strength, balance, and lower extremity flexibility and to refine and reinforce his home exercise program. He visits with his primary care pediatrician regularly, often bringing the latest color belt that he has earned in karate. His mother feels that the stimulant medication, his home exercise program, and martial arts have helped with attention, focus, and quality of life.

LEAD AUTHORS

Paul S. Carbone, MD, FAAP
Peter J. Smith, MD, MA, FAAP
Charron Lewis, MD, FAAP
Claire LeBlanc, MD, FAAP

COUNCIL ON CHILDREN WITH DISABILITIES EXECUTIVE COMMITTEE, 2021–2022

Garey Noritz, MD, FAAP, Chairperson
Rishi Agrawal, MD, MPH, FAAP
Kathryn A. Ellerbeck, MD, MPH, FAAP
Jessica E.A. Foster, MD, MPH, FAAP
Ellen Fremion, MD, FAAP, FACP
Sheryl Frierson, MD, MEd, FAAP
Mary O'Connor Leppert, MD, FAAP
Barbara S. Saunders, DO, FAAP
Christopher Stille, MD, MPH, FAAP
Jilda Vargus-Adams, MD, MSc, FAAP
Katharine Zuckerman, MD, MPH, FAAP

PAST COUNCIL ON CHILDREN WITH DISABILITIES EXECUTIVE COMMITTEE MEMBERS

Lynn Davidson, MD, FAAP
Kenneth Norwood Jr, MD, FAAP
Larry Yin, MD, MSPH, FAAP
Dennis Z. Kuo, MD, MHS, FAAP, Immediate Past Chairperson

LIAISONS

Allysa Ware, MSW – *Family Voices*
Marie Mann, MD, MPH, FAAP – *Maternal and Child Health Bureau*
Edwin Simpser, MD, FAAP – *Section on Home Care*
Jennifer Poon, MD, FAAP – *Section on Developmental and Behavioral Pediatrics*
Marshalyn Yeargin-Allsopp, MD, FAAP – *Centers for Disease Control and Prevention*

STAFF

Alexandra Kuznetsov

COUNCIL ON SPORTS MEDICINE AND FITNESS EXECUTIVE COMMITTEE 2019–2020

M. Alison Brooks, MD, FAAP, Chairperson

Susannah M. Briskin, MD, FAAP
Greg Canty, MD, FAAP
Rebecca L. Carl, MD, MS, FAAP
Alex B. Diamond, DO, MPH, FAAP
William Hennrikus, MD, FAAP
Kelsey Logan, MD, MPH, FAAP
Andrew R. Peterson, MD, MSPH, FAAP
Francisco Jose Silva, MD, FAAP
Paul R. Stricker, MD, FAAP
Kevin D. Walter, MD, FAAP

PAST COUNCIL ON SPORTS MEDICINE AND FITNESS EXECUTIVE COMMITTEE MEMBERS

Blaise A. Nemeth, MD, MS, FAAP
Cynthia R. LaBella, MD, FAAP,
Immediate Past Chairperson

CONSULTANT

Avery D. Faigenbaum, EdD, FACSM

LIAISONS

Donald W. Bagnall – *National Athletic Trainers' Association*

PAST LIAISONS

Claire LeBlanc, MD, FAAP – *Canadian Paediatric Society*

STAFF

Anjie Emanuel, MPH

ABBREVIATIONS

AAI: atlantoaxial instability
CWD: children with disabilities
CYSHCN: children and youth with special health care needs
ICF: International Classification of Functioning, Disability and Health
IEP: Individualized Education Program
PAVS: physical activity vital sign

Address correspondence to Paul S. Carbone, MD, FAAP. Email: paul.carbone@hsc.utah.edu

PEDIATRICS (ISSN Numbers: Print, 0031-4005; Online, 1098-4275).

FINANCIAL DISCLOSURE: Dr Smith has disclosed his spouse has an employee relationship with Walgreens; Drs Carbone, Lewis, and LeBlanc have indicated they have no financial relationships relevant to this article to disclose.

FUNDING: No external funding.

POTENTIAL CONFLICT OF INTEREST: The authors have indicated they have no potential conflicts of interest to disclose.

REFERENCES

1. McPherson M, Arango P, Fox H, et al. A new definition of children with special health care needs. *Pediatrics.* 1998;102(1 pt 1):137–140
2. Health Resources & Services Administration. Children and youth with special health care needs. Available at: https://mchb.hrsa.gov/maternal-child-health-topics/children-and-youth-special-health-needs. Accessed April 14, 2019
3. US Department of Education. Individuals with Disabilities Education Act. Available at: https://sites.ed.gov/idea/. Accessed April 14, 2019
4. World Health Organization. *Towards a Common Language for Functioning, Disability and Health.* Geneva, Switzerland: World Health Organization; 2002
5. Cohen E, Kuo DZ, Agrawal R, et al. Children with medical complexity: an emerging population for clinical and research initiatives. *Pediatrics.* 2011;127(3):529–538
6. World Health Organization. International Classification of Functioning, Disability and Health (ICF). Available at: https://www.who.int/classifications/icf/en/. Accessed April 15, 2019
7. Rosenbaum P, Gorter JW. The 'F-words' in childhood disability: I swear this is how we should think! *Child Care Health Dev.* 2012;38(4):457–463
8. World Health Organization. Physical activity. Available at: https://www.who.int/dietphysicalactivity/pa/en/. Accessed April 15, 2019
9. Special Olympics. Available at: www.specialolympics.org. Accessed April 20, 2019
10. Rimmer JH, Padalabalanarayanan S, Malone LA, Mehta T. Fitness facilities still lack accessibility for people with disabilities. *Disabil Health J.* 2017;10(2):214–221
11. Woodmansee C, Hahne A, Imms C, Shields N. Comparing participation in physical recreation activities between children with disability and children with typical development: a secondary analysis of matched data. *Res Dev Disabil.* 2016;49–50:268–276
12. Li C, Haegele JA, Wu L. Comparing physical activity and sedentary behavior levels between deaf and hearing adolescents. *Disabil Health J.* 2019;12(3):514–518
13. Bandini L, Danielson M, Esposito LE, et al. Obesity in children with developmental and/or physical disabilities. *Disabil Health J.* 2015;8(3):309–316
14. Oppewal A, Hilgenkamp TI, van Wijck R, Evenhuis HM. Cardiorespiratory fitness in individuals with intellectual disabilities–a review. *Res Dev Disabil.* 2013;34(10):3301–3316
15. Wouters M, Evenhuis HM, Hilgenkamp TI. Systematic review of field-based physical fitness tests for children and adolescents with intellectual disabilities. *Res Dev Disabil.* 2017;61:77–94
16. Centers for Disease Control and Prevention. Overweight and obesity among people with disabilities. Available at: https://www.cdc.gov/ncbddd/

disabilityandhealth/documents/obesityfactsheet2010.pdf. Accessed April 15, 2019

17. Neter JE, Schokker DF, de Jong E, Renders CM, Seidell JC, Visscher TL. The prevalence of overweight and obesity and its determinants in children with and without disabilities. *J Pediatr*. 2011;158(5):735–739
18. Must A, Phillips S, Curtin C, Bandini LG. Barriers to physical activity in children with autism spectrum disorders: relationship to physical activity and screen time. *J Phys Act Health*. 2015;12(4):529–534
19. Jones RA, Downing K, Rinehart NJ, et al. Physical activity, sedentary behavior and their correlates in children with autism spectrum disorder: a systematic review. *PLoS One*. 2017;12(2):e0172482
20. Maher CA, Toohey M, Ferguson M. Physical activity predicts quality of life and happiness in children and adolescents with cerebral palsy. *Disabil Rehabil*. 2016;38(9):865–869
21. Te Velde SJ, Lankhorst K, Zwinkels M, Verschuren O, Takken T, de Groot J; HAYS study group. Associations of sport participation with self-perception, exercise self-efficacy and quality of life among children and adolescents with a physical disability or chronic disease-a cross-sectional study. *Sports Med Open*. 2018;4(1):38
22. Nyquist A, Jahnsen RB, Moser T, Ullenhag A. The coolest I know - a qualitative study exploring the participation experiences of children with disabilities in an adapted physical activities program. *Disabil Rehabil*. 2020;42(17):2501–2509
23. Lobelo F, Muth ND, Hanson S, Nemeth BA; Council on Sports Medicine and Fitness; Section on Obesity. Physical activity assessment and counseling in pediatric clinical settings. *Pediatrics*. 2020;145(3):e20193992
24. Bright Futures. Promoting physical activity. Available at: https://brightfutures.aap.org/Bright%20Futures%20Documents/BF4_PhysicalActivity.pdf. Accessed November 1, 2020
25. International Paralympic Committee. Available at: https://www.paralympic.org/. Accessed November 5, 2020
26. Deaflympics. Available at: https://www.deaflympics.com/. Accessed November 5, 2020
27. Adams RC, Levy SE; Council on Children with Disabilities. Shared decision-making and children with disabilities: pathways to consensus. *Pediatrics*. 2017;139(6):e20170956
28. Lai B, Lee E, Wagatsuma M, et al. Research trends and recommendations for physical activity interventions among children and youth with disabilities: a review of reviews. *Adapt Phys Activ Q*. 2020;37(2):211–234
29. Arbour-Nicitopoulos KP, Grassmann V, Orr K, McPherson AC, Faulkner GE, Wright FV. A scoping review of inclusive out-of-school time physical activity programs for children and youth with physical disabilities. *Adapt Phys Activ Q*. 2018;35(1):111–138
30. Lai B, Lee E, Kim Y, et al. Leisure-time physical activity interventions for children and adults with cerebral palsy: a scoping review. *Dev Med Child Neurol*. 2021;63(2):162–171
31. O'Brien TD, Noyes J, Spencer LH, Kubis HP, Hastings RP, Whitaker R. Systematic review of physical activity and exercise interventions to improve health, fitness and well-being of children and young people who use wheelchairs. *BMJ Open Sport Exerc Med*. 2016;2(1):e000109
32. Chad KE, Bailey DA, McKay HA, Zello GA, Snyder RE. The effect of a weight-bearing physical activity program on bone mineral content and estimated volumetric density in children with spastic cerebral palsy. *J Pediatr*. 1999;135(1):115–117
33. Alemdaroğlu I, Karaduman A, Yilmaz OT, Topaloğlu H. Different types of upper extremity exercise training in Duchenne muscular dystrophy: effects on functional performance, strength, endurance, and ambulation. *Muscle Nerve*. 2015;51(5):697–705
34. Jansen M, van Alfen N, Geurts AC, de Groot IJ. Assisted bicycle training delays functional deterioration in boys with Duchenne muscular dystrophy: the randomized controlled trial "no use is disuse". *Neurorehabil Neural Repair*. 2013;27(9):816–827
35. de Groot JF, Takken T, van Brussel M, et al. Randomized controlled study of home-based treadmill training for ambulatory children with spina bifida. *Neurorehabil Neural Repair*. 2011;25(7):597–606
36. McCoy SM, Jakicic JM, Gibbs BB. Comparison of obesity, physical activity, and sedentary behaviors between adolescents with autism spectrum disorders and without. *J Autism Dev Disord*. 2016;46(7):2317–2326
37. Oriel KN, George CL, Peckus R, Semon A. The effects of aerobic exercise on academic engagement in young children with autism spectrum disorder. *Pediatr Phys Ther*. 2011;23(2):187–193
38. Rosenthal-Malek A, Mitchell S. Brief report: the effects of exercise on the self-stimulatory behaviors and positive responding of adolescents with autism. *J Autism Dev Disord*. 1997;27(2):193–202
39. Gabriels RL, Agnew JA, Holt KD, et al. Pilot study measuring the effects of therapeutic horseback riding on school-age children and adolescents with autism spectrum disorders. *Res Autism Spectr Disord*. 2012;6(2):578–588
40. Rosenblatt LE, Gorantla S, Torres JA, et al. Relaxation response-based yoga improves functioning in young children with autism: a pilot study. *J Altern Complement Med*. 2011;17(11):1029–1035
41. Bahrami F, Movahedi A, Marandi SM, Abedi A. Kata techniques training consistently decreases stereotypy in children with autism spectrum disorder. *Res Dev Disabil*. 2012;33(4):1183–1193
42. Pan CY. Effects of water exercise swimming program on aquatic skills and social behaviors in children with autism spectrum disorders. *Autism*. 2010;14(1):9–28
43. McDaniel Peters BC, Wood W. Autism and equine-assisted interventions: a systematic mapping review. *J Autism Dev Disord*. 2017;47(10):3220–3242
44. Cerrillo-Urbina AJ, García-Hermoso A, Sánchez-López M, Pardo-Guijarro MJ, Santos Gómez JL, Martínez-Vizcaíno V. The effects of physical exercise in children with attention deficit hyperactivity disorder: a systematic review and

meta-analysis of randomized control trials. *Child Care Health Dev.* 2015;41(6):779–788

45. Wu WL, Yang YF, Chu IH, Hsu HT, Tsai FH, Liang JM. Effectiveness of a cross-circuit exercise training program in improving the fitness of overweight or obese adolescents with intellectual disability enrolled in special education schools. *Res Dev Disabil.* 2017;60:83–95
46. Shields N, Taylor NF, Wee E, Wollersheim D, O'Shea SD, Fernhall B. A community-based strength training programme increases muscle strength and physical activity in young people with Down syndrome: a randomised controlled trial. *Res Dev Disabil.* 2013;34(12):4385–4394
47. Tint A, Thomson K, Weiss JA. A systematic literature review of the physical and psychosocial correlates of Special Olympics participation among individuals with intellectual disability. *J Intellect Disabil Res.* 2017;61(4):301–324
48. Bohnert A, Lieb R, Arola N. More than leisure: organized activity participation and socio-emotional adjustment among adolescents with autism spectrum disorder. *J Autism Dev Disord.* 2019;49(7):2637–2652
49. Spratt E, Mercer MA, Grimes A, et al. Translating benefits of exercise on depression for youth with autism spectrum disorder and neurodevelopmental disorders. *J Psychol Psychiatr.* 2018;2:109
50. de Valle KL, Davidson ZE, Kennedy RA, Ryan MM, Carroll KM. Physical activity and the use of standard and complementary therapies in Duchenne and Becker muscular dystrophies. *J Pediatr Rehabil Med.* 2016;9(1):55–63
51. Dursun OB, Erhan SE, Ibiş EO, et al. The effect of ice skating on psychological well-being and sleep quality of children with visual or hearing impairment. *Disabil Rehabil.* 2015;37(9):783–789
52. Carlon SL, Taylor NF, Dodd KJ, Shields N. Differences in habitual physical activity levels of young people with cerebral palsy and their typically developing peers: a systematic review. *Disabil Rehabil.* 2013;35(8):647–655
53. Buffart LM, van der Ploeg HP, Bauman AE, et al. Sports participation in adolescents and young adults with myelomeningocele and its role in total physical activity behaviour and fitness. *J Rehabil Med.* 2008;40(9):702–708
54. Bandini LG, Gleason J, Curtin C, et al. Comparison of physical activity between children with autism spectrum disorders and typically developing children. *Autism.* 2013;17(1):44–54
55. Phillips AC, Holland AJ. Assessment of objectively measured physical activity levels in individuals with intellectual disabilities with and without Down's syndrome. *PLoS One.* 2011;6(12):e28618
56. Hinckson EA, Curtis A. Measuring physical activity in children and youth living with intellectual disabilities: a systematic review. *Res Dev Disabil.* 2013;34(1):72–86
57. Bedell G, Coster W, Law M, et al. Community participation, supports, and barriers of school-age children with and without disabilities. *Arch Phys Med Rehabil.* 2013;94(2):315–323
58. Wilson PB, Haegele JA, Zhu X. Mobility status as a predictor of obesity, physical activity, and screen time use among children aged 5-11 years in the United States. *J Pediatr.* 2016;176:23–29.e1
59. Shields N, Synnot A. Perceived barriers and facilitators to participation in physical activity for children with disability: a qualitative study. *BMC Pediatr.* 2016;16:9
60. Shields N, Synnot AJ, Barr M. Perceived barriers and facilitators to physical activity for children with disability: a systematic review. *Br J Sports Med.* 2012;46(14):989–997
61. Wiart L, Darrah J, Kelly M, Legg D. Community fitness programs: what is available for children and youth with motor disabilities and what do parents want? *Phys Occup Ther Pediatr.* 2015;35(1):73–87
62. Martin Ginis KA, Ma JK, Latimer-Cheung AE, Rimmer JH. A systematic review of review articles addressing factors related to physical activity participation among children and adults with physical disabilities. *Health Psychol Rev.* 2016;10(4):478–494
63. Wright A, Roberts R, Bowman G, Crettenden A. Barriers and facilitators to physical activity participation for children with physical disability: comparing and contrasting the views of children, young people, and their clinicians. *Disabil Rehabil.* 2019;41(13):1499–1507
64. Stirling AE, Bridges EJ, Cruz EL, Mountjoy ML; Canadian Academy of Sport and Exercise Medicine. Canadian Academy of Sport and Exercise Medicine position paper: abuse, harassment, and bullying in sport. *Clin J Sport Med.* 2011;21(5):385–391
65. Logan K, Cuff S; Council on Sports Medicine and Fitness. Organized sports for children, preadolescents, and adolescents. *Pediatrics.* 2019;143(6):e20190997
66. Curtin C, Hyman SL, Boas DD, et al. Weight management in primary care for children with autism: expert recommendations. *Pediatrics.* 2020;145(suppl 1):S126–S139
67. Wrightslaw. Physical education for students with disabilities. Available at: https://www.wrightslaw.com/info/pe.index.htm. Accessed May 28, 2019
68. US Government Accountability Office. *Students With Disabilities: More Information and Guidance Could Improve Opportunities in Physical Education and Athletics.* Washington, DC: US Government Accountability Office; 2010
69. Ng KW, Tynjälä J, Rintala P, Kokko S, Kannas L. Do adolescents with long-term illnesses and disabilities have increased risks of sports related injuries? *Inj Epidemiol.* 2017;4(1):13
70. Pitchford EA, Siebert E, Hamm J, Yun J. Parental perceptions of physical activity benefits for youth with developmental disabilities. *Am J Intellect Dev Disabil.* 2016;121(1):25–32
71. Courtney-Long EA, Stevens AC, Carroll DD, Griffin-Blake S, Omura JD, Carlson SA. Primary care providers' level of preparedness for recommending physical activity to adults with disabilities. *Prev Chronic Dis.* 2017;14:E114
72. Jaarsma EA, Dijkstra PU, de Blécourt AC, Geertzen JH, Dekker R. Barriers and facilitators of sports in children with physical disabilities: a mixed-method study. *Disabil Rehabil.* 2015;37(18):1617–1623; quiz 1624–1625
73. Grant RW, Schmittdiel JA, Neugebauer RS, Uratsu CS, Sternfeld B. Exercise as a vital sign: a quasi-experimental

analysis of a health system intervention to collect patient-reported exercise levels. *J Gen Intern Med.* 2014; 29(2):341–348

74. Daniels SR, Hassink SG; Committee on Nutrition. The role of the pediatrician in primary prevention of obesity. *Pediatrics.* 2015;136(1). Available at: www.pediatrics.org/cgi/content/full/136/1/e275
75. Binns HJ, Mueller MM, Ariza AJ. Healthy and fit for prevention: the influence of clinician health and fitness on promotion of healthy lifestyles during health supervision visits. *Clin Pediatr (Phila).* 2007;46(9):780–786
76. American Therapeutic Recreation Association. About recreational therapy. Available at: https://www.atra-online.com/page/AboutRecTherapy. Accessed June 12, 2019
77. Rosso EGF. Brief report: coaching adolescents with autism spectrum disorder in a school-based multi-sport program. *J Autism Dev Disord.* 2016;46(7):2526–2531
78. Data Resource Center for Child & Adolescent Health. National Survey of Children's Health interactive data query (2016–present). Available at: https://www.childhealthdata.org/browse/survey. Accessed November 11, 2020
79. Centers for Disease Control and Prevention. National programs on health promotion for people with disabilities. Available at: https://www.cdc.gov/ncbddd/disabilityandhealth/national-programs.html. Accessed November 6, 2020
80. Yazdani S, Yee CT, Chung PJ. Factors predicting physical activity among children with special needs. *Prev Chronic Dis.* 2013;10:E119
81. National Park Service. Entrance passes. Available at: https://www.nps.gov/planyourvisit/passes.htm. Accessed June 12, 2019
82. Kent C, Cordier R, Joosten A, Wilkes-Gillan S, Bundy A. Can I learn to play? Randomized control trial to assess effectiveness of a peer-mediated intervention to improve play in children with autism spectrum disorder. *J Autism Dev Disord.* 2021;51(6):1823–1838
83. Klavina A, Block ME. The effect of peer tutoring on interaction behaviors in inclusive physical education. *Adapt Phys Activ Q.* 2008;25(2):132–158
84. Pate RR, Davis MG, Robinson TN, Stone EJ, McKenzie TL, Young JC; American Heart Association Council on Nutrition, Physical Activity, and Metabolism (Physical Activity Committee); Council on Cardiovascular Disease in the Young; Council on Cardiovascular Nursing. Promoting physical activity in children and youth: a leadership role for schools: a scientific statement from the American Heart Association Council on Nutrition, Physical Activity, and Metabolism (Physical Activity Committee) in collaboration with the Councils on Cardiovascular Disease in the Young and Cardiovascular Nursing. *Circulation.* 2006;114(11):1214–1224
85. Child and Adolescent Health Measurement Initiative. 2017–18 National Survey of Children's Health (NSCH) combined data set. www.childhealthdata.org. Accessed April 28, 2020
86. Lipkin PH, Okamoto J; Council on Children With Disabilities; Council on School Health. The Individuals With Disabilities Education Act (IDEA) for children with special educational needs. *Pediatrics.* 2015;136(6). Available at: www.pediatrics.org/cgi/content/full/136/6/e1650
87. Centers for Disease Control and Prevention. Results from the school health policies and practices study 2014. 2015. Available at: https://www.cdc.gov/healthyyouth/data/shpps/pdf/SHPPS-508-final_101315.pdf. Accessed January 6, 2020
88. Jin J, Yun J, Agiovlasitis S. Impact of enjoyment on physical activity and health among children with disabilities in schools. *Disabil Health J.* 2018;11(1):14–19
89. Yun J, Beamer J. Promoting physical activity in adapted physical education. *J Phys Educ Recreat Dance.* 2018;89(4):7–13
90. Society of Health and Physical Educators. CSPAP Comprehensive School Physical Activity Program. Available at: https://www.shapeamerica.org/cspap/what.aspx. Accessed January 6, 2021
91. Council on School Health. Role of the school nurse in providing school health services. *Pediatrics.* 2016;137(6):e20160852
92. Aspen Institute Project Play. Sport for All Play for Life. Available at: www.aspenprojectplay.org. Accessed October 21, 2021
93. Jaakkola T, Yli-Piipari S, Huotari P, Watt A, Liukkonen J. Fundamental movement skills and physical fitness as predictors of physical activity: a 6-year follow-up study. *Scand J Med Sci Sports.* 2016;26(1):74–81
94. Kantomaa MT, Purtsi J, Taanila AM, et al. Suspected motor problems and low preference for active play in childhood are associated with physical inactivity and low fitness in adolescence. *PLoS One.* 2011;6(1):e14554
95. Bopp T, Stellefson M, Weatherall B, Spratt S. Promoting physical literacy for disadvantaged youth living with chronic disease. *Am J Health Educ.* 2019;50(3):153–158
96. Noritz GH, Murphy NA; Neuromotor Screening Expert Panel. Motor delays: early identification and evaluation. *Pediatrics.* 2013;131(6). Available at: www.pediatrics.org/cgi/content/full/131/6/e2016
97. Cairney J, Clark HJ, James ME, Mitchell D, Dudley DA, Kriellaars D. The preschool physical literacy assessment tool: testing a new physical literacy tool for the early years. *Front Pediatr.* 2018;6:138
98. Farhat F, Masmoudi K, Hsairi I, et al. The effects of 8 weeks of motor skill training on cardiorespiratory fitness and endurance performance in children with developmental coordination disorder. *Appl Physiol Nutr Metab.* 2015;40(12):1269–1278
99. Houtrow A, Murphy N; Council on Children With Disabilities. Prescribing physical, occupational, and speech therapy services for children with disabilities. *Pediatrics.* 2019;143(4):e20190285
100. Yogman M, Garner A, Hutchinson J, Hirsh-Pasek K, Golinkoff RM; Committee on Psychological Aspects of Child and Family Health; Council on Communications and Media. The power of play: a pediatric role in enhancing development in young children. *Pediatrics.* 2018;142(3):e20182058
101. Murray R, Ramstetter C; Council on School Health, American Academy of

Pediatrics. The crucial role of recess in school. *Pediatrics.* 2013;131(1):183–188

102. Kretzmann M, Shih W, Kasari C. Improving peer engagement of children with autism on the school playground: a randomized controlled trial. *Behav Ther.* 2015;46(1):20–28
103. US Department of Health and Human Services. 2018 Physical Activity Guidelines Advisory Committee scientific report. 2018. Available at: https://health.gov/sites/default/files/2019-09/PAG_Advisory_Committee_Report.pdf. Accessed March 15, 2021
104. US Department of Health and Human Services. *Physical Activity Guidelines for Americans.* Washington, DC: US Department of Health and Human Services; 2018
105. Tremblay MS, Leblanc AG, Carson V, et al; Canadian Society for Exercise Physiology. Canadian physical activity guidelines for the early years (aged 0-4 years). *Appl Physiol Nutr Metab.* 2012;37(2):345–369
106. Lipnowski S, Leblanc CM; Canadian Paediatric Society, Healthy Active Living and Sports Medicine Committee. Healthy active living: physical activity guidelines for children and adolescents. *Paediatr Child Health.* 2012;17(4):209–212
107. Klenck C, Gebke K. Practical management: common medical problems in disabled athletes. *Clin J Sport Med.* 2007;17(1):55–60
108. Patel DR, Greydanus DE. Sport participation by physically and cognitively challenged young athletes. *Pediatr Clin North Am.* 2010;57(3):795–817
109. Fullerton HD, Borckardt JJ, Alfano AP. Shoulder pain: a comparison of wheelchair athletes and nonathletic wheelchair users. *Med Sci Sports Exerc.* 2003;35(12):1958–1961
110. Dec KL, Sparrow KJ, McKeag DB. The physically-challenged athlete: medical issues and assessment. *Sports Med.* 2000;29(4):245–258
111. Simon LM, Ward DC. Preparing for events for physically challenged athletes. *Curr Sports Med Rep.* 2014;13(3):163–168
112. Bergeron MF, Devore C, Rice SG; Council on Sports Medicine and Fitness and Council on School Health, American Academy of Pediatrics. Policy statement—climatic heat stress and exercising children and adolescents. *Pediatrics.* 2011;128(3). Available at: www.pediatrics.org/cgi/content/full/128/3/e741
113. Ramirez M, Yang J, Bourque L, et al. Sports injuries to high school athletes with disabilities. *Pediatrics.* 2009;123(2):690–696
114. Srinivasan SM, Pescatello LS, Bhat AN. Current perspectives on physical activity and exercise recommendations for children and adolescents with autism spectrum disorders. *Phys Ther.* 2014;94(6):875–889
115. Bull MJ; Committee on Genetics. Health supervision for children with Down syndrome. *Pediatrics.* 2011;128(2):393–406
116. Bernhardt DT, Roberts WO, eds. *PPE: Preparticipation Physical Evaluation.* 5th ed. Itasca, IL: American Academy of Pediatrics; 2019
117. US Department of Health and Human Services. The national youth sports strategy. 2019. Available at: https://health.gov/sites/default/files/2019-10/National_Youth_Sports_Strategy.pdf. Accessed March 16, 2021
118. Denny SA, Quan L, Gilchrist J, et al; Council on Injury, Violence, and Poison Prevention. Prevention of drowning. *Pediatrics.* 2019;143(5):e20190850
119. Rice SG; American Academy of Pediatrics Council on Sports Medicine and Fitness. Medical conditions affecting sports participation. *Pediatrics.* 2008;121(4):841–848
120. Donahue S, Nixon C; Section on Opthamology, American Academy of Pediatrics; Committee on Practice and Ambulatory Medicine, American Academy of Pediatrics; American Academy of Ophthalmology; American Association for Pediatric Ophthalmology and Strabismus; American Association of Certified Orthoptists. Visual system assessment in infants, children, and young adults by pediatricians. *Pediatrics.* 2016;137(1):28–30
121. International Paralympic Committee. Position statement on autonomic dysreflexia and boosting. In: *International Paralympic Committee Handbook.* Bonn, Germany: International Paralympic Committee; 2016

Recommendations for Prevention and Control of Influenza in Children, 2021–2022

- *Policy Statement*
  - *PPI: AAP Partnership for Policy Implementation*

See Appendix 1 for more information.

POLICY STATEMENT Organizational Principles to Guide and Define the Child Health Care System and/or Improve the Health of all Children

American Academy of Pediatrics
DEDICATED TO THE HEALTH OF ALL CHILDREN™

Recommendations for Prevention and Control of Influenza in Children, 2021–2022

COMMITTEE ON INFECTIOUS DISEASES

American Academy of Pediatrics, Itasca, Illinois

https://doi.org/10.1542/peds.2021-053744

PEDIATRICS (ISSN Numbers: Print, 0031-4005; Online, 1098-4275).

Dr Munoz has a royalties relationship with Up to Date.

G No external funding.

T T T T T Dr Munoz has a Data and Safety Monitoring Board member relationship with Moderna and Pfizer; has a research relationship with Pfizer, Moderna, and Gilead; and is a member of the European Society for Paediatric Infectious Diseases Research Committee and the International Neonatal and Maternal Immunization Symposium Scientific Committee.

To cite COMMITTEE ON INFECTIOUS DISEASES. Recommendations for Prevention and Control of Influenza in Children, 2021–2022. *Pediatrics*. 2021;148(4):e2021053744

This statement updates the recommendations of the American Academy of Pediatrics for the routine use of influenza vaccine and antiviral medications in the prevention and treatment of influenza in children during the 2021–2022 influenza season. A detailed review of the evidence supporting these recommendations is published in the accompanying technical report.[1] The American Academy of Pediatrics recommends annual influenza immunization of all children without medical contraindications, starting at 6 months of age. Influenza vaccination is an important intervention to protect vulnerable populations and reduce the burden of respiratory illnesses during circulation of severe acute respiratory syndrome coronavirus 2, which is expected to continue during the 2021–2022 influenza season. Any licensed, recommended, age-appropriate vaccine available can be administered, without preference for one product or formulation over another. Antiviral treatment of influenza with any licensed, recommended, age-appropriate influenza antiviral medication is recommended for children with suspected or confirmed influenza who are hospitalized, have severe or progressive disease, or have underlying conditions that increase their risk of complications of influenza. Antiviral treatment may be considered for any previously healthy, symptomatic outpatient not at high risk for influenza complications, in whom an influenza diagnosis is confirmed or suspected, if treatment can be initiated within 48 hours of illness onset and for children whose siblings or household contacts either are younger than 6 months or have a high-risk condition that predisposes them to complications of influenza.

T T

Children consistently have the highest attack rates of influenza in the community during seasonal influenza epidemics. Children play a pivotal role in the transmission of influenza virus infection to household and other close contacts and can experience substantial morbidity, including severe or fatal complications from influenza infection.[2] Children younger than 5

years, especially those younger than 2 years, and children with certain underlying medical conditions are at increased risk of hospitalization and complications attributable to influenza (Table 1).[2] School-aged children bear a large influenza disease burden and are more likely to seek influenza-related medical care compared with healthy adults.[2,3] Reducing influenza virus transmission among children decreases the burden of childhood influenza and transmission of influenza virus to household contacts and community members of all ages.[2,3] Influenza vaccination is particularly important during the severe acute respiratory syndrome coronavirus 2 pandemic to reduce the burden of respiratory illnesses and hospitalizations and preserve the capacity of the health care infrastructure. The American Academy of Pediatrics (AAP) recommends routine influenza vaccination and antiviral agents for the prevention and treatment of influenza in children, respectively. This policy statement summarizes updates and recommendations for the 2021–2022 influenza season. An accompanying technical report provides further detail regarding recent influenza seasons, influenza vaccine effectiveness (VE), detailed updates of inactivated influenza vaccines (IIVs) and live attenuated influenza vaccines (LAIVs), influenza vaccination coverage, vaccine implementation, and timing of vaccination and duration of protection.[1]

UPDATES FOR THE 2021–2022 INFLUENZA SEASON

1. All pediatric and adult seasonal influenza vaccines are quadrivalent. Trivalent vaccines are no longer expected to be available in the United States.
2. The composition of the influenza vaccines for 2021–2022 has been updated. The recommended influenza A(H1N1)pdm09 and A(H3N2) components of the vaccine are new for this season. The influenza B components are unchanged from the previous season.
3. The vaccine formulations available for children 6 through 35 months of age are unchanged from last season (Table 2). Afluria Quadrivalent is the only vaccine for children 6 through 35 months of age available in a dosing volume of 0.25-mL prefilled syringe. Fluzone Quadrivalent, which was previously available in a 0.25-mL and a 0.5-mL prefilled syringe, is only available in a 0.5-mL presentation for this age group. However, a 0.25-mL dose is still an approved option if drawn from a multidose vial. The presentation and approved dose for the 2 other vaccines available for this age group, Fluarix and FluLaval, is 0.5 mL.
4. The age indication for the cell culture–based IVV, Flucelvax Quadrivalent, has been extended to ages 2 years and older (previously indicated for 4 years and older), providing one more option for young children.
5. Any licensed, recommended, age-appropriate vaccine available can be administered, without preference for one product or formulation over another.
6. Children 6 months through 8 years of age who are receiving influenza vaccine for the first time, who have received only 1 dose ever before July 1, 2021, or whose

TABLE 1 People at High Risk of Influenza Complications

Children aged <5 y, and especially those aged <2 y,[a] regardless of the presence of underlying medical conditions
Adults aged ≥50 y, and especially those aged ≥65 y
Children and adults with chronic pulmonary (including asthma and cystic fibrosis), hemodynamically significant cardiovascular disease (except hypertension alone), or renal, hepatic, hematologic (including sickle cell disease and other hemoglobinopathies), or metabolic disorders (including diabetes mellitus)
Children and adults with immunosuppression attributable to any cause, including that caused by medications or by HIV infection
Children and adults with neurologic and neurodevelopment conditions (including disorders of the brain, spinal cord, peripheral nerve, and muscle, such as cerebral palsy, epilepsy, stroke, intellectual disability, moderate to severe developmental delay, muscular dystrophy, or spinal cord injury)
Children and adults with conditions that compromise respiratory function or handling of secretions (including tracheostomy and mechanical ventilation)[6]
Women who are pregnant or postpartum during the influenza season
Children and adolescents aged <19 y who are receiving long-term aspirin therapy or salicylate-containing medications (including those with Kawasaki disease and rheumatologic conditions) because of increased risk of Reye syndrome
American Indian and Alaska Native people[b]
Children and adults with obesity (ie, BMI ≥40 for adults and based on age for children)
Residents of chronic care facilities and nursing homes

Adapted from the Centers for Disease Control and Prevention. Prevention and control of seasonal influenza with vaccines: recommendations of the Advisory Committee on Immunization Practices—United States, 2021–22 influenza season. *MMWR Recomm Rep.* 2021, In press.

[a] The Centers for Disease Control and Prevention recommendations state: Although all children younger than 5 years old are considered at higher risk for complications from influenza, the highest risk is for those younger than 2 years old, with the highest hospitalization and death rates among infants younger than 6 months old.

[b] American Indian and Alaska Native (AI and AN) children have a higher rate of influenza complications.[7–10] Most at-risk AI and AN children will also qualify in other high-risk categories to receive appropriate antiviral treatment. In the setting of a shortage, AI and AN children should be prioritized to receive influenza vaccine or antiviral medications, according to local public health guidelines.

TABLE 2 Recommended Seasonal Influenza Vaccines for Different Age Groups: United States, 2021–2022 Influenza Season

Vaccine	Trade Name (Manufacturer)	Age Group	Presentation and Hemagglutinin Antigen Content (IIVs and RIV4) or Virus Count (LAIV4) per Dose for Each Antigen	Thimerosal Mercury Content (mg Hg/0.5-mL Dose)	CPT Code
Quadrivalent standard dose: egg-based vaccines					
IIV4	Afluria Quadrivalent (Seqirus)	6–35 mo	0.25-mL prefilled syringe (7.5 μg/0.25 mL)	0	90685
	Afluria Quadrivalent (Seqirus)	≥36 mo	0.5-mL prefilled syringe (15 μg/0.5 mL)	0	90686
	Afluria Quadrivalent (Seqirus)	≥6 mo	5.0-mL multidose vial[a] (15 μg/0.5 mL)	24.5	90687
	Fluarix Quadrivalent (GlaxoSmithKline)	≥6 mo	0.5-mL prefilled syringe (15 μg/0.5 mL)	0	90686
	FluLaval Quadrivalent (GlaxoSmithKline)	≥6 mo	0.5-mL prefilled syringe (15 μg/0.5 mL)	0	90686
	Fluzone Quadrivalent (Sanofi Pasteur)	≥6 mo	0.5-mL prefilled syringe (15 μg/0.5 mL) (0.25 mL no longer available)	0	90686
	Fluzone Quadrivalent (Sanofi Pasteur)	≥6 mo	0.5-mL single-dose vial (15 μg/0.5 mL)	0	90686
	Fluzone Quadrivalent (Sanofi Pasteur)	≥6 mo	5.0-mL multidose vial[a] (15 μg/0.5 mL)	25	90687
Quadrivalent standard dose: cell culture–based vaccines					
ccIIV4	Flucelvax Quadrivalent (Seqirus)	≥2 y	0.5-mL prefilled syringe (15 μg/0.5 mL)	0	90674
	Flucelvax Quadrivalent (Seqirus)	≥2 y	5.0-mL multidose vial[a] (15 μg/0.5 mL)	25	90756
Quadrivalent standard dose: egg-based with adjuvant vaccines					
aIIV4 MF-59 adjuvanted	Fluad Quadrivalent (Seqirus)	≥65 y	0.5-mL prefilled syringe ((15 μg/0.5 mL)	0	90653
Quadrivalent high dose: egg-based vaccine					
IIV4	Fluzone High Dose (Sanofi Pasteur)	≥65 y	0.7-mL prefilled syringe (60 μg/0.7 mL)	0	90662
Recombinant vaccine					
RIV4	Flublok Quadrivalent (Sanofi Pasteur)	≥18 y	0.5-mL prefilled syringe (45 μg/0.5 mL)	0	90682
Live attenuated vaccine					
LAIV4	FluMist Quadrivalent (AstraZeneca)	2–49 y	0.2-mL prefilled intranasal sprayer (Virus dose: 10 6.5–7.5 FFU/0.2 mL)	0	90672

Adapted from the Centers for Disease Control and Prevention. Prevention and control of seasonal influenza with vaccines: recommendations of the Advisory Committee on Immunization Practices (ACIP)—United States, 2021–2022 influenza season. *MMWR Recomm Rep.* 2021. In press. Table has been reformatted and updated. Implementation guidance on supply, pricing, payment, CPT coding, and liability issues can be found at www.aapredbook.org/implementation. aIIV4, quadrivalent adjuvanted inactivated influenza vaccine; ccIIV4, quadrivalent cell culture–based inactivated influenza vaccine; CPT, *Current Procedural Terminology*; FFU, fluorescent focus unit; LAIV4, quadrivalent live attenuated influenza vaccine; RIV4, quadrivalent recombinant influenza vaccine.

[a] For vaccines that include a multidose-vial presentation, a maximum of 10 doses can be drawn from a multidose vial.

vaccination status is unknown should be offered vaccination as soon as influenza vaccines become available and should receive 2 doses of vaccine 4 weeks apart, ideally by the end of October (Fig 1). Children needing only 1 dose of influenza vaccine, regardless of age, should also receive vaccination ideally by the end of October. Data available to date on waning immunity do not support delaying vaccination in children.

7. Influenza vaccine may be administered simultaneously with or any time before or after administration of the currently available novel coronavirus disease 2019 (COVID-19) vaccines. Given that it is unknown whether reactogenicity of COVID-19 vaccines will be increased with coadministration of influenza vaccine, the reactogenicity profile of the vaccines should be considered, and providers should consult the most current Advisory Committee on Immunization Practices (ACIP)/AAP guidance regarding coadministration of COVID-19 vaccines with influenza vaccines.
8. Children with acute moderate or severe COVID-19 should not receive influenza vaccine until they have recovered; children with mild illness may be vaccinated.
9. The language on contraindications for IIV and LAIV has been updated to harmonize with recommendations of the ACIP and package inserts. A documented previous severe reaction to any IIV or LAIV is a contraindication to vaccination with IIV or LAIV.
10. The importance of influenza vaccination during the severe acute respiratory syndrome coronavirus 2 pandemic is emphasized.

HIGH-RISK GROUPS IN PEDIATRICS

Children and adolescents with certain underlying medical conditions have a high risk of complications from influenza (Table 1). Although universal influenza vaccination is recommended for everyone starting at 6 months of age, emphasis should be placed in ensuring that high-risk and vulnerable children and their household contacts and caregivers receive annual influenza vaccine.

SEASONAL INFLUENZA VACCINES

The seasonal influenza vaccines licensed for children and adults for the 2021–2022 season are shown in Table 2. More than one product may be appropriate for a given patient, and vaccination should not be delayed to obtain a specific product.

All 2021–2022 seasonal influenza vaccines will be quadrivalent and contain the same influenza strains as recommended by the World Health Organization and the US Food and Drug Administration Vaccines and Related Biological Products Advisory Committee for the Northern Hemisphere.[4,5] Both influenza A(H1N1) and A(H3N2) components are different in this

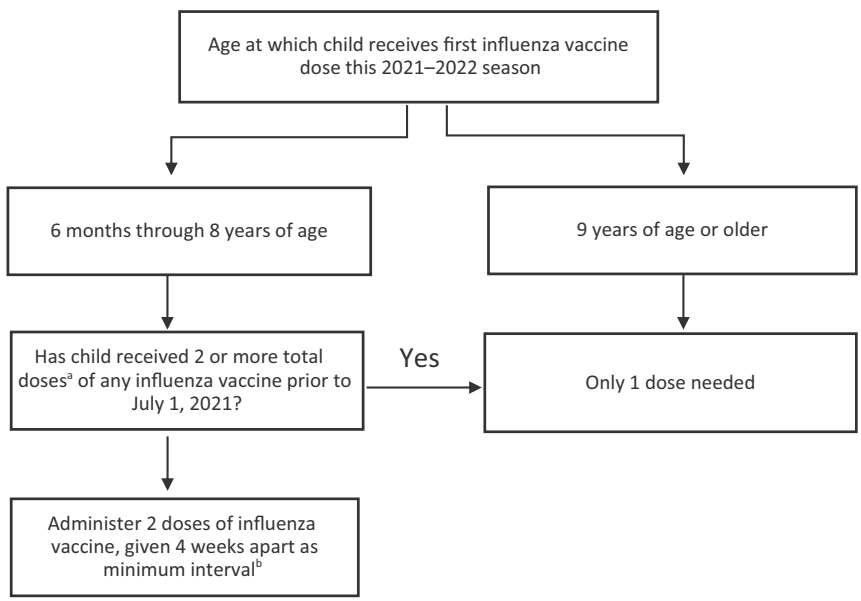


FIGURE 1 Number of 2021–2022 seasonal influenza vaccine doses for children based on age and previous vaccination history. [a] The 2 doses need not have been received during the same season or consecutive seasons. [b] Administer 2 doses based on age at receipt of the first dose of influenza vaccine during the season. Children who receive the first dose before their ninth birthday should receive 2 doses, even if they turn 9 years old during the same season.

season's vaccine. The B components are unchanged. The influenza A strains may be different for egg-based versus cell- or recombinant-based vaccines on the basis of their optimal characteristics for each platform, but all are matched to the strains expected to circulate in the 2021–2022 season.

1. Quadrivalent vaccines contain:
   a. influenza A(H1N1) component:
      i. egg-based vaccines: A/Victoria/2570/2019 (H1N1) pdm09-like virus (new this season);
      ii. cell- or recombinant-based vaccines: A/Wisconsin/588/2019 (H1N1) pdm09-like virus (new this season).
   b. Influenza A(H3N2) component:
      i. egg-based vaccines: A/Cambodia/e0826360/2020 (H3N2)-like virus (new this season);
      ii. cell- or recombinant-based vaccines: A/Cambodia/e0826360/2020 (H3N2)-like virus (new this season).
   c. B/Victoria component:
      i. all vaccines: B/Washington/02/2019-like virus (B/Victoria/2/87 lineage) (unchanged).
   d. B/Yamagata component:
      i. all vaccines: B/Phuket/3073/2013-like virus (B/Yamagata/16/88 lineage) (unchanged).
2. Trivalent vaccines do not include the B/Yamagata component (not available in United States).

INFLUENZA VACCINE RECOMMENDATIONS

1. The AAP recommends annual influenza vaccination for everyone 6 months and older, including children and adolescents, during the 2021–2022 influenza season.
2. For the 2021–2022 influenza season, the AAP recommends that any licensed influenza vaccine appropriate for age and health status can be used for influenza vaccination in children. IIV and LAIV are options for children for whom these vaccines are appropriate. This recommendation is based on review of current available data on LAIV and IIV VE. The AAP will continue to review VE data as they become available and update these recommendations if necessary.
3. The AAP does not have a preference for any influenza vaccine product over another for children who have no contraindication to influenza vaccination and for whom more than one licensed product appropriate for age and health status is available. Pediatricians should administer whichever formulation is available in their communities to achieve the highest possible coverage this influenza season.
4. Children 6 through 35 months of age may receive any licensed, age-appropriate IIV available this season, at the dose indicated for the vaccine. No product is preferred over another for this age group. Children 36 months (3 years) and older should receive a 0.5-mL dose of any available, licensed, age-appropriate vaccine.
5. The number of seasonal influenza vaccine doses recommended to be administered to children in the 2021–2022 influenza season remains unchanged and depends on the child's age at the time of the first administered dose and vaccine history (Fig 1).
6. Children 6 months through 8 years of age who are receiving influenza vaccine for the first time or who have received only 1 dose before July 1, 2021, or whose vaccination status is unknown, should receive 2 doses of influenza vaccine 4 weeks apart, ideally by the end of October, and vaccines should be offered as soon as they become available. Children needing only 1 dose of influenza vaccine, regardless of age, should also receive vaccination ideally by the end of October.
7. Influenza vaccine may be administered simultaneously with or any time before or after administration of the currently available COVID-19 vaccines. Given that it is unknown whether reactogenicity of COVID-19 vaccines will be increased with coadministration of influenza vaccine, the reactogenicity profile of the vaccines should be considered, and providers should consult the most current ACIP/AAP guidance regarding coadministration of COVID-19 vaccines with influenza vaccines.
8. Children with acute moderate or severe COVID-19 should not receive influenza vaccine until they have recovered; children with mild illness may be vaccinated.
9. Efforts should be made to ensure vaccination for children in high-risk groups (Table 1) and their contacts, unless contraindicated.
10. Product-specific contraindications must be considered when selecting the type of vaccine to administer. Children who have had an allergic reaction after a previous dose of any influenza vaccine should be evaluated by an allergist to determine if future receipt of the vaccine is appropriate.
11. Children with egg allergy can receive influenza vaccine (IIV or LAIV) without any additional precautions beyond those recommended for all vaccines.

12. Pregnant women should receive IIV at any time during pregnancy, to protect themselves and their infants, who benefit from the transplacental transfer of antibodies. Women in the postpartum period who did not receive vaccination during pregnancy should receive influenza vaccine before discharge from the hospital. Influenza vaccination during breastfeeding is safe for mothers and their infants.
13. The AAP supports mandatory vaccination of health care personnel (HCP) as a crucial element in preventing influenza and reducing health care–associated influenza infections because HCP often care for individuals at high risk for influenza-related complications.

INFLUENZA VACCINE CONTRAINDICATIONS AND PRECAUTIONS

The contraindications and precautions for the use of IIV and LAIV are described in Table 3, and further details are provided in the technical report.[1] Anaphylactic and severe allergic reactions to any influenza vaccine are contraindications to vaccination. The AAP recommends that children who have had an allergic reaction after a previous dose of any influenza vaccine should be evaluated by an allergist to determine if future receipt of the vaccine is appropriate.

INFLUENZA TREATMENT RECOMMENDATIONS

Antivirals available for the treatment and prophylaxis of influenza in children are described in Table 4.

1. Antiviral medications are important in the control of influenza but are not a substitute for influenza vaccination. Pediatricians should promptly identify patients suspected of having influenza infection for timely initiation of antiviral treatment, when indicated and based on shared decision-making between the pediatrician and child's caregiver, to reduce morbidity and mortality. Although best results are observed when the child is treated within 48 hours of symptom onset, antiviral therapy should still be considered beyond 48 hours of symptom onset in children with severe disease or those at high risk of complications.
2. Antiviral treatment should be offered as early as possible to the following individuals, regardless of influenza vaccination status:
   - Any hospitalized child with suspected or confirmed influenza disease, regardless of duration of symptoms.
   - Any child, inpatient or outpatient, with severe, complicated, or progressive illness attributable to influenza, regardless of duration of symptoms.
   - Children with influenza infection of any severity if they are at high risk of complications of influenza infection (Table 1), regardless of duration of symptoms.
3. Treatment may be considered for the following individuals:
   - Any previously healthy, symptomatic outpatient not at high risk for influenza complications, in whom influenza is confirmed or suspected on the basis of clinical judgment, if treatment can be initiated within 48 hours of illness onset.
   - Children with suspected or confirmed influenza disease whose siblings or household contacts either are younger than 6 months or have a high-risk condition that predisposes them to complications of influenza (Table 1).

INFLUENZA CHEMOPROPHYLAXIS RECOMMENDATIONS

Antiviral chemoprophylaxis is recommended after known or suspected influenza exposure in the following situations:

- For children at high risk of complications from influenza for whom influenza vaccine is contraindicated.
- For children at high risk of complications during the 2 weeks after influenza vaccination, before optimal immunity is achieved.
- For family members or HCP who are unvaccinated and are likely to have ongoing, close exposure to
  - unvaccinated children at high risk or
  - unvaccinated infants and toddlers who are younger than 24 months.
- For control of influenza outbreaks for unvaccinated staff and children in a closed institutional setting with children at high risk (eg, extended-care facilities).
- As a supplement to vaccination among children at high risk, including children who are immunocompromised and may not respond with sufficient protective immune responses after influenza vaccination.
- As postexposure antiviral chemoprophylaxis for family members and close contacts of an infected person if those people are at high risk of complications from influenza.
- For children at high risk of complications and their family members and close contacts, as well as HCP, when circulating strains of

TABLE 3 Influenza Vaccines Contraindications and Precautions

Vaccine	Contraindication	Precaution	Provider Discretion	Not Contraindications
IIV	• Anaphylaxis or severe allergic reaction to previous influenza vaccination	• History of GBS within 6 wk of previous influenza vaccination	• Defer to resolution of illness for moderate to severe febrile illness, including COVID-19	• Minor illness, with or without fever • Egg allergy
LAIV	• Anaphylaxis or severe allergic reaction to previous influenza vaccination	• History of GBS within 6 wk of previous influenza vaccination	• Defer to resolution of illness for moderate to severe febrile illness, including COVID-19	• Minor illness, with or without fever
	• Age <2 y	• Diagnosis of asthma and aged >5 y with certain chronic underlying conditions (metabolic disease, diabetes mellitus, chronic pulmonary and/or cardiac disease, renal dysfunction, or hemoglobinopathies)	• Defer to resolution of symptoms or use IIV if a patient has nasal congestion that could impede vaccine delivery	• Egg allergy
	• Age 2–4 y with asthma or history of wheezing • Cochlear implants • Active CSF leaks • Primary or acquired immunodeficiency • On immunosuppressive or immunomodulatory therapy • Anatomic or functional asplenia (including sickle cell disease) • Close contacts or caregivers of severely immunocompromised individuals • On aspirin or salicylate-containing medications • Immunization with a live-virus vaccine within the previous 4 wk, except if given the same day • Taking or have recently taken influenza antiviral medications[a] • Currently pregnant			

CSF, cerebrospinal fluid; GBS, Guillain-Barré syndrome.
[a] Until 48 h (oseltamivir, zanamivir), 5 d (peramivir), and up to 2 wk (baloxavir) after stopping the influenza antiviral therapy.

influenza virus in the community are not well matched by seasonal influenza vaccine virus strains on the basis of current data from the Centers for Disease Control and Prevention and state or local health departments.

TABLE 4 Recommended Dosage and Schedule of Influenza Antiviral Medications for Treatment and Chemoprophylaxis in Children for the 2021–2022 Influenza Season: United States

Medication	Treatment	Chemoprophylaxis[a]
Oseltamivir[b]		
Adults	75 mg, twice daily for 5 d	75 mg, once daily for 10 d
Children ≥12 mo (based on body wt)	Duration in all groups is 5 d	Duration in all groups is 10 d
≤15 kg (≤33 lb)	30 mg, twice daily	30 mg, once daily
>15 kg–23 kg (>33 lb–51 lb)	45 mg, twice daily	45 mg, once daily
>23 kg–40 kg (>51 lb–88 lb)	60 mg, twice daily	60 mg, once daily
>40 kg (>88 lb)	75 mg, twice daily	75 mg, once daily
Infants 9–11 mo[c]	3.5 mg/kg per dose, twice daily	3.5 mg/kg per dose, once daily
Term infants 0–8 mo[c]	3 mg/kg per dose, twice daily	3 mg/kg per dose, once daily for infants 3–8 mo. Not recommended for infants aged <3 mo because of limited safety and efficacy data in this age group
Preterm infants[d]		
<38 wk postmenstrual age	1.0 mg/kg per dose, twice daily	—
38 through 40 wk postmenstrual age	1.5 mg/kg per dose, twice daily	—
>40 wk postmenstrual age	3.0 mg/kg per dose, twice daily	—
Zanamivir[e]		
Adults	10 mg (two 5-mg inhalations), twice daily for 5 d	10 mg (two 5-mg inhalations), once daily for 10 d
Children		
≥7 y for treatment	10 mg (two 5-mg inhalations), twice daily for 5 d	10 mg (two 5-mg inhalations), twice daily for 10 d
≥5 y for chemoprophylaxis	10 mg (two 5-mg inhalations), twice daily for 5 d	10 mg (two 5-mg inhalations), twice daily for 10 d
Peramivir		
Adults	One 600-mg intravenous infusion, given over 15–30 min	Not recommended
Children (2–12 y)	One 12-mg/kg dose, up to 600-mg maximum, via intravenous infusion for 15–30 min	Not recommended
Children (13–17 y)	One 600-mg dose, via intravenous infusion for 15–30 min	Not recommended
Baloxavir		
People aged ≥12 y who weigh >40 kg	40–80 kg: one 40-mg dose, orally ≥80 kg: one 80-mg dose, orally	40–80 kg: one 40-mg dose, orally ≥80 kg: one 80-mg dose, orally

Adapted from the 2018 Infectious Diseases Society of America guidelines[11] and https://www.cdc.gov/flu/professionals/antivirals/summary-clinicians.htm. —, not applicable.

[a] Centers for Disease Control and Prevent recommends routine chemoprophylaxis with oseltamivir or zanamivir for 7 days, 10 days only if part of institutional outbreak (https://www.cdc.gov/flu/professionals/antivirals/summary-clinicians.htm).

[b] The duration of treatment with oseltamivir is 5 days. Oseltamivir is administered orally without regard to meals, although administration with meals may improve gastrointestinal tolerability. Oseltamivir is available as Tamiflu in 30-mg, 45-mg, and 75-mg capsules and as a powder for oral suspension that is reconstituted to provide a final concentration of 6 mg/mL. For the 6-mg/mL suspension, a 30-mg dose is given with 5 mL of oral suspension, a 45-mg dose is given with 7.5 mL oral suspension, a 60-mg dose is given with 10 mL oral suspension, and a 75-mg dose is given with 12.5 mL oral suspension. If the commercially manufactured oral suspension is not available, a suspension can be compounded by retail pharmacies (final concentration also 6 mg/mL), based on instructions contained in the package label. In patients with renal insufficiency, the dose should be adjusted on the basis of creatinine clearance. For treatment of patients with creatinine clearance 10–30 mL/min: 75 mg, once daily for 5 days. For chemoprophylaxis of patients with creatinine clearance 10–30 mL/min: 30 mg, once daily for 10 days after exposure or 75 mg, once every other day for 10 days after exposure (5 doses). See https://www.cdc.gov/flu/professionals/antivirals/summary-clinicians.htm and Infectious Diseases Society of America guidelines.[11]

[c] Approved by the US Food and Drug Administration for children as young as 2 weeks of age. Given preliminary pharmacokinetic data and limited safety data, oseltamivir can be used to treat influenza in both term and preterm infants from birth because benefits of therapy are likely to outweigh possible risks of treatment. Of note, the Center for Disease Control and Prevention recommends a 3 mg/kg/dose, twice daily, for all infants <12 months old; the Infectious Diseases Society of America guidelines[11] include both AAP and Center for Disease Control and Prevention recommendations.

[d] Oseltamivir dosing for preterm infants. The weight-based dosing recommendation for preterm infants is lower than that for term infants. Preterm infants may have lower clearance of oseltamivir because of immature renal function, and doses recommended for term infants may lead to high drug concentrations in this age group. Limited data from the National Institute of Allergy and Infectious Diseases Collaborative Antiviral Study Group provide the basis for dosing preterm infants by using their postmenstrual age (gestational age + chronological age). For extremely preterm infants (aged <28 wks), please consult a pediatric infectious disease physician.

[e] The duration of treatment with zanamivir is 5 days. Zanamivir is administered by inhalation by using a proprietary "Diskhaler" device distributed together with the medication. Zanamivir is a dry powder, not an aerosol, and should not be administered by using nebulizers, ventilators, or other devices typically used for administering medications in aerosolized solutions. Zanamivir is not recommended for people with chronic respiratory diseases, such as asthma or chronic obstructive pulmonary disease, which increase the risk of bronchospasm.

ABBREVIATIONS

AAP: American Academy of Pediatrics
ACIP: Advisory Committee on Immunization Practices
COVID-19: novel coronavirus disease 2019
HCP: health care personnel
IIV: inactivated influenza vaccine
LAIV: live attenuated influenza vaccine
VE: vaccine effectiveness

REFERENCES

1. Munoz FM; Committee on Infectious Diseases. Recommendations for prevention and control of influenza in children, 2021–2022. *Pediatrics*. 2021;148(4):e2021053745
2. Grohskopf LA, Alyanak E, Broder KR, et al. Prevention and control of influenza with vaccines: recommendations of the Advisory Committee on Immunization Practices - United States, 2020–21 influenza season. *MMWR Recomm Rep*. 2020;69(8):1–24
3. Shope TR, Walker BH, Aird LD, Southward L, McCown JS, Martin JM. Pandemic influenza preparedness among child care center directors in 2008 and 2016. *Pediatrics*. 2017;139(6):e20163690
4. World Health Organization. Recommended composition of influenza virus vaccines for use in the 2021-2022 northern hemisphere influenza season. Available at: https://www.who.int/publications/i/item/recommended-composition-of-influenza-virus-vaccines-for-use-in-the-2021-2022-northern-hemisphere-influenza-season. Accessed June 9, 2021
5. Grohskopf LA, Alyanak E, Ferdinands JM, et al. Prevention and control of seasonal influenza with vaccines: recommendations of the Advisory Committee on Immunization Practices (ACIP)—United States, 2021–2022 influenza season. *MMWR Recomm Rep*. 2021;70(5):1–28
6. Miyakawa R, Barreto NB, Kato RM, Neely MN, Russell CJ. Early use of anti-influenza medications in hospitalized children with tracheostomy. *Pediatrics*. 2019;143(3):e20182608
7. Centers for Disease Control and Prevention. Deaths related to 2009 pandemic influenza A (H1N1) among American Indian/Alaska Natives - 12 states, 2009. *MMWR Morb Mortal Wkly Rep*. 2009;58(48):1341–1344
8. Dee DL, Bensyl DM, Gindler J, et al. Racial and ethnic disparities in hospitalizations and deaths associated with 2009 pandemic Influenza A (H1N1) virus infections in the United States. *Ann Epidemiol*. 2011;21(8):623–630
9. Gounder PP, Callinan LS, Holman RC, et al. Influenza hospitalizations among American Indian/Alaska native people and in the United States general population. *Open Forum Infect Dis*. 2014;1(1):ofu031
10. Hennessy TW, Bruden D, Castrodale L, et al; Investigative Team. A case-control study of risk factors for death from 2009 pandemic influenza A(H1N1): is American Indian racial status an independent risk factor? *Epidemiol Infect*. 2016;144(2):315–324
11. Uyeki TM, Bernstein HH, Bradley JS, et al. Clinical practice guidelines by the Infectious Diseases Society of America: 2018 update on diagnosis, treatment, chemoprophylaxis, and institutional outbreak management of seasonal influenza. *Clin Infect Dis*. 2019;68(6):e1–e47

Recommendations for Prevention and Control of Influenza in Children, 2021–2022

- *Technical Report*
  - *PPI: AAP Partnership for Policy Implementation*
    See Appendix 1 for more information.

TECHNICAL REPORT

American Academy of Pediatrics
DEDICATED TO THE HEALTH OF ALL CHILDREN™

Recommendations for Prevention and Control of Influenza in Children, 2021–2022

COMMITTEE ON INFECTIOUS DISEASES

This technical report accompanies the recommendations of the American Academy of Pediatrics for the routine use of the influenza vaccine and antiviral medications in the prevention and treatment of influenza in children during the 2021–2022 season. Influenza vaccination is an important intervention to protect vulnerable populations and reduce the burden of respiratory illnesses during circulation of severe acute respiratory syndrome coronavirus 2, which is expected to continue during this influenza season. In this technical report, we summarize recent influenza seasons, morbidity and mortality in children, vaccine effectiveness, vaccination coverage, and detailed guidance on storage, administration, and implementation. We also provide background on inactivated and live attenuated influenza vaccine recommendations, vaccination during pregnancy and breastfeeding, diagnostic testing, and antiviral medications for treatment and chemoprophylaxis.

abstract

American Academy of Pediatrics, Itasca, Illinois

DOI: https://doi.org/10.1542/peds.2021-053745

PEDIATRICS (ISSN Numbers: Print, 0031-4005; Online, 1098-4275).

To cite: AAP Committee on Infectious Diseases Recommendations for Prevention and Control of Influenza in Children, 2021–2022. *Pediatrics*. 2021;148(4):e2021053745

INTRODUCTION

This technical report accompanies the recommendations of the American Academy of Pediatrics (AAP) for the routine use of influenza vaccine and antiviral medications in the prevention and treatment of influenza in children during the 2021–2022 season.[1]

SUMMARY OF RECENT INFLUENZA SEASONS IN THE UNITED STATES

2017–2018, 2018–2019, and 2019–2020 Influenza Seasons

The 2017–2018 influenza season was the first season classified as a high-severity season for all age groups, with high levels of outpatient clinic and emergency department visits for influenzalike illness, high rates of influenza-related hospitalization, and high mortality.[2–4] Influenza A (H3N2) predominated early, followed by a second wave of

influenza B/Yamagata from March 2018 onward. Although hospitalization rates for children did not exceed those reported during the 2009 pandemic, they did surpass rates reported in previous high-severity A(H3N2)-predominant seasons. Excluding the 2009 pandemic, the 188 pediatric deaths reported during the 2017–2018 season (approximately half of which occurred in otherwise healthy children) were the highest reported since influenza-associated pediatric mortality became a nationally notifiable condition in 2004.[2–4] Among pediatric deaths of children 6 months and older who were eligible for vaccination and for whom vaccination status was known, approximately 80% had not received the influenza vaccine during the 2017–2018 season.[2] Influenza vaccine effectiveness (VE) for the 2017–2018 season in children is shown in Table 1.[3]

The 2018–2019 influenza season was the longest-lasting season reported in the United States in the past decade, with elevated levels of influenzalike illness activity for a total duration of 21 consecutive weeks (compared with an average duration of 16 weeks).[5] Variations in circulating strains affected vaccine efficacy. Influenza A(H1N1)pdm09 viruses predominated from October to mid-February, and influenza A(H3N2) viruses were identified more frequently from February to May. Influenza B (B/Victoria lineage predominant) represented approximately 5% of circulating strains. Most characterized influenza A(H3N2) viruses were antigenically distinct from the A(H3N2) component of the 2018–2019 vaccine. The vaccine's A(H3N2) virus belonged to subclade 3C.2a1. Cocirculation of multiple genetically diverse subclades of A(H3N2) was documented. Circulating viruses identified belonged to subclade 3C.2a1 or clade 3C.3a, with 3C.3a viruses accounting for >70% of the A(H3N2) viruses in the United States. This likely contributed to an overall lower VE against influenza A(H3N2) this season, despite achieving the highest vaccination coverage reported in the last decade in children (62.6% overall) (Table 1, Fig 1).[5,6]

The 2018–2019 season was of moderate severity, with similar hospitalization rates in children as during the 2017–2018 season (71 per 100 000 among children 0–4 years old and 20.4 per 100 000 among children 5–17 years old), which were higher than those observed in previous seasons from 2013–2014 to 2016–2017.[5] Among 1132 children hospitalized with influenza and for whom data were available, 55% had at least 1 underlying medical condition; the most commonly reported underlying conditions were asthma or reactive airway disease (26%), neurologic disorders (15.6%), and obesity (11.6%).[7] A total of 144 influenza-associated pediatric deaths were reported.

The 2019–2020 influenza season was unusual and complicated by the

TABLE 1 Adjusted VE in Children in the United States, by Season, as Reported by the CDC, US Influenza VE Network

Influenza Type and Age Group	2017 2018 3N2 and B/ amagata, VE (95 CI)	2018 2019 1N1 and 3N2, VE (95 CI)	2019 2020 B/Victoria and 1N1, VE (95 CI)
Influenza A and B			
Overall all ages	38 (31 to 43)	29 (21 to 35)	39 (32 to 44)
mo to 8 y	8 (55 to 77)	48 (37 to 58)	34 (19 to 4)
9 17 y	32 (1 to 44)	7 (–20 to 28)	40 (22 to 53)
Influenza A(1N1)pdm09			
Overall all ages	2 (50 to 71)	44 (37 to 51)	30 (21 to 39)
mo to 8 y	87 (71 to 95)	59 (47 to 9)	23 (–3 to 42)
9 17 y	70 (4 to 7)	24 (–18 to 51)	29 (–7 to 52)
Influenza A(3N2)			
Overall all ages	22 (12 to 31)	9 (–4 to 20)	NA
mo to 8 y	54 (33 to 9)	24 (1 to 42)	NA
9 17 y	18 (– to 3)	3 (–30 to 28)	NA
Influenza B/Victoria			
Overall all ages	7 (45 to 89)	Not reported	45 (37 to 52)
mo to 8 y	Not reported	Not reported	39 (20 to 54)
9 17 y	Note reported	Not reported	43 (23 to 58)
Influenza B/ amagata			
Overall all ages	48 (39 to 55)	Not reported	NA
mo to 8 y	77 (49 to 90)	Not reported	NA
9 17 y	28 (1 to 48)	Not reported	NA

VE is estimated as 100 (1 – odds ratio ratio of the odds of being vaccinated among outpatients with influenza-positive test results on the CDC's real-time reverse transcriptase polymerase chain reaction to the odds of being vaccinated among outpatients with influenza-negative test results); odds ratios were estimated by using logistic regression. Adjusted for study site, age group, sex, race and/or ethnicity, self-rated general health, number of days from illness onset to enrollment, and month of illness using logistic regression. NA, not applicable.

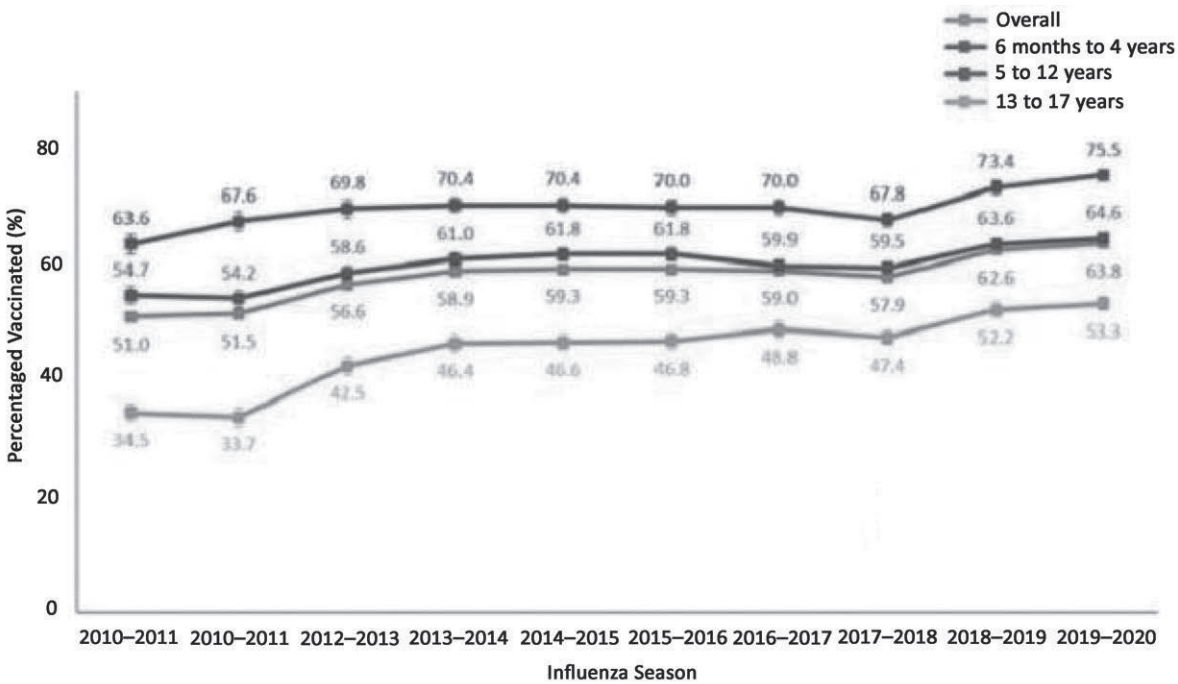


FIGURE 1 Influenza vaccination coverage in children 6 months to 17 years of age in the United States, 2010–2020. Error bars represent 95 CIs around the estimates. Adapted from Centers for Disease Control and Prevention. Flu vaccination coverage, United States, 2019–20 influenza season. Available at https //www.cdc.gov/flu/fluvaxview/coverage-1920estimates.htm ref10. Accessed uly 12, 2021; and National Immunization Survey-Flu (NIS-Flu) (https //www.cdc.gov/vaccines/imzmanagers/nis/about.html).

emergence of the severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2) pandemic in early 2020. Influenza activity began early in October 2019, continuing through mid-March 2020, with an abrupt decline after the implementation of social distancing measures for mitigation of the SARS-CoV-2 pandemic. Although influenza B/Victoria viruses predominated early in the season, influenza A(H1N1)pdm09 viruses were the most predominant circulating strain. Influenza A(H3N2) and the B/Yamagata lineage represented approximately 4.1% and 0.8% of circulating strains, respectively. A majority of characterized influenza A(H1N1)pdm09 (82.5%) and influenza B/Victoria (59.7%) viruses were antigenically similar to the viruses included in the 2019–2020 influenza vaccine. Less than half (46.5%) of influenza A(H3N2) viruses were antigenically similar to the A(H3N2) component of the 2019–2020 vaccine. During this season, the predominant A(H3N2) circulating clade was 3C.2a, subclade 3C.2a1, with cocirculation of a small proportion of 3C.3a, in contrast to the 2018–2019 season, when 3C.3a strains predominated. Estimates of the effectiveness of the 2019–2020 seasonal influenza vaccines against medically attended influenza illness from the US Flu VE Network are shown in Table 1.[8] Susceptibility to available antiviral agents remained greater than 99% for all circulating strains, but 0.5% of A(H1N1)pdm09 isolates tested by the Centers for Disease Control and Prevention (CDC) exhibited substantially reduced inhibition to oseltamivir and peramivir. Reduced susceptibility to baloxavir has not been reported in the United States to date.[9]

The 2019–2020 season was of moderate severity, although 3 peaks of influenzalike illness activity and the highest hospitalization rates in children, 68.2 per 100 000 population overall, were reported this season. The first peak of activity occurred in early January, likely associated with influenza B circulation; the second peak occurred in February, when influenza A(H1N1)pdm09 became predominant; and the third peak in March was associated with cocirculation of influenza and SARS-CoV-2. The CDC now has a separate surveillance report for novel coronavirus disease 2019 (COVID-19)–like illness.[10] The cumulative influenza hospitalization rates per 100 000 population were 92.3 among children 0 to 4 years old and 23.5 among children 5 to 17 years old. Hospitalization rates in children 0 to 4 years old were higher than those seen for this age group during the 2009 influenza pandemic, higher than the rate in adults 50 to 64 years old this season (89.4 per 100 000), and the highest

on record for this age group. Among children hospitalized with influenza and for whom data were available, 48.6% had no recorded underlying condition and 42.9% had at least 1 underlying medical condition; the most commonly reported underlying conditions were asthma or reactive airway disease (22.1%), neurologic disorders (17.5%), and obesity (12%).

There were 199 laboratory-confirmed influenza-associated pediatric deaths. Most (62.2%) of those children died after being admitted to the hospital. The median age of the pediatric deaths was 6.1 years (range, 2 months to 17 years). Seventy-seven of the pediatric deaths were associated with influenza A viruses, and 122 were associated with influenza B viruses. Among the 183 children with a known medical history, 42.6% of deaths occurred in children who had at least 1 underlying medical condition recognized by the Advisory Committee on Immunization Practices (ACIP) to increase the risk of influenza-attributable disease severity. Therefore, most (57.4%) had no known underlying medical conditions. The majority of the deaths occurred in children 2 to 12 years of age: 6.0% were younger than 6 months, 17.1% were 6 to 23 months of age, 20.6% were 2 to 4 years of age, 36.2% were 5 to 11 years of age, and 20.1% were 12 to 17 years of age. Among 72 children who died and were tested, 50% had a bacterial coinfection. Among 141 children who were 6 months or older at the time of illness onset, and therefore would have been eligible for influenza vaccination and for whom vaccination status was known, most (74%) were unvaccinated. Only 37 (26%) had received at least 1 dose of the influenza vaccine (30 had complete vaccination, and 7 had received 1 of 2 ACIP-recommended doses).

2020–2021 Influenza Season

The 2020–2021 influenza season was substantially and unusually mild, likely because of the circulation of SARS-CoV-2 and the implementation of pandemic mitigation measures. The circulation of influenza viruses was low, without a typical seasonal peak. From September 2020 to May 22, 2021, $<$0.2% of specimens tested were positive for influenza. Among public laboratory isolates, both influenza A (61.4%) and B (38.9%) viruses had been isolated. Among influenza A strains, 52.2% were influenza A(H3N2), 45% were A(H1N1)pdm09, and 2.5% were H3N2v. Furthermore, 1 human infection with a novel influenza A(H1N2) virus variant (A(H1N2)v) was reported in a child who recovered from the illness. This is the first influenza A(H1N2)v virus identified in the United States. Among influenza B strains, both Victoria (60%) and Yamagata (40%) lineages were reported. VE data could not be obtained because of low virus circulation. However, the A(H1N1)pdm09, A(H3N2), and B/Victoria strains that were genetically characterized were similar to the strains included in the vaccine. No antiviral resistance was observed among tested isolates.

The hospitalization rate during the 2020–2021 influenza season (0.8 per 100 000) is the lowest reported since routine data collection began in 2005 by the CDC. As a reference, the end-of-season hospitalization rate was only one-tenth of the previous lowest-severity season in 2011–2012. As such, age-specific hospitalization rates and rates by patient characteristics, including underlying medical conditions, are not available. The overall pneumonia, influenza, and/or COVID-19 mortality observed this season was attributable primarily to COVID-19 and not influenza. No influenza-associated pediatric deaths were identified from this past season. One influenza-associated pediatric death that occurred in January 2020 was reported during the 2020–2021 season.

INFLUENZA MORBIDITY AND MORTALITY IN CHILDREN

Influenza viruses are a common cause of acute lower respiratory tract infection (ALRTI) in children. Pediatric hospitalizations and deaths caused by influenza can be substantial. A recent study estimated that globally, influenza virus accounts for 7% of all ALRTIs, 5% of ALRTI hospitalizations, and 4% of ALRTI deaths in children younger than 5 years.[11] In the United States, the rates of influenza-associated hospitalization for children younger than 5 years consistently exceed the rates for children 5 to 17 years of age, and during the 2019–2020 season, they exceeded the hospitalization rates of adults 50 to 64 years of age.[7] Children 5 to 17 years of age also experienced higher than usual hospitalization rates during the 2019–2020 season. The impact of the anticipated SARS-CoV-2 cocirculation with influenza in the 2021–2022 season is unknown at this time. It is, therefore, particularly important that children are protected against influenza through timely vaccination in the 2021–2022 influenza season.

HIGH-RISK GROUPS IN PEDIATRICS

Children and adolescents with certain underlying medical conditions have a high risk of complications from influenza (Table 2). In addition, influenza vaccination is particularly important in African American and Hispanic/Latinx populations who have been identified as having higher rates of

TABLE 2

People at High Risk of Influenza Complications
Children <5 y, and especially those <2 y,[a] regardless of the presence of underlying medical conditions
Adults ≥50 y, and especially those ≥65 y
Children and adults with chronic pulmonary disease (including asthma and cystic fibrosis); hemodynamically significant cardiovascular disease (except hypertension alone); or renal, hepatic, hematologic (including sickle cell disease and other hemoglobinopathies), or metabolic disorders (including diabetes mellitus)
Children and adults with immunosuppression attributable to any cause, including that caused by medications or by HIV infection
Children and adults with neurologic and neurodevelopment conditions (including disorders of the brain, spinal cord, peripheral nerve, and muscle, such as cerebral palsy, epilepsy, stroke, intellectual disability, moderate to severe developmental delay, muscular dystrophy, or spinal cord injury)
Children and adults with conditions that compromise respiratory function or handling of secretions (including tracheostomy and mechanical ventilation)[124]
Women who are pregnant or post partum during the influenza season
Children and adolescents <19 y who are receiving long-term aspirin therapy or salicylate-containing medications (including those with Kawasaki disease and rheumatologic conditions) because of increased risk of Reye syndrome
American Indian/Alaska Native people[b]
Children and adults with obesity (ie, BMI ≥40 for adults and based on age for children)
Residents of chronic care facilities and nursing homes

Adapted from Grohskopf LA, Alyanak E, Ferdinands JM, et al. Prevention and control of seasonal influenza with vaccines: recommendations of the Advisory Committee on Immunization Practices—United States, 2021–22 influenza season. *MMWR Recomm Rep.* 2021;70(5):1–28

[a] The CDC recommendations state that although all children younger than 5 y old are considered at higher risk for complications from influenza, the highest risk is for those younger than 2 y old, with the highest hospitalization and death rates among infants younger than 6 mo old.

[b] American Indian/Alaska Native (AI/AN) children have higher rate of influenza complications.[125–128] Most at-risk AI/AN children will also qualify in other high-risk categories to receive appropriate antiviral treatment. In the setting of a shortage, AI/AN children should be prioritized to receive influenza vaccine or antiviral medications according to local public health guidelines.

hospitalization from influenza and being more vulnerable to COVID-19.[12] Although universal influenza vaccination is recommended for everyone starting at 6 months of age, emphasis should be placed on ensuring that people in high-risk groups and their household contacts and caregivers receive the annual influenza vaccine.

EFFECTIVENESS OF INFLUENZA VACCINATION ON HOSPITALIZATION AND MORTALITY

Several studies demonstrated that influenza vaccination effectively decreased hospitalization in children in places where universal pediatric immunization was implemented. In a study conducted by the US New Vaccine Surveillance Network in 2015–2016, among 1653 children enrolled from 7 pediatric hospitals, the adjusted VE in children with complete influenza immunization against any influenza-associated hospitalization was 56% (95% confidence interval [CI], 34% to 71%), 68% (95% CI, 36% to 84%) against A(H1N1)pdm09, and 44% (95% CI, −1% to 69%) against B viruses.[13] A study in children 6 months to 8 years of age conducted in Israel over 3 influenza seasons from 2015 to 2017 demonstrated that over all seasons, fully vaccinated children had a VE against hospitalization of 53.9% (95% CI, 38.6% to 68.3%), whereas partial vaccination was not effective (25.6%; 95% CI, −3% to 47%).[14] In this study, a VE against hospitalization as high as 60% to 80% was observed when circulating and vaccine influenza A and B strains matched. After establishing free vaccination for preschool-aged children and children at risk because of comorbid medical conditions in Australia in 2018, VE of the influenza vaccine in preventing influenza hospitalization was estimated to be 78.8% (95% CI, 66.9% to 86.4%).[15] In the United Kingdom, during the 2018–2019 season, the overall adjusted VE against influenza-confirmed hospitalization was reported to be 53% (95% CI, 33.3% to 66.8%), with protection varying by strain. Protection was 63.5% (95% CI, 34.4% to 79.7%) against influenza A(H1N1)pdm09, but there was no protection against influenza A(H3N2).[16] Finally, in a systematic review and meta-analysis of 28 studies, Kalligeros et al[17] concluded that the influenza vaccine offered significant protection against any type of influenza-related hospitalization in children 6 months to 17 years of age, with a VE of 57.5% (95% CI, 54.8% to 65.5%). Strain-specific VE was higher for influenza A(H1N1)pdm09 (75.1%; 95% CI, 54.8% to 93.3%) and influenza B (50.9%; 95% CI, 41.7% to 59.9%), compared with influenza A(H3N2) (40.8%; 95% CI, 25.6% to 55.9%). As expected, children who were fully vaccinated were better protected (VE 61.8%; 95% CI, 54.4% to 69.1%) compared with those who were partially vaccinated (VE 33.91%; 95% CI, 21.1% to 46.7%). Notably, VE was higher in children younger than 5 years (61.7%; 95% CI, 49.3% to 74.1%) than in children 6 to 17 years of age (54.4%; 95% CI, 35.1% to 73.6%). In the United States, the CDC estimated that during the 2018–2019 season, influenza vaccination prevented 20% of projected hospitalizations associated with infection with the A(H1N1)pdm09 virus among

children 5 to 17 years of age and 43% among children 6 months to 4 years of age.[18]

Historically, up to 80% of influenza-associated pediatric deaths have occurred in unvaccinated children 6 months and older. Influenza vaccination is associated with reduced risk of laboratory-confirmed influenza-related pediatric death.[19] In one case-cohort analysis comparing vaccination uptake in laboratory-confirmed influenza-associated pediatric deaths to estimated vaccination coverage among pediatric cohorts in the United States from 2010 to 2014, Flannery et al[19] found that only 26% of children had received the vaccine before illness onset, compared to an average vaccination coverage of 48%. Overall VE against influenza-associated death in children was 65% (95% CI, 54% to 74%). More than half of children in this study who died of influenza had ≥1 underlying medical condition associated with increased risk of severe influenza-related complications; only 1 in 3 of these at-risk children had been vaccinated; yet VE against death in children with underlying conditions was 51% (95% CI, 31% to 67%). Similarly, influenza vaccination reduces by three-quarters the risk of severe life-threatening laboratory-confirmed influenza in children requiring admission to the ICU.[20] The influenza virus type might also affect the severity of disease. In a study of hospitalizations for influenza A versus B, the odds of mortality were significantly greater with influenza B than with influenza A and were not entirely explained by underlying health conditions.[21]

SEASONAL INFLUENZA VACCINES

The seasonal influenza vaccines licensed for children and adults for the 2021–2022 season are shown in Table 3. More than one product may be appropriate for a given patient, and vaccination should not be delayed to obtain a specific product.

All 2021–2022 seasonal influenza vaccines will be quadrivalent and contain the same influenza strains as recommended by the World Health Organization (WHO) and the US Food and Drug Administration's (FDA's) Vaccines and Related Biological Products Advisory Committee for the Northern Hemisphere.[22] Both influenza A(H1N1) and A(H3N2) components are different in this season's vaccine. The B components are unchanged. The influenza A strains may be different for egg-based versus cell- or recombinant-based vaccines on the basis of their optimal characteristics for each platform, but all are matched to the strains expected to circulate in the 2021–2022 season.

1. Quadrivalent vaccines contain the following:
   a. influenza A(H1N1) component:
      i. egg-based vaccines: A/Victoria/2570/2019 (H1N1) pdm09-like virus (new this season); and
      ii. cell- or recombinant-based vaccines: A/Wisconsin/588/2019 (H1N1) pdm09-like virus (new this season);
   b. influenza A(H3N2) component:
      i. egg-based vaccines: A/Cambodia/e0826360/2020 (H3N2)-like virus (new this season); and
      ii. cell- or recombinant-based vaccines: A/Cambodia/e0826360/2020 (H3N2)-like virus (new this season);
   c. B/Victoria component:
      i. all vaccines: B/Washington/02/2019-like virus (B/Victoria/2/87 lineage) (unchanged); and
   d. B/Yamagata component:
      i. all vaccines: B/Phuket/3073/2013-like virus (B/Yamagata/16/88 lineage) (unchanged).
2. Trivalent vaccines do not include the B/Yamagata component (not available in United States).

Inactivated Influenza Vaccine

For the 2021–2022 season, all licensed inactivated influenza vaccines (IIVs) for children and adults in the United States are quadrivalent vaccines, with specific age indications for available formulations (Table 3). Among vaccines available for children, 4 are egg based (seed strains grown in eggs) and 1 is cell culture based (seed strains grown in Madin-Darby canine kidney cells). All inactivated egg-based vaccines (Afluria Quadrivalent, Fluarix Quadrivalent, Flulaval Quadrivalent, and Fluzone Quadrivalent) are licensed for children 6 months and older and are available in single-dose, thimerosal-free, prefilled syringes. The only pediatric cell culture–based vaccine (Flucelvax Quadrivalent) is now licensed for children 2 years and older.[23] The extension of the age indication down from 4 years to 2 years of age in March 2021 was based on data from a randomized double-blind clinical efficacy study conducted among children 2 to 18 years of age over 3 seasons (2017 in the Southern Hemisphere and 2017–2018 and 2018–2019 in the Northern Hemisphere), in which Flucelvax Quadrivalent demonstrated efficacy against laboratory-confirmed influenza illness of 54.6% (95% CI, 45.7% to 62.1%), compared with a control vaccine (meningococcal serogroup ACWY conjugate vaccine).[24]

A quadrivalent recombinant baculovirus-expressed hemagglutinin influenza vaccine (quadrivalent recombinant influenza vaccine [RIV4]) (Flublok

TABLE 3 Recommended Seasonal Influenza Vaccines for Different Age Groups: United States, 2021–2022 Influenza Season

Vaccine	Trade Name (Manufacturer)	Age Group	Presentation and Hemagglutinin Antigen Content (IIVs and RIV4) or Virus Count (LAIV4) per Dose for Each Antigen	Thimerosal Mercury Content, µg Hg/0.5-mL Dose	CPT Code
Quadrivalent standard dose: egg-based vaccines					
IIV4	Afluria Quadrivalent (Seqirus)	6–35 mo	0.25-mL prefilled syringe (7.5 µg/0.25 mL)	0	90685
	—	≥36 mo	0.5-mL prefilled syringe (15 µg/0.5 mL)	0	90686
	—	≥6 mo	5.0-mL multidose vial[a] (15 µg/0.5 mL)	24.5	90687
IIV4	Fluarix Quadrivalent (GlaxoSmithKline)	≥6 mo	0.5-mL prefilled syringe (15 µg/0.5 mL)	0	90686
IIV4	FluLaval Quadrivalent (GlaxoSmithKline)	≥6 mo	0.5-mL prefilled syringe (15 µg/0.5 mL)	0	90686
IIV4	Fluzone Quadrivalent (Sanofi Pasteur)	≥6 mo	0.5-mL prefilled syringe (15 µg/0.5 mL) (0.25 mL no longer available)	0	90686
	—	≥6 mo	0.5-mL single-dose vial (15 µg/0.5 mL)	0	90686
	—	≥6 mo	5.0-mL multidose vial[a] (15 µg/0.5 mL)	25	90687
Quadrivalent standard dose: cell culture–based vaccines					
ccIIV4	Flucelvax Quadrivalent (Seqirus)	≥2 y	0.5-mL prefilled syringe (15 µg/0.5 mL)	0	90674
	—	≥2 y	5.0 mL multidose vial[a] (15 µg/0.5 mL)	25	90756
Quadrivalent standard dose: egg-based with adjuvant vaccines					
aIIV4 MF-59 adjuvanted	Fluad Quadrivalent (Seqirus)	≥65 y	0.5-mL prefilled syringe (15 µg/0.5 mL)	0	90653
Quadrivalent high dose: egg-based vaccine					
IIV4	Fluzone High-Dose Quadrivalent (Sanofi Pasteur)	≥65 y	0.7-mL prefilled syringe (60 µg/0.7 mL)	0	90662
Recombinant vaccine					
RIV4	Flublok Quadrivalent (Sanofi Pasteur)	≥18 y	0.5-mL prefilled syringe (45 µg/0.5 mL)	0	90682
Live attenuated vaccine					
LAIV4	FluMist Quadrivalent (AstraZeneca)	2–49 y	0.2-mL prefilled intranasal sprayer (virus dose: 10 6.5–7.5 FFU/0.2 mL)	0	90672

Adapted from Grohskopf LA, Alyanak E, Ferdinands JM, et al. Prevention and control of seasonal influenza with vaccines: recommendations of the Advisory Committee on Immunization Practices—United States, 2021–22 influenza season. *MMWR Recomm Rep.* 2021;70(5):1–28. The implementation guidance on supply, pricing, payment, CPT coding, and liability issues can be found at www.aapredbook.org/implementation. aIIV4, quadrivalent adjuvanted inactivated influenza vaccine; ccIIV4, quadrivalent cell culture–based inactivated influenza vaccine; CPT, *Current Procedural Terminology*; FFU, fluorescent focus unit; —, not applicable.

[a] For vaccines that include a multidose vial presentation, a maximum of 10 doses can be drawn from a multidose vial.

Quadrivalent) is licensed only for people 18 years and older. A high-dose quadrivalent inactivated influenza vaccine (IIV4) (Fluzone High-Dose Quadrivalent) containing 4 times the amount of antigen for each virus strain compared with the standard-dose vaccines is licensed only for people 65 years and older. The quadrivalent MF-59 adjuvanted inactivated vaccine (Fluad Quadrivalent) was licensed for people 65 years and older in February 2020.[23] Adjuvants may be included in a vaccine to elicit a more robust immune response, which could lead to a reduction in the number of doses required for children. In one pediatric study, the relative vaccine efficacy of an MF-59 adjuvanted influenza vaccine was significantly greater than that of a nonadjuvanted vaccine in the 6- to 23-month age group.[25] Adjuvanted seasonal influenza vaccines are not licensed for children in the United States.

Children 36 months (3 years) and older can receive any age-appropriate licensed IIV, administered at a 0.5-mL dose containing 15 μg of hemagglutinin (HA) from each strain. Children 6 to 35 months of age may receive any age-appropriate licensed IIV without preference for one product over another. Several vaccines have been licensed for children 6 to 35 months of age since 2017 (Table 3). All are quadrivalent, but the dose volume, and therefore the antigen content, may vary among different IIV products. In addition to a 0.25-mL (7.5 μg of HA per vaccine virus) Fluzone Quadrivalent vaccine, a 0.5-mL formulation of Fluzone Quadrivalent containing 15 μg of HA per vaccine virus per dose was licensed in January 2019 after these 2 formulations were shown to have comparable safety and immunogenicity in a single randomized multicenter study.[26–28] Only the 0.5-mL Fluzone prefilled syringe will be available this season. In addition, 2 other vaccines, Fluarix Quadrivalent[29] and FluLaval Quadrivalent,[30] are licensed at a 0.5-mL dose in children 6 to 35 months of age. These 2 vaccines do not have a 0.25-mL dose formulation. Afluria Quadrivalent is the only pediatric vaccine that has a 0.25-mL presentation for children 6 to 35 months of age. Afluria 0.5 mL is licensed for children 3 years and older only.[31]

Given that different formulations of IIV for children 6 to 35 months of age are available, care should be taken to administer the appropriate volume and dose for each product. In each instance, the recommended volume may be administered from an appropriate prefilled syringe, a single-dose vial, or a multidose vial, as supplied by the manufacturer. For vaccines that include a multidose vial presentation, a maximum of 10 doses can be drawn from a multidose vial. Importantly, dose volume is different from the number of doses needed to complete vaccination. Children 6 months to 8 years of age who require 2 doses of the vaccine for the 2021–2022 season should receive 2 separate doses at the recommended dose volume specified for each product.

IIVs are well tolerated in children and can be used in healthy children as well as those with underlying chronic medical conditions. CDC best practice guidelines should be followed for administration (https://www.cdc.gov/vaccines/hcp/acip-recs/general-recs/). The most common injection site adverse reactions after administration of IIV in children are injection site pain, redness, and swelling. The most common systemic adverse events are drowsiness, irritability, loss of appetite, fatigue, muscle aches, headache, arthralgia, and gastrointestinal tract symptoms.

IIVs can be administered concomitantly with other inactivated or live vaccines.[32–36] The influenza vaccine may be administered simultaneously or at any time before or after administration of the currently available COVID-19 vaccines.[37] In general, although data are not available for concomitant administration of COVID-19 with other vaccines in children, extensive experience with non-COVID-19 vaccines has demonstrated that immunogenicity and adverse event profiles are generally similar when vaccines are administered simultaneously as when they are administered alone. Furthermore, concomitant administration with the influenza vaccine is being evaluated in adults (unpublished observations presented at ACIP Influenza Workgroup meeting, February 2, 2021), and data in children are anticipated to inform recommendations. Given that it is unknown whether reactogenicity of COVID-19 vaccines will be increased with coadministration of the influenza vaccine, the reactogenicity profile of the vaccines should be considered, and providers should consult the most current ACIP and AAP guidance regarding coadministration of COVID-19 vaccines with influenza vaccines.[38] Overall, the benefits of timely vaccination with same-day administration of IIV and other recommended vaccines outweigh the risk of potential reactogenicity in children.

Thimerosal-containing vaccines are not associated with an increased risk of autism spectrum disorder in children. Thimerosal from vaccines has not been linked to any neurologic condition. The AAP supports the current WHO recommendations for use of

thimerosal as a preservative in multiuse vials in the global vaccine supply.[39] Despite the lack of evidence of harm, some states have legislation restricting the use of vaccines that contain even trace amounts of thimerosal. The benefits of protecting children against the known risks of influenza are clear. Therefore, to the extent permitted by state law, children should receive any available formulation of IIVs rather than delaying vaccination while waiting for reduced thimerosal-content or thimerosal-free vaccines. IIV formulations that are free of even trace amounts of thimerosal are widely available (Table 3).

Live Attenuated (Intranasal) Influenza Vaccine

The intranasal live attenuated influenza vaccine (LAIV) was initially licensed in the United States in 2003 for people 5 to 49 years of age as a trivalent formulation (trivalent live attenuated influenza vaccine [LAIV3]), and the approved age group was extended to 2 years of age in 2007. The quadrivalent formulation (quadrivalent live attenuated influenza vaccine [LAIV4]), licensed in 2012, was first available during the 2013–2014 influenza season, replacing the LAIV3.

The CDC conducted a systematic review of published studies evaluating the effectiveness of the LAIV3 and LAIV4 in children from the 2010–2011 to the 2016–2017 influenza seasons, including data from US and European studies.[40] The data suggested that the effectiveness of the LAIV3 or LAIV4 for the influenza A(H1N1)pdm09 strain was lower than that of the IIV in children 2 to 17 years of age. The LAIV was similarly effective against influenza B and A/H3N2 strains in some age groups compared with the IIV. The LAIV was not recommended by the CDC or AAP for use in children during the 2016–2017 and 2017–2018 seasons, given concerns about its effectiveness against A(H1N1)pdm09. For the 2017–2018 season, a new A(H1N1)pdm09-like virus strain (A/Slovenia/2903/2015) was included in the LAIV4, replacing the previous A/Bolivia/559/2013 strain. A study conducted by the LAIV4 manufacturer evaluated viral shedding and immunogenicity associated with the LAIV4 formulation containing the new A(H1N1) pdm09-like virus among US children 24 to 48 months of age.[41] Shedding and immunogenicity data suggested that the new influenza A(H1N1)pdm09-like virus included in its latest formulation had improved replicative fitness over previous LAIV4 influenza A(H1N1)pdm09-like virus strains, resulting in an improved immune response comparable to that of the LAIV3 available before the 2009 pandemic. Shedding and replicative fitness are not known to correlate with efficacy, and no published effectiveness estimates for this revised formulation of the vaccine against influenza A(H1N1)pdm09 viruses were available before the start of the 2018–2019 influenza season because influenza A(H3N2) and influenza B viruses predominated during the 2017–2018 Northern Hemisphere season. Therefore, for the 2018–2019 influenza season, the AAP recommended the IIV4 or trivalent inactivated influenza vaccine as the primary choice for influenza vaccination in children, with LAIV4 use reserved for children who would not otherwise receive an influenza vaccine and for whom LAIV use was appropriate for age (2 years and older) and health status (ie, healthy, without any underlying chronic medical condition).

In February 2019, the AAP Committee on Infectious Diseases reviewed available data on influenza epidemiology and VE for the 2018–2019 season and agreed that harmonizing recommendations between the AAP and CDC for the use of LAIVs in the 2019–2020 season was appropriate. After the February 2020 ACIP meeting, the AAP Committee on Infectious Diseases reviewed available epidemiological and effectiveness data for the previous and current seasons to inform recommendations for the 2020–2021 season. Despite the early circulation of A(H1N1)pdm09 during the 2018–2019 season and its predominance during the 2019–2020 season, low use of the LAIV4 in the US population has limited the evaluation of product-specific VE, and no additional US data on VE for the LAIV4 are available. Although the proportion of the LAIV used for vaccination is unknown, interim overall VE (not specific to a type of vaccine) for the 2019–2020 influenza season showed reassuring protection in children against circulating influenza A and B strains (Table 1).[42] Furthermore, influenza vaccine coverage rates in children were stable until the COVID-19 pandemic.[6] In European surveillance networks where uninterrupted use of the LAIV has continued from the 2016–2017 to the 2019–2020 seasons, the United Kingdom was the only country to report final VE against medically attended influenza for the 2018–2019 season. In children 2 to 17 years of age, the reported VE was 49.9% (95% CI, −14.3% to 78.0%) for A(H1N1)pdm09 and 27.1% (95% CI, −130.5% to 77%) for A(H3N2).[43] The final adjusted VE in the United States (where mostly the IIV was used) for 2018–2019 against A(H1N1)pdm09 was 59% (95% CI, 47% to 69%) for children 6 months to 8 years of age but only 24% (95% CI, −18% to 51%) for children 9 to 17 years of age. The

reported US VE was 24% (95% CI, 1% to 42%) in children 6 months to 8 years of age and 3% (95% CI, −30% to 28%) in children 9 to 17 years of age for A(H3N2).[44] Direct comparisons cannot be made given differences in reporting of VE for various age groups. Other countries that use the LAIV (Canada, Finland) have not reported LAIV4-specific VE in the past several seasons. Small case numbers and low LAIV use may also limit accurate VE calculations in these countries. In general, as long as use of the LAIV is low relative to the IIV, it will be difficult to estimate LAIV VE accurately. Furthermore, important variability in VE against all strains is reported for both the IIV and LAIV.

Influenza VE varies from season to season and is affected by many factors, including age and health status of the recipient, influenza type and subtype, existing immunity from previous infection or vaccination, and degree of antigenic match between vaccine and circulating virus strains. It is possible that VE also differs among individual vaccine products; however, product-specific comparative effectiveness data are lacking for most vaccines. Additional experience over multiple influenza seasons will help to determine optimal use of the available vaccine formulations in children. The AAP will continue to monitor annual influenza surveillance and VE reports to update influenza vaccine recommendations if necessary.

The most commonly reported reactions of the LAIV4 in children are runny nose or nasal congestion, headache, decreased activity or lethargy, and sore throat. The LAIV4 may be administered simultaneously with other inactivated or live vaccines, but if not given simultaneously, it is recommended that administration of other live vaccines is separated by a 4-week interval from LAIV4 vaccination.

LAIV and Immunocompromised Hosts

The IIV is the vaccine of choice for anyone in close contact with a subset of severely immunocompromised people (ie, those requiring a protected environment). The IIV is preferred over the LAIV for contacts of severely immunocompromised people because of a theoretical risk of infection attributable to LAIV strains in an immunocompromised contact of an LAIV-immunized person. Available data indicate a low risk of transmission of the virus from both children and adults vaccinated with the LAIV. Health care personnel (HCP) immunized with the LAIV may continue to work in most units of a hospital, including the NICU and general oncology ward, using standard infection-control techniques. As a precautionary measure, people recently vaccinated with the LAIV should restrict contact with severely immunocompromised patients for 7 days after immunization, although there have been no reports of LAIV transmission from a vaccinated person to an immunocompromised person. In the theoretical scenario in which symptomatic LAIV infection develops in an immunocompromised host, LAIV strains are susceptible to antiviral medications.

INFLUENZA VACCINE CONTRAINDICATIONS AND PRECAUTIONS

Anaphylactic and severe allergic reactions to any influenza vaccine are contraindications to vaccination. The AAP recommends that children who have had an allergic reaction after a previous dose of any influenza vaccine should be evaluated by an allergist to determine if future receipt of the vaccine is appropriate.

Minor illnesses, with or without fever, are not contraindications to the use of influenza vaccines, including among children with mild upper respiratory infection symptoms or allergic rhinitis. In children with a moderate to severe febrile illness (eg, high fever, active infection, requiring hospitalization), on the basis of the judgment of the clinician, vaccination should be deferred until resolution of the illness. Children with confirmed COVID-19 can receive the influenza vaccine when the acute illness has resolved and/or illness is mild. Children with an amount of nasal congestion that would notably impede vaccine delivery into the nasopharyngeal mucosa should have the LAIV deferred until resolution or may receive the IIV.

A precaution for vaccination is a condition in a recipient that might increase the risk or seriousness of a possible vaccine-related adverse reaction. A precaution also may exist for conditions that might compromise the ability of the host to develop immunity after vaccination. Vaccination may be recommended in the presence of a precaution if the benefit of protection from the vaccine outweighs the potential risks.

A history of Guillain-Barré syndrome (GBS) after influenza vaccination is considered a precaution for the administration of influenza vaccines. GBS is rare, especially in children, and there is a lack of evidence on risk of GBS after influenza vaccination in children. Nonetheless, regardless of age, a history of GBS <6 weeks after a previous dose of the influenza vaccine is a precaution for administration of the influenza vaccine. GBS may occur after influenza infection. The benefits of influenza vaccination might

outweigh the risks for certain people who have a history of GBS (particularly if not associated with previous influenza vaccination) and who also are at high risk for severe complications from influenza.

Specific precautions for the LAIV include a diagnosis of asthma in children 5 years and older and the presence of certain chronic underlying medical conditions, including metabolic disease, diabetes mellitus, other chronic disorders of the pulmonary or cardiovascular systems, renal dysfunction, or hemoglobinopathies. Because the safety of the LAIV has not been definitively established in these situations, the IIV should be considered, and vaccination should not be delayed in these high-risk groups. People who should not receive the LAIV are listed below.

People in whom the LAIV is contraindicated include the following:

- children younger than 2 years;
- children 2 to 4 years of age with a diagnosis of asthma or a history of recurrent wheezing or a medically attended wheezing episode in the previous 12 months because of the potential for increased wheezing after immunization; in this age range, many children have a history of wheezing with respiratory tract illnesses and are eventually diagnosed with asthma;
- children with cochlear implants or active cerebrospinal fluid leaks;
- children who have a known or suspected primary or acquired immunodeficiency or who are receiving immunosuppressive or immunomodulatory therapies;
- children with anatomic or functional asplenia, including from sickle cell disease;
- close contacts and caregivers of those who are severely immunocompromised and require a protected environment;
- children and adolescents receiving aspirin or salicylate-containing medications;
- children who have received other live-virus vaccines within the previous 4 weeks (except for the rotavirus vaccine); however, the LAIV can be administered on the same day with other live-virus vaccines if necessary;
- children taking an influenza antiviral medication until 48 hours (oseltamivir, zanamivir), 5 days (peramivir), or 2 weeks (baloxavir) after stopping the influenza antiviral therapy; if a child recently received the LAIV but has an influenza illness for which antiviral agents are appropriate, the antiviral agents should be given; if antiviral agents are necessary for treatment within 2 weeks of LAIV immunization, reimmunization or administration of IIV is indicated because of the potential effects of antiviral medications on LAIV replication and immunogenicity; and
- pregnant women.

INFLUENZA VACCINES AND EGG ALLERGY

There is strong evidence that individuals with egg allergies can safely receive the influenza vaccine without any additional precautions beyond those recommended for any vaccine.[45,46] The presence of an egg allergy in an individual is not a contraindication to receive the IIV or LAIV. Vaccine recipients with egg allergies are at no greater risk for a systemic allergic reaction than those without egg allergies. Therefore, precautions, such as choice of a particular vaccine, special observation periods, or restriction of administration to particular medical settings, are not warranted and constitute an unnecessary barrier to immunization. It is not necessary to inquire about an egg allergy before the administration of any influenza vaccine, including on screening forms. Routine prevaccination questions regarding anaphylaxis after receipt of any vaccine are appropriate. Standard vaccination practice for all vaccines in children should include the ability to respond to rare acute hypersensitivity reactions. Children who have had a previous allergic reaction to the influenza vaccine should be evaluated by an allergist to determine if future receipt of the vaccine is appropriate.

INFLUENZA VACCINES DURING PREGNANCY AND BREASTFEEDING

The influenza vaccine is recommended by the ACIP, the American College of Obstetrics and Gynecology, and the American Academy of Family Physicians for all women during any trimester of gestation for the protection of mothers against influenza and its complications.[23,47] Substantial evidence has accumulated regarding the efficacy of maternal influenza immunization in preventing laboratory-confirmed influenza disease and its complications in both mothers and their infants in the first 2 to 6 months of life.[47–52] Pregnant women who are immunized against influenza at any time during their pregnancy provide protection to their infants during their first 6 months of life, when they are too young to receive the influenza vaccine themselves, through transplacental passage of antibodies.[49–57] Infants born to women who receive influenza vaccination during pregnancy have been shown to have a risk reduction of up to 72% (95% CI, 39% to 87%) for laboratory-confirmed influenza hospitalization in the first few months of life.[55]

It is safe to administer the IIV to pregnant women during any trimester of gestation and post partum. Any licensed, recommended, and age-appropriate influenza vaccine may be used, although experience with the use of the RIV4 in pregnant women is limited. The LAIV is contraindicated during pregnancy. Data on the safety of influenza vaccination at any time during pregnancy continues to support the safety of influenza immunization during pregnancy.[47,49–54,58] In a 5-year retrospective cohort study from 2003 to 2008 with more than 10 000 women, influenza vaccination in the first trimester was not associated with an increase in the rates of major congenital malformations.[59] Similarly, a systematic review and meta-analysis of studies of congenital anomalies after vaccination during pregnancy, including data from 15 studies (14 cohort studies and 1 case-control study), did not show any association between congenital defects and influenza vaccination in any trimester, including the first trimester of gestation.[60] Assessments of any association with influenza vaccination and preterm birth and infants small for gestational age have yielded inconsistent results, with most studies reporting a protective effect or no association against these outcomes.[61,62] The authors of a cohort study from the Vaccines and Medications in Pregnancy Surveillance System of vaccine exposure during the 2010–2011 to 2013–2014 influenza seasons found no significant association of spontaneous abortion with influenza vaccine exposure in the first trimester or within the first 20 weeks' gestation.[63] One observational Vaccine Safety Datalink study conducted during the 2010–2011 and 2011–2012 influenza seasons indicated an association between receipt of the IIV containing H1N1pdm09 and risk of spontaneous abortion when an H1N1pdm09-containing vaccine had also been received the previous season.[64] A follow-up study conducted by the same investigators with a larger population and stricter outcome measures did not show this association and further supported the safety of the influenza vaccine during pregnancy.[65]

Women in the postpartum period who did not receive influenza vaccination during pregnancy should be encouraged to discuss receiving the influenza vaccine before discharge from the hospital with their obstetrician, family physician, nurse midwife, or other trusted provider. Women who traditionally experience barriers to preventive care (eg, women who do not qualify for Medicaid) should be offered vaccination before hospital discharge or offered information in their preferred language about free vaccine clinics. Vaccination during breastfeeding is safe for mothers and their infants.

Breastfeeding is strongly recommended to protect infants against influenza viruses by activating innate antiviral mechanisms, specifically type 1 interferons. Human milk from mothers vaccinated during the third trimester also contains higher levels of influenza-specific immunoglobulin A.[66] Greater exclusivity of breastfeeding in the first 6 months of life decreases the episodes of respiratory illness with fever in infants of vaccinated mothers. For infants born to mothers with confirmed influenza illness at delivery, breastfeeding is encouraged, and guidance on breastfeeding practices can be found at https://www.cdc.gov/breastfeeding/breastfeeding-special-circumstances/maternal-or-infant-illnesses/influenza.html and at https://www.cdc.gov/flu/professionals/infectioncontrol/peri-post-settings.htm. Breastfeeding should be encouraged even if the mother or infant has influenza illness. The mother should pump and feed expressed milk if she or her infant is too sick to breastfeed. If the breastfeeding mother requires antiviral agents, treatment with oral oseltamivir is preferred. The CDC does not recommend use of baloxavir for treatment of pregnant women or breastfeeding mothers. There are no available efficacy or safety data in pregnant women, and there are no available data on the presence of baloxavir in human milk, the effects on the breastfed infant, or the effects on milk production.

VACCINE STORAGE AND ADMINISTRATION

The AAP storage and handling tip sheet provides resources for practices to develop comprehensive vaccine management protocols to keep the temperature for vaccine storage constant during a power failure or other disaster.[67] The AAP recommends the development of a written disaster plan for all practice settings. During the COVID-19 pandemic, the AAP recommends that influenza vaccine administration follow CDC guidance for administration of immunizations (https://www.cdc.gov/vaccines/pandemic-guidance/index.html). Vaccination in the medical home is ideal to ensure that pediatric patients receive other vaccinations and routine care in a timely manner and receive catch-up immunizations if delays have occurred because of the pandemic. In general, infection-prevention measures should be in place for all patient encounters, including screening for symptoms, physical distancing, respiratory and hand hygiene, and surface decontamination. In

addition to standard precautions and hand hygiene, during the COVID-19 pandemic, it is recommended that vaccine administrators wear a surgical face mask (not N95 or respirator) at all times and eye protection if the level of community spread is moderate or elevated.[68] Administration of the LAIV intranasally is not an aerosol-generating procedure; however, vaccine administrators are advised to wear gloves when administering the LAIV given the potential for contact with respiratory secretions. Gloves used for intranasal or intramuscular vaccine administration should be changed with every patient. Gowns are not required.

IIVs

IIVs for intramuscular injection are shipped and stored at 2°C to 8°C (36°F–46°F); vaccines that are inadvertently frozen should not be used. These vaccines are administered intramuscularly into the anterolateral thigh of infants and young children and into the deltoid muscle of older children and adults. Given that various IIVs are available, careful attention should be paid to ensure that each product is used according to its approved age indication, dosing, and volume of administration (Table 3). A 0.5-mL unit dose of any IIV should not be split into 2 separate 0.25-mL doses. If a lower dose than recommended is inadvertently administered to a child 36 months or older (eg, 0.25 mL), an additional 0.25-mL dose should be administered to provide a full dose of 0.5 mL as soon as possible. The total number of full doses appropriate for age should be administered. If a child is inadvertently vaccinated with a formulation only approved for adults, the dose should be counted as valid.

LAIV

The cold-adapted, temperature-sensitive LAIV4 formulation is shipped and stored at 2°C to 8°C (35°F–46°F) and administered intranasally in a prefilled single-use sprayer containing 0.2 mL of the vaccine. A removable dose-divider clip is attached to the sprayer to facilitate administration of 0.1 mL separately into each nostril. If the child sneezes immediately after administration, the dose should not be repeated.

TIMING OF VACCINATION AND DURATION OF PROTECTION

Although peak influenza activity in the United States tends to occur from January to March, influenza can circulate from early fall (October) to late spring (May), with one or more disease peaks. This pattern of circulation was substantially altered during the COVID-19 pandemic. Predicting the onset and duration or the severity of the influenza season with accuracy is impossible. It is also challenging to balance public health strategies needed to achieve high vaccination coverage with achieving optimal individual immunity for protection against influenza at the peak of seasonal activity, knowing that the duration of immunity after vaccination can wane over time. Initiation of influenza vaccination before influenza is circulating in the community and continuing to vaccinate throughout the influenza season are important components of an effective influenza vaccination strategy.

Complete influenza vaccination by the end of October is recommended by the CDC and AAP. Children who need 2 doses of the vaccine should receive their first dose as soon as possible when the vaccine becomes available, to allow sufficient time for receipt of the second dose ≥4 weeks after the first, before the onset of the influenza season. Children who require only 1 dose of the influenza vaccine should also ideally be vaccinated by the end of October. Recent data in adults suggest that early vaccination (July or August) might be associated with suboptimal immunity before the end of the influenza season, and the CDC now discourages vaccination in the summer months, particularly among older adults.[37]

Although the evidence is limited in children, recent reports raise the possibility that early vaccination might contribute to reduced protection later in the influenza season.[69–80] In these studies, VE decreased within a single influenza season, and this decrease was correlated with increasing time after vaccination. However, this decay in VE was not consistent across different age groups and varied by season and virus subtypes. In some studies, waning VE was more evident among older adults and younger children[72,74] and with influenza A(H3N2) viruses more than influenza A(H1N1) or B viruses.[73,76,78] A multiseason analysis from the US Flu VE Network found that VE declined by approximately 7% per month for influenza A (H3N2) and influenza B and by 6% to 11% per month for influenza A (H1N1)pdm09 in individuals 9 years and older.[71] VE remained greater than 0 for at least 5 to 6 months after vaccination. A more recent study of children older than 2 years also found evidence of declining VE, with an odds ratio increasing approximately 16% with each additional 28 days from vaccine administration.[77] Another study evaluating VE from the 2011–2012 to the 2013–2014 influenza seasons demonstrated 54% to 67% protection from 0 to 180 days after vaccination.[75] Finally, a multiseason study in Europe from 2011–2012 to 2014–2015 showed a

steady decline in VE down to 0% protection by 111 days after vaccination.[76]

Further evaluation is needed before any policy change in timing of influenza administration in children is made. An early onset of the influenza season is a concern when considering delaying vaccination. Until there are definitive data demonstrating waning immunity influences VE in children, administration of the influenza vaccine should not be delayed to a later date because this increases the likelihood of missing influenza vaccination altogether.[81] Providers may continue to offer vaccination as long as influenza is circulating and until June 30 of each year, when the seasonal influenza vaccine expires, because the duration of influenza circulation is unpredictable. Furthermore, a person may experience more than 1 influenza infection during a given season because of the various cocirculating strains. Although influenza activity in the United States is typically low during the summer, influenza cases and outbreaks can occur, particularly among international travelers, who may be exposed to influenza year-round, depending on the destination.

VACCINE IMPLEMENTATION

The AAP Partnership for Policy Implementation has developed a series of definitions using accepted health information technology standards to assist in the implementation of vaccine recommendations in computer systems and quality measurement efforts. This document is available at https://www.aap.org/enus/professional-resources/quality-improvement/Pages/Partnership-for-Policy-Implementation.aspx. In addition, the AAP has developed implementation guidance on supply, payment, coding, and liability issues; these documents can be found at https://www.aap.org/en/patient-care-pages-in-progress/influenza/managing-influenzavaccination-in-your-practice/. The committee supports adequate payment from public and private payers for the vaccine product and administration in the pediatric population. Information on preparing your practice to administerinfluenza vaccines during the COVID-19 pandemic can be found at https://services.aap.org/en/pages/2019-novel-coronaviruscovid-19-infections/help-for-pediatricians/preparing-for-flu-season/. HCP, influenza campaign organizers, and public health agencies are encouraged to collaborate to develop improved strategies for planning, distribution, communication, and administration of vaccines. For example, pediatricians can play a key role in educating and assisting early childhood education centers and schools in educating parents on the importance of influenza immunization. Resources for effective communication and messaging strategies, including promoting vaccinations and providing resources for pediatricians to communicate with patients, families, and the communities they serve, are available on the AAP Web site (https://services.aap.org/en/news-room/campaigns-and-toolkits/immunizations and https://www.aap.org/en-us/advocacy-and-policy/aap-health-initiatives/immunizations/Influenza-Implementation-Guidance/Pages/Patient-Family-and-Community.aspx).

Pediatricians and other pediatric health care providers should plan to make the influenza vaccine easily accessible for all children. Examples include sending alerts to families that vaccine is available (eg, e-mails, texts, letters, patient portals, practice-specific Web sites, or social media platforms); creating walk-in influenza vaccination clinics; extending hours beyond routine times during peak vaccination periods; administering the influenza vaccine during both well-child examinations and sick visits as well as in hospitalized patients, especially those at high risk of influenza complications, before hospital discharge (unless medically contraindicated); implementing standing orders for influenza vaccination; considering how to immunize parents, adult caregivers, and siblings (see risk management guidance associated with adult immunizations in ref 85) at the same time as children; and working with other institutions (eg, schools, child care programs, local public health departments, and religious organizations) or alternative care sites, such as pharmacies and hospital emergency departments, to expand venues for administering the vaccine. If a child receives the influenza vaccine outside his or her medical home, such as at a pharmacy, retail-based clinic, or another practice setting, appropriate documentation of vaccination should be provided to the patient to be shared with his or her medical home and entered into the state or regional immunization information system (ie, registry).

Concerted efforts among the aforementioned groups, plus vaccine manufacturers, distributors, and payers, are necessary to prioritize distribution appropriately to the primary care office setting and patient-centered medical home before other venues, especially when vaccine supplies are delayed or limited. Payers should eliminate remaining patient responsibility cost barriers to the influenza vaccine where they still exist. Similar efforts should be made to eliminate the vaccine supply discrepancy between

privately insured patients and those eligible for vaccination through the Vaccines for Children program. American Indian and Alaskan native children, who are eligible for vaccines through the Vaccines for Children program, are at higher risk for influenza complications and should be prioritized in a vaccine shortage (Table 2).

Population health can benefit from pediatricians' discussions about vaccine safety and effectiveness. Pediatricians and their office staff can influence vaccine acceptance by explaining the importance of annual influenza vaccination for children and emphasizing when a second dose of the vaccine is indicated. The AAP and CDC have created communication resources to convey these important messages and to help the public understand influenza recommendations. Resources will be available on *Red Book Online* (https://redbook.solutions.aap.org/selfserve/ssPage.aspx?SelfServeContentId=influenza-resources).

The AAP supports mandatory influenza vaccination programs for all HCP in all settings, including outpatient settings. Optimal prevention of influenza in the health care setting depends on the vaccination of at least 90% of HCP. Vaccine coverage among HCP was 81.1% during the 2018–2019 season, up from 78.4% the previous year.[86] Influenza vaccination programs for HCP benefit the health of employees, their patients, and members of the community, especially because HCP frequently come into contact with patients at high risk of influenza illness in their clinical settings. Mandatory influenza immunization for all HCP is considered to be ethical, just, and necessary to improve patient safety. For the prevention and control of influenza, HCP must prioritize the health and safety of their patients, honor the requirement of causing no harm, and act as role models for both their patients and colleagues by receiving influenza vaccination annually.

INFLUENZA VACCINE COVERAGE

Although national influenza vaccination coverage among children had remained stable and even increased in the past several seasons before the COVID-19 pandemic, overall vaccination coverage remains suboptimal (Fig 1). The Healthy People 2020 national target of 70% of children and adults vaccinated against influenza was not achieved, with coverage lagging by 6 percentage points for children and almost 20 percentage points for adults. The newly launched Healthy People 2030 has, therefore, set a target for influenza vaccination of people ≥6 months of age at 70%.[87] Additional options for vaccination of children may provide a means to improve coverage, particularly in pharmacies and child care and school-based settings. Achieving high coverage rates of the influenza vaccine in infants and children is a priority to protect them against influenza disease and its complications.

The AAP and CDC recommend vaccine administration at any visit to the medical home during influenza season when it is not contraindicated, at specially arranged vaccine-only sessions, and through cooperation with public health departments, community sites, schools, and Head Start and child care facilities to provide the influenza vaccine. It is important that annual delivery of the influenza vaccine to primary care medical homes be timely to avoid missed opportunities. If alternate venues, including pharmacies and other retail-based clinics, are used for vaccination, a system of patient record transfer is crucial to maintain the accuracy of immunization records. Immunization information systems should be used whenever available and prioritized to document influenza vaccination. Two-dimensional barcodes have been used to facilitate more efficient and accurate documentation of vaccine administration, with limited experience to date. Additional information concerning current vaccines shipped with two-dimensional barcodes can be found at www.cdc.gov/vaccines/programs/iis/2d-vaccine-barcodes/.

Children's likelihood of being immunized according to recommendations appears to be associated with the immunization practices of their parents. The authors of one study found that children were 2.77 times (95% CI, 2.74 to 2.79) more likely to be immunized against seasonal influenza if their parents were immunized.[48] When parents who were previously not immunized had received immunization for seasonal influenza, their children were 5.44 times (95% CI, 5.35 to 5.53) more likely to receive the influenza vaccine.

Pediatric offices may choose to serve as a venue for providing influenza vaccination for parents and other care providers of children, if the practice is acceptable to both pediatricians and the adults who are to be vaccinated, particularly when it can help reduce inequities in vaccination access. Medical liability and payment issues, along with medical record documentation requirements, need to be considered before a pediatrician begins immunizing adults (see risk management guidance associated with adult immunizations in ref 85). Pediatric practices should be aware of payment implications, including nonpayment or having the parent inappropriately attributed by a payer as a patient of the pediatrician's office. The AAP supports efforts to overcome these payment barriers with insurance

payers to maximize influenza immunization rates. To avoid errors in claims processing and payment and in the exchange of immunization data, pediatricians are reminded that parents should have their own basic medical record, in which their influenza vaccination should be documented. Adults should be encouraged to have a medical home and communicate their vaccination status to their primary care provider. Offering adult vaccinations in the pediatric practice setting should not undermine the adult medical home model. Vaccination of close contacts of children at high risk of influenza-related complications (Table 2) is intended to reduce children's risk of exposure to influenza (ie, "cocooning"). The practice of cocooning also may help protect infants younger than 6 months, who are too young to be immunized with the influenza vaccine.

SURVEILLANCE

Information about influenza surveillance is available through the CDC Voice Information System (influenza update at 1-800-232-4636) or at www.cdc.gov/flu/index.htm. Although yearly influenza data on circulating strains do not necessarily predict which and in what proportion strains will circulate in the subsequent season, it is instructive to be aware of the previous season's influenza surveillance data to use as a guide to empirical therapy until current seasonal data are available from the CDC. Information is posted weekly on the CDC Web site (www.cdc.gov/flu/weekly/fluactivitysurv.htm).

INFLUENZA ANTIVIRALS

Antiviral agents available for both influenza treatment and chemoprophylaxis in children of all ages can be found in Table 4 (including doses for preterm infants that have not been evaluated by the FDA) and on the CDC Web site (www.cdc.gov/flu/professionals/antivirals/index.htm). These include the neuraminidase inhibitors (NAIs) (oseltamivir, zanamivir, peramivir) and a selective inhibitor of influenza cap-dependent endonuclease (baloxavir), all of which have activity against influenza A and B viruses.[88]

Oral oseltamivir (Tamiflu) remains the antiviral drug of choice for the management of illness caused by influenza virus infections. Although more difficult to administer, inhaled zanamivir (Relenza) is an equally acceptable alternative for patients who do not have chronic respiratory disease. Options are limited for children who cannot absorb orally or enterally administered oseltamivir or tolerate inhaled zanamivir. Intravenous (IV) peramivir (Rapivab), a third NAI, was approved in September 2017 as a treatment of acute uncomplicated influenza in nonhospitalized children 2 years and older who have been symptomatic for no more than 2 days. The efficacy of peramivir in patients with serious influenza requiring hospitalization has not been established.[88] IV zanamivir is not approved in the United States and has not been available for compassionate use since the 2017–2018 season.[69,70] Baloxavir marboxil (Xofluza) was approved in 2018 for the early treatment of uncomplicated influenza in outpatients 12 years and older who have been ill for no more than 2 days.[89] This antiviral agent for influenza has a different mechanism of action (cap-endonuclease inhibitor) than NAIs and requires only a single oral dose for treatment of uncomplicated influenza. A recently completed phase 3 randomized, double-blind, active controlled study in children 1 to 12 years of age demonstrated that baloxavir treatment was well tolerated and resulted in a similar median time to alleviation of signs and symptoms of influenza as oseltamivir in ambulatory children with acute influenza.[90] Another study suggests that baloxavir is also effective in reducing viral titers and achieving comparable time to alleviation of symptoms as NAIs in high-risk patients ≥12 years of age with uncomplicated influenza.[91] A clinical trial of baloxavir treatment of influenza in hospitalized patients 12 years and older is ongoing (https://clinicaltrials.gov/ct2/show/NCT03684044?cond=baloxavir&rank=6). In November 2020, baloxavir was approved by the FDA for single-dose postexposure prophylaxis in people 12 years of age an older after exposure to someone with influenza.[92,93]

INFLUENZA TREATMENT

Randomized controlled trials (RCTs) conducted to date to evaluate the efficacy of influenza antiviral medications among outpatients with uncomplicated influenza have found that timely treatment can reduce the duration of influenza symptoms and fever in pediatric populations.[94–98] Observational studies in pediatric and adult populations suggest that antiviral agents are safe and could reduce the risk of certain influenza complications, including hospitalization and death.[99–103] The number of published RCTs in children is limited, and interpretation of the results of these studies needs to take into consideration the size of the study (the number of events might not be sufficient to assess specific outcomes in small studies), the variations in the case definition of influenza illness (clinically diagnosed versus laboratory confirmed), the time of treatment administration in relation to the onset of illness, and the child's age and health status as important variables. A Cochrane review of 6

TABLE 4 Recommended Dosage and Schedule of Influenza Antiviral Medications for Treatment and Chemoprophylaxis in Children for the 2021–2022 Influenza Season: United States

Medication	Treatment	Chemoprophylaxis[a]
Oseltamivir[b]		
Adults	75 mg, twice daily for 5 d	75 mg, once daily for 5 d
Children ≥12 mo (based on body wt)	Duration in all groups is 5 d	Duration in all groups is 10 d
≤15 kg (≤33 lb)	30 mg, twice daily	30 mg, once daily
>15–23 kg (>33–51 lb)	45 mg, twice daily	45 mg, once daily
>23–40 kg (>51–88 lb)	60 mg, twice daily	60 mg, once daily
>40 kg (>88 lb)	75 mg, twice daily	75 mg, once daily
Infants 9–11 mo[c]	3.5 mg/kg per dose, twice daily	3.5 mg/kg per dose, once daily
Term infants 0–8 mo[c]	3 mg/kg per dose, twice daily	3 mg/kg per dose, once daily for infants 3–8 mo; not recommended for infants <3 mo old because of limited safety and efficacy data in this age group
Preterm infants[d]		
<38 wk postmenstrual age	1.0 mg/kg per dose, twice daily	—
38–40 wk postmenstrual age	1.5 mg/kg per dose, twice daily	—
>40 wk postmenstrual age	3.0 mg/kg per dose, twice daily	—
Zanamivir[e]		
Adults	10 mg (two 5-mg inhalations), twice daily for 5 d	10 mg (two 5-mg inhalations), once daily for 10 d
Children (≥7 y for treatment, ≥5 y for chemoprophylaxis)	10 mg (two 5-mg inhalations), twice daily for 5 d	10 mg (two 5-mg inhalations), once daily for 10 d
Peramivir		
Adults	One 600-mg IV infusion, given over 15–30 min	Not recommended
Children (2–12 y)	One 12 mg/kg dose, up to 600 mg maximum, via IV infusion for 15–30 min	Not recommended
Children (13–17 y)	One 600 mg dose, via IV infusion for 15–30 min	Not recommended
Baloxavir		
People ≥12 y who weigh >40 kg	40–80 kg: one 40-mg dose, orally ≥80 kg: one 80-mg dose, orally	40–80 kg: one 40-mg dose, orally ≥80 kg: one 80-mg dose, orally

Adapted from Uyeki TM, Bernstein HH, Bradley JS, et al. Clinical practice guidelines by the Infectious Diseases Society of America: 2018 update on diagnosis, treatment, chemoprophylaxis, and institutional outbreak management of seasonal influenza [published correction appears in *Clin Infect Dis*. 2019;68(10):1790]. *Clin Infect Dis*. 2019;68(6):e1–e47; and https://www.cdc.gov/flu/professionals/antivirals/summary-clinicians.htm. —, not applicable.

[a] The CDC recommends routine chemoprophylaxis with oseltamivir or zanamivir for 7 d and for 10 d only if part of an institutional outbreak (https://www.cdc.gov/flu/professionals/antivirals/summary-clinicians.htm).

[b] The duration of treatment with oseltamivir is 5 d. Oseltamivir is administered orally regardless of meals, although administration with meals may improve gastrointestinal tolerability. Oseltamivir is available as Tamiflu in 30-, 45-, and 75-mg capsules and as a powder for oral suspension that is reconstituted to provide a final concentration of 6 mg/mL. For the 6-mg/mL suspension, a 30-mg dose is given with 5 mL of oral suspension, a 45-mg dose is given with 7.5 mL oral suspension, a 60-mg dose is given with 10 mL oral suspension, and a 75-mg dose is given with 12.5 mL oral suspension. If the commercially manufactured oral suspension is not available, a suspension can be compounded by retail pharmacies (final concentration also 6 mg/mL) on the basis of instructions contained in the package label. In patients with renal insufficiency, the dose should be adjusted on the basis of creatinine clearance. For treatment of patients with creatinine clearance 10–30 mL/min: 75 mg once daily for 5 d. For chemoprophylaxis of patients with creatinine clearance 10–30 mL/min: 30 mg once daily for 10 d after exposure or 75 mg, once every other day, for 10 d after exposure (5 doses). See https://www.cdc.gov/flu/professionals/antivirals/summary-clinicians.htm and Infectious Diseases Society of America guidelines.[88]

[c] Approved by the FDA for children as young as 2 wk of age. Given preliminary pharmacokinetic data and limited safety data, oseltamivir can be used to treat influenza in both term and preterm infants from birth because benefits of therapy are likely to outweigh possible risks of treatment. Of note, the CDC recommends 3 mg/kg per dose twice daily for all infants <12 mo old; the Infectious Diseases Society of America guidelines[88] include both AAP and CDC recommendations.

[d] Oseltamivir dosing for preterm infants: the wt-based dosing recommendation for preterm infants is lower than that for term infants. Preterm infants may have lower clearance of oseltamivir because of immature renal function, and doses recommended for term infants may lead to high drug concentrations in this age group. Limited data from the National Institute of Allergy and Infectious Diseases Collaborative Antiviral Study Group provide the basis for dosing preterm infants by using their postmenstrual age (gestational age + chronological age). For extremely preterm infants (<28 wk), please consult a pediatric infectious disease physician.

[e] The duration of treatment with zanamivir is 5 d. Zanamivir is administered by inhalation by using a proprietary "Diskhaler" device distributed together with the medication. Zanamivir is a dry powder, not an aerosol, and should not be administered by using nebulizers, ventilators, or other devices typically used for administering medications in aerosolized solutions. Zanamivir is not recommended for people with chronic respiratory diseases, such as asthma or chronic obstructive pulmonary disease, which increase the risk of bronchospasm.

RCTs involving treatment of 2356 children with clinically diagnosed influenza, of whom 1255 had laboratory-confirmed influenza, showed that in children with laboratory-confirmed influenza, oral oseltamivir and inhaled zanamivir reduced the median duration of illness by 36 hours (26%; $P < .001$) and 1.3 days (24%; $P < .001$), respectively.[98] Among the studies reviewed, one trial of oseltamivir in children with asthma who had laboratory-confirmed influenza showed only a nonsignificant reduction in illness duration (10.4 hours; 8%; $P = .542$). Oseltamivir significantly reduced acute otitis media in children 1 to 5 years of age with laboratory-confirmed influenza (risk difference, −0.14; 95% CI,

−0.24 to −0.04).[98] Another Cochrane review of RCTs in adults and children, which included 20 oseltamivir (9623 participants) and 26 zanamivir trials (14 628 participants),[95] found no effect of oseltamivir in reducing the duration of illness in children with asthma, but in otherwise healthy children, there was a reduction by a mean difference of 29 hours (95% CI, 12 to 47 hours; $P = .001$). No significant effect was observed with zanamivir. Regarding complications, this review did not find a significant effect of NAIs on reducing hospitalizations, pneumonia, bronchitis, otitis media, or sinusitis in children.[95] More recently, a meta-analysis of 5 new RCTs that included 1598 children with laboratory-confirmed influenza showed that treatment with oseltamivir significantly reduced the duration of illness in this population by 17.6 hours (95% CI, −34.7 to −0.62 hours).[96] When children with asthma were excluded, this difference was larger (−29.9 hours; 95% CI, −53.9 to −5.8 hours). The risk of otitis media was 34% lower in this group as well. Similarly, a meta-analysis conducted by Tejada et al[103] showed a statistically significant reduction in the risk of acute otitis media occurrence among treated children over placebo recipients (odds ratio, 0.48; 95% CI, 0.30 to 0.77). Overall, efficacy outcomes are best demonstrated in patients with laboratory-confirmed influenza. All these studies confirmed vomiting as an occasional adverse effect of oseltamivir, occurring in approximately 5% of treated patients. The balance between benefits and harms should be considered when making decisions about the use of NAIs for either treatment or chemoprophylaxis of influenza.

Although prospective comparative studies to determine the efficacy of influenza antiviral medications in hospitalized patients or pediatric patients with comorbidities have not been conducted, and prospectively collected data to determine the role of antiviral agents in treating severe influenza are limited, on the basis of information obtained from retrospective observational studies and meta-analyses conducted to date in both adults and children, most experts support the use of antiviral medications as soon as possible to treat pediatric patients with severe influenza, including hospitalized patients.[97,99–102,104] In an observational epidemiological study conducted in adult patients hospitalized with severe laboratory-confirmed influenza in Spain over 6 influenza seasons (2010–2016), the authors evaluated the effectiveness of NAIs, concluding that when started early after the onset of symptoms (≤48 hours or ≤5 days), NAI treatment was associated with a reduction in influenza-associated deaths (adjusted odds ratio, 0.37 [95% CI, 0.22 to 0.63]; and adjusted odds ratio, 0.50 [95% CI, 0.32 to 0.79], respectively).[99] However, treatment initiation more than 5 days after the onset of influenza symptoms was not associated with reduction in mortality in hospitalized adults.

Importantly, and despite limited evidence from prospectively conducted trials, treatment with oseltamivir for children with serious, complicated, or progressive disease presumptively or definitively caused by influenza, irrespective of influenza vaccination status (the circulating strains may not be well matched with vaccine strains) or whether illness began greater than 48 hours before admission, is recommended by the AAP, CDC, Infectious Diseases Society of America,[88] and Pediatric Infectious Diseases Society. Earlier treatment provides better clinical responses. However, treatment after 48 hours of symptoms in adults and children with moderate to severe disease or with progressive disease has been shown to provide some benefit and should be offered.[105–107] In a retrospective study of 653 PICU admissions from 2009 to 2012, the estimated risk of death was reduced in NAI-treated cases (odds ratio 0.36; 95% CI, 0.16 to 0.83).[105] No additional benefit exists for double-dose NAI therapy on reduction of mortality or virological clearance compared with standard-dose therapy on the basis of a recent systematic review and meta-analysis of 10 published studies[108] (4 RCT and 6 observational studies) involving 20 947 adult and pediatric patients.

Children younger than 2 years are at an increased risk of hospitalization and complications attributable to influenza. The FDA has approved oseltamivir for treatment of children as young as 2 weeks of age. Given preliminary pharmacokinetic data and limited safety data, the CDC and AAP support the use of oseltamivir to treat influenza in both term and preterm infants from birth because benefits of therapy of neonatal influenza are likely to outweigh possible risks of treatment.

Oseltamivir is available in capsule and oral suspension formulations. The available capsule doses are 30, 45, and 75 mg, and the commercially manufactured liquid formulation has a concentration of 6 mg/mL in a 60-mL bottle. If the commercially manufactured oral suspension is not available, the capsule may be opened and the contents mixed with simple syrup or Ora-Sweet SF (sugar free) by retail pharmacies to a final concentration of 6 mg/mL.

In adverse event data collected systematically in prospective trials, vomiting was the only adverse effect

reported more often with oseltamivir compared with a placebo when studied in children 1 to 12 years of age (ie, 15% of treated children versus 9% receiving a placebo). In addition, after reports from Japan of oseltamivir-attributable neuropsychiatric adverse effects, a review of controlled clinical trial data and ongoing surveillance has failed to establish a link between this drug and neurologic or psychiatric events.[109,110]

Clinical judgment (based on underlying conditions, disease severity, time since symptom onset, and local influenza activity) is an important factor in treatment decisions for pediatric patients who present with influenzalike illness. Antiviral treatment should be started as soon as possible after illness onset and should not be delayed while waiting for a definitive influenza test result because early therapy provides the best outcomes.

Influenza diagnostic tests vary by method, availability, processing time, sensitivity, and cost (Table 5), all of which should be considered in making the best clinical decision. Positive and negative predictive values of influenza test results are influenced by the level of influenza activity in the population being tested, the characteristics of a test compared to a gold standard, pretest probability, whether the influenza virus is actively replicating in the person, proper collection and transport of specimens, and proper test procedures. Testing should be performed when timely results will be available to influence clinical management or infection-control measures. Although decisions on treatment and infection control can be made on the basis of positive rapid test results, particularly when influenza is known to be circulating, negative results should not always be used in a similar fashion because of the suboptimal sensitivity and potential for false-negative results. An updated list of rapid influenza diagnostic tests is available at https://www.cdc.gov/flu/professionals/diagnosis/table-ridt.html. Positive results of rapid influenza diagnostic tests are helpful because they may reduce additional testing to identify the cause of the child's influenzalike illness and promote appropriate antimicrobial stewardship. Available FDA-approved rapid molecular assays based on nucleic acid detection are highly sensitive and specific diagnostic tests that can provide rapid results. An updated list of these tests is available at https://www.cdc.gov/flu/professionals/diagnosis/table-nucleic-acid-detection.html. Molecular assays are preferred in hospitalized patients because they are more sensitive compared with antigen detection. Early detection, prompt antiviral treatment, and infection-control interventions can

TABLE 5 Comparison of Types of Influenza Diagnostic Tests[a]

Testing Category	Method	Influenza Viruses Detected	Distinguishes Influenza A Virus Subtypes	Time to Results	Performance
Rapid molecular assay	Nucleic acid amplification	Influenza A or B viral RNA	No	15–30 min	High sensitivity; high specificity
Rapid influenza diagnostic test	Antigen detection	Influenza A or B virus antigens	No	10–15 min	Low to moderate sensitivity (higher with analyzer devise); high specificity
Direct and indirect immunofluorescence assays	Antigen detection	Influenza A or B virus antigens	No	1–4 h	Moderate sensitivity; high specificity
Molecular assays (including RT-PCR)	Nucleic acid amplification	Influenza A or B viral RNA	Yes, if subtype primers are used	1–8 h	High sensitivity; high specificity
Multiplex molecular assays	Nucleic acid amplification	Influenza A or B viral RNA, other viral or bacterial targets (RNA or DNA)	Yes, if subtype primers are used	1–2 h	High sensitivity; high specificity
Rapid cell culture (shell vial and cell mixtures)	Virus isolation	Influenza A or B virus	Yes	1–3 d	High sensitivity; high specificity
Viral culture (tissue cell culture)	Virus isolation	Influenza A or B virus	Yes	3–10 d	High sensitivity; high specificity

Source: Uyeki.[88]

[a] Negative results may not rule out influenza. Respiratory tract specimens should be collected as close to illness onset as possible for testing. Clinicians should consult the manufacturer's package insert for the specific test for the approved respiratory specimen(s). Specificities are generally high (>95%) for all tests compared to reverse transcriptase-polymerase chain reaction (RTP CR). FDA-cleared rapid influenza diagnostic tests are Clinical Laboratory Improvements Act (CLIA)-waived; most FDA-cleared rapid influenza molecular assays are CLIA-waived, depending on the specimen.

lead to improved individual patient outcomes and allow for effective cohorting and disease containment.

People with suspected influenza who are at higher risk of influenza complications should be offered treatment with antiviral medications (Table 2). Efforts should be made to minimize treatment of patients who are not infected with influenza. Otherwise healthy children who have suspected influenza with an uncomplicated presentation at times when influenza viruses are known to be circulating in the community should be considered for antiviral medication, particularly if they are in contact with other children who either are younger than 6 months (because they are not able to receive influenza vaccine) or have high-risk conditions (including age <5 years) that predispose them to complications of influenza. If there is a local shortage of antiviral medications, local public health authorities should be consulted to provide additional guidance about testing and treatment.

INFLUENZA CHEMOPROPHYLAXIS

Randomized placebo-controlled studies showed that oral oseltamivir and inhaled zanamivir were efficacious when administered as chemoprophylaxis to household contacts after a family member had laboratory-confirmed influenza.[88] Baloxavir received FDA approval in November 2020 for influenza chemoprophylaxis.[93,111] When compared with a placebo as a preventive treatment of adults and children, the proportion of household members 12 years and older who developed influenza was 1 in participants treated with a single dose of baloxavir within 48 hours of exposure to a symptomatic household contact with influenza and 13 in the placebo-treated group.[93] Baloxavir was well tolerated in this randomized study conducted in apan during the 2018–2019 influenza season. There are no data on IV peramivir for chemoprophylaxis.

Decisions on whether to administer antiviral chemoprophylaxis should take into account the exposed person's risk of influenza complications, vaccination status, the type and duration of contact, recommendations from local or public health authorities, and clinical judgment. Optimally, postexposure chemoprophylaxis should only be used when antiviral agents can be started within 48 hours of exposure the lower once-daily dosing for chemoprophylaxis with oral oseltamivir or inhaled zanamivir should not be used for treatment of children symptomatic with influenza.[112] Early full treatment doses (rather than chemoprophylaxis doses) should be used in high-risk symptomatic patients without waiting for laboratory confirmation.

Chemoprophylaxis should not be considered a substitute for vaccination. The influenza vaccine should always be offered before and throughout the influenza season when not contraindicated. Antiviral medications are important adjuncts to influenza vaccination for control and prevention of influenza disease. Toxicities may be associated with antiviral agents, and indiscriminate use might limit availability. Pediatricians should inform recipients of antiviral chemoprophylaxis that risk of influenza is lowered but still remains while taking the medication, and susceptibility to influenza returns when medication is discontinued. Although antiviral use is not a contraindication to vaccination with IIVs, it is likely that LAIV effectiveness will be decreased for children receiving oseltamivir or other influenza antiviral agents.[112]

Among some high-risk people, both vaccination with IIV and antiviral chemoprophylaxis may be considered.[112] Updates will be available at www.aapredbook.org/flu and at www.cdc.gov/flu/professionals/antivirals/index.htm.

ANTIVIRAL RESISTANCE

Antiviral resistance to any drug can emerge, necessitating continuous population-based assessment conducted by the CDC. During the 2019–2020 influenza season, >99 of influenza A(H1N1)pdm09 and B/Victoria viruses tested were susceptible to oseltamivir, peramivir, and zanamivir, and all were susceptible to baloxavir. All tested influenza A(H3N2) and B/amagata viruses were susceptible to these antiviral agents. Decreased susceptibility to baloxavir has been reported in apan, where its use has been more common,[113–117] and surveillance for resistance among circulating influenza viruses is ongoing in apan and the United States.[9,118,119] In contrast, high levels of resistance to amantadine and rimantadine persist among the influenza A viruses currently circulating. Adamantane medications are not recommended for use against influenza unless resistance patterns change.[88]

Viral surveillance and resistance data from the CDC and WHO indicate that the majority of currently circulating influenza viruses likely to cause influenza in North America during the 2021–2022 influenza season continue to be susceptible to oseltamivir, zanamivir, peramivir, and baloxavir.[7] If a newly emergent oseltamivir- or peramivir-resistant virus is a concern, recommendations for alternative treatment will be available from the CDC and AAP. Resistance characteristics can change for an individual patient over the duration of a treatment

course, especially in those who are severely immunocompromised. Up-to-date information on current recommendations and therapeutic options can be found on the AAP Web site (www.aap.org or www.aapredbook.org/flu), through state-specific AAP chapter Web sites, or on the CDC Web site (www.cdc.gov/flu/).

FUTURE DIRECTIONS

Safety and effectiveness data for influenza vaccines used during the 2020–2021 influenza season will be analyzed as they become available and reported by the CDC as they are each season. However, new data might not be available given the low levels of circulation of influenza during the COVID-19 pandemic. Continued evaluation of the safety, immunogenicity, and effectiveness of influenza vaccines, especially for at-risk and diverse populations, is important. The duration of protection, the potential role of previous influenza vaccination on overall VE, and VE by vaccine formulation, virus strain, timing of vaccination, and subject age and health status in preventing outpatient medical visits, hospitalizations, and deaths continue to be evaluated. For the 2021–2022 influenza season, it will be particularly important to understand the effect of SARS-CoV-2 and influenza virus cocirculation on the epidemiology and morbidity of influenza in the pediatric population. Understanding how to better educate parents about influenza symptoms and how to recognize when to seek medical attention would be informative. Additionally, with limited data on the use of antiviral agents in hospitalized children and in children with underlying medical conditions, prospective clinical trials to inform optimal timing and efficacy of antiviral treatment in these populations are warranted. This is particularly relevant as new antiviral agents or new indications for existing antiviral agents become available. At this time, the FDA has accepted supplemental new drug applications for baloxavir marboxil for the treatment of acute uncomplicated influenza in pediatric patients from 1 to 12 years of age.[120]

There is also a need for more systematic health services research on influenza vaccine uptake and refusal as well as identification of methods to enhance uptake. Developing influenza vaccination programs in nontraditional settings, including the pediatric emergency department, may also increase distribution.[121,122] Further investigation is needed concerning vaccine acceptance and hesitancy and methods to overcome parental concerns and improve coverage. This might be particularly relevant with the introduction of the COVID-19 vaccine for children and adolescents in 2021. Efforts may include evaluating the strategy of offering to immunize parents and adult child care providers in the pediatric office setting and understanding the level of family contact satisfaction with this approach; how practices handle the logistic, liability, legal, and financial barriers that limit or complicate this service; and most importantly, how this practice may affect disease rates in children and adults. Furthermore, ongoing efforts should include broader implementation and evaluation of mandatory HCP vaccination programs in both inpatient and outpatient settings.

Efforts should be made to create adequate outreach (eg, mobile integrated health care) and infrastructure to facilitate the optimal distribution of the vaccine so that more people are immunized. Given the experience with COVID-19, pediatricians have become more involved in pandemic preparedness and disaster planning efforts. A bidirectional partner dialogue between pediatricians and public health decision-makers assists efforts to address children's issues during the initial state, regional, and local plan development stages. Additional information on this topic can be found at https://pediatrics.aappublications.org/content/pediatrics/early/2017/05/11/peds.2016-3690.full.pdf.

Access-to-care issues, lack of immunization records, and questions regarding who can provide consent may be addressed by linking children (eg, those in foster care or the juvenile justice system or refugee, immigrant, or homeless children) with a medical home, using all health care encounters as vaccination opportunities, and more consistently using immunization registry data.

Development efforts continue for universal influenza vaccines that induce broader protection and eliminate the need for annual vaccination.[123] The success of mRNA and other novel technologies used in the development of COVID-19 vaccines may accelerate the prospects of broad influenza vaccines. Understanding the establishment of immunity against influenza in early life and the development of a safe immunogenic vaccine for infants younger than 6 months are essential. Studies on the effectiveness and safety of influenza vaccines containing adjuvants that enhance immune responses to influenza vaccines or that use novel routes of administration are needed.

Efforts to improve the vaccine development process to allow for a shorter interval between identification of vaccine strains and vaccine production continue. New antiviral drugs are in various development phases given the need to improve options for the treatment and chemoprophylaxis of influenza.

Pediatricians can remain informed of advances and other updates during the influenza season by following the CDC Influenza page (www.cdc.gov/flu) and the AAP *Red Book Online* Influenza Resource Page (www.aapredbook.org/flu).

ADDITIONAL RESOURCES

Lessin HR, Edwards KM; Committee on Practice and Ambulatory Medicine; Committee on Infectious Diseases. Immunizing parents and other close family contacts in the pediatric office setting. *Pediatrics*. 2012;129(1). Available at: www.pediatrics.org/cgi/content/full/129/1/e247;

Committee on Infectious Diseases. Influenza immunization for all health care personnel: keep it mandatory. *Pediatrics*. 2015;136(4):809–818;

Frush K; American Academy of Pediatrics Committee on Pediatric Emergency Medicine. Preparation for emergencies in the offices of pediatricians and pediatric primary care providers. *Pediatrics*. 2007;120(1):200–212. Reaffirmed November 2018;

Committee on Practice and Ambulatory Medicine; Committee on Infectious Diseases; Committee on State Government Affairs; Council on School Health; Section on Administration and Practice Management. Medical versus nonmedical immunization exemptions for child care and school attendance. *Pediatrics*. 2016;138(3):e20162145;

Edwards KM, Hackell JM; Committee on Infectious Diseases; Committee on Practice and Ambulatory Medicine. Countering vaccine hesitancy. *Pediatrics*. 2016;138(3):e20162146;

American Academy of Pediatrics Committee on Pediatric Emergency Medicine; American Academy of Pediatrics Committee on Medical Liability; Task Force on Terrorism. The pediatrician and disaster preparedness. *Pediatrics*. 2006;117(2):560–565. Reaffirmed September 2013; and

American Academy of Pediatrics. Influenza. In: Kimberlin DW, Brady MT, Jackson MA, Long SS, eds. *Red Book: 2018 Report of the Committee on Infectious Diseases*. 31st ed. Itasca, IL: American Academy of Pediatrics; 2018:447–457. Available at: http://aapredbook.aappublications.org/flu.

LEAD AUTHOR COMMITTEE ON INFECTIOUS DISEASES, 2021–2022

Yvonne A. Maldonado, MD, FAAP, Chairperson

Sean T. O'Leary, MD, MPH, FAAP, Vice Chairperson

Monica I. Ardura, DO, MSCS, FAAP

Ritu Banerjee, MD, PhD, FAAP

Kristina A. Bryant, MD, FAAP

James D. Campbell, MD, MS, FAAP

Mary T. Caserta, MD, FAAP

Chandy C. John, MD, MS, FAAP

Jeffrey S. Gerber, MD, PhD, FAAP

Athena P. Kourtis, MD, PhD, MPH, FAAP

Adam J. Ratner, MD, MPH, FAAP

José R. Romero, MD, FAAP

Samir S. Shah, MD, MSCE, FAAP

Kenneth M. Zangwill, MD, FAAP

PAST COMMITTEE ON INFECTIOUS DISEASES MEMBERS

Dawn Nolt, MD, MPH, FAAP

Flor M. Munoz, MD, MSc, FAAP

Ruth Lynfield, MD, FAAP

William J. Steinbach, MD, FAAP

Theoklis E. Zaoutis, MD, MSCE, FAAP

PARTNERSHIP FOR POLICY IMPLEMENTATION

Juan D. Chaparro, MD, MS, FAAP

Jeremy J. Michel, MD, MHS, FAAP

EX OFFICIO

David W. Kimberlin, MD, FAAP, *Red Book* Editor

Elizabeth D. Barnett MD, FAAP, *Red Book* Associate Editor

Ruth Lynfield, MD, FAAP, *Red Book* Associate Editor

Mark H. Sawyer, MD, FAAP, *Red Book* Associate Editor

Henry H. Bernstein, DO, MHCM, FAAP, *Red Book Online* Associate Editor

H. Cody Meissner, MD, FAAP, Visual *Red Book* Associate Editor

LIAISONS

Amanda C. Cohn, MD, FAAP – *Centers for Disease Control and Prevention*

Karen M. Farizo, MD – *US Food and Drug Administration*

Natasha B. Halasa, MD, MPH, FAAP – *Pediatric Infectious Diseases Society*

David Kim, MD, HHS – *Office of Infectious Disease and HIV/AIDS Policy*

Eduardo López Medina, MD, MSc – *Sociedad Latinoamericana de Infectologia Pediatrica*

Denee Moore, MD, FAAFP – *American Academy of Family Physicians*

Scot B. Moore, MD, FAAP – *Committee on Practice Ambulatory Medicine*

Lakshmi Panagiotakopoulos, MD, MPH, FAAP – *Centers for Disease Control and Prevention*

Laura Sauvé, MD, FCPS – *Canadian Pediatric Society*

Neil S. Silverman, MD – *American College of Obstetricians and Gynecologists*

Jeffrey R. Starke, MD, FAAP – *American Thoracic Society*

Kay M. Tomashek, MD, MPH, DTM – *National Institutes of Health*

STAFF

Jennifer M. Frantz, MPH

ABBREVIATIONS

AAP: American Academy of Pediatrics
ACIP: Advisory Committee on Immunization Practices
ALRTI: acute lower respiratory tract infection
CDC: Centers for Disease Control and Prevention
CI: confidence interval
COVID-19: novel coronavirus disease 2019
FDA: US Food and Drug Administration
GBS: Guillain-Barré syndrome
HA: hemagglutinin
HCP: health care personnel
IIV: inactivated influenza vaccine
IIV4: quadrivalent inactivated influenza vaccine
IV: intravenous
LAIV: live attenuated influenza vaccine
LAIV3: trivalent live attenuated influenza vaccine
LAIV4: quadrivalent live attenuated influenza vaccine
NAI: neuraminidase inhibitor
RCT: randomized controlled trial
RIV4: quadrivalent recombinant influenza vaccine
SARS-CoV-2: severe acute respiratory syndrome coronavirus 2
VE: vaccine effectiveness
WHO: World Health Organization

REFERENCES

1. Munoz FM; Committee on Infectious Diseases. Recommendations for prevention and control of influenza in children, 2021–2022. *Pediatrics.* 2021;148(4):e2021053744
2. Garten R, Blanton L, Elal AIA, et al. Update: influenza activity in the United States during the 2017–18 season and composition of the 2018–19 influenza vaccine. *MMWR Morb Mortal Wkly Rep.* 2018;67(22):634–642
3. Centers for Disease Control and Prevention. Seasonal influenza vaccine effectiveness, 2017-2018. Available at: https://www.cdc.gov/flu/vaccines-work/2017-2018.html. Accessed May 31, 2019
4. Biggerstaff M, Kniss K, Jernigan DB, et al. Systematic assessment of multiple routine and near real-time indicators to classify the severity of influenza seasons and pandemic in the United States, 2003-2004 through 2015-2016. *Am J Epidemiol.* 2018;187(5):1040–1050
5. Xu X, Blanton L, Elal AIA, et al. Update: influenza activity in the United States during the 2018-19 season and composition of the 2019-20 influenza vaccine. *MMWR Morb Mortal Wkly Rep.* 2019;68(24):544–551
6. Centers for Disease Control and Prevention. Flu vaccination coverage, United States, 2018–19 influenza season. Available at: https://www.cdc.gov/flu/fluvaxview/coverage-1819estimates.htm. Accessed May 4, 2020

7. Centers for Disease Control and Prevention. Weekly US influenza surveillance report (FluView). Available at: https://www.cdc.gov/flu/weekly/. Accessed May 31, 2020
8. Centers for Disease Control and Prevention. US flu VE data for 2019-2020. Available at: https://www.cdc.gov/flu/vaccines-work/2019-2020.html. Accessed June 9, 2021
9. Gubareva LV, Mishin VP, Patel MC, et al. Assessing baloxavir susceptibility of influenza viruses circulating in the United States during the 2016/17 and 2017/18 seasons. *Euro Surveill.* 2019;24(3):1800666
10. Centers for Disease Control and Prevention. COVID data tracker weekly review. Available at: https://www.cdc.gov/coronavirus/2019-ncov/covid-data/covidview.html. Accessed May 4, 2020
11. Wang X, Li Y, O'Brien KL, et al; Respiratory Virus Global Epidemiology Network. Global burden of respiratory infections associated with seasonal influenza in children under 5 years in 2018: a systematic review and modelling study. *Lancet Glob Health.* 2020;8(4):e497 e510
12. Centers for Disease Control and Prevention. Flu disparities among racial and ethnic minority groups. Available at: https://www.cdc.gov/flu/highrisk/disparities-racial-ethnic-minority-groups.html. Accessed June 24, 2021
13 Feldstein LR, Ogokeh C, Rha B, et al. Vaccine effectiveness against influenza hospitalization among children in the United States, 2015-2016. *J Pediatr Infect Dis Soc.* 2021;10(2):75 82
14. Segaloff HE, Leventer-Roberts M, Riesel D, et al. Influenza vaccine effectiveness against hospitalization in fully and partially vaccinated children in Israel: 2015-2016, 2016-2017, and 2017-2018. *Clin Infect Dis.* 2019;69(12):2153 2161
15. Blyth CC, Cheng AC, Crawford NW, et al; Paediatric Active Enhanced Disease Surveillance (PAEDS), Influenza Complications Alert Network (FluCAN) Collaboration. The impact of new universal child influenza programs in Australia: vaccine coverage, effectiveness and disease epidemiology in hospitalised children in 2018. *Vaccine.* 2020;38(13):2779 2787
16. Pebody RG, Zhao H, Whitaker HJ, et al. Effectiveness of influenza vaccine in children in preventing influenza associated hospitalisation, 2018/19, England. *Vaccine.* 2020;38(2):158 164
17. Kalligeros M, Shehadeh F, Mylona EK, et al. Influenza vaccine effectiveness against influenza-associated hospitalization in children: a systematic review and meta-analysis. *Vaccine.* 2020;38(14):2893 2903
18. Chung JR, Rolfes MA, Flannery B, et al; US Influenza Vaccine Effectiveness Network, the Influenza Hospitalization Surveillance Network, and the Assessment Branch, Immunization Services Division, Centers for Disease Control and Prevention. Effects of influenza vaccination in the United States during the 2018-2019 influenza season. *Clin Infect Dis.* 2020;71(8):e368 e376
19. Flannery B, Reynolds SB, Blanton L, et al. Influenza vaccine effectiveness against pediatric deaths: 2010-2014. *Pediatrics.* 2017;139(5):e20164244
20. Ferdinands JM, Olsho LE, Agan AA, et al; Pediatric Acute Lung Injury and Sepsis Investigators (PALISI) Network. Effectiveness of influenza vaccine against life-threatening RT-PCR-confirmed influenza illness in US children, 2010-2012. *J Infect Dis.* 2014;210(5):674 683
21. Tran D, Vaudry W, Moore D, et al; members of the Canadian Immunization Monitoring Program Active. Hospitalization for influenza A versus B. *Pediatrics.* 2016;138(3):e20154643
22. World Health Organization. Recommended composition of influenza virus vaccines for use in the 2021-2022 northern hemisphere influenza season. Available at: https://www.who.int/publications/i/item/recommended-composition-of-influenza-virus-vaccines-for-use-in-the-2021-2022-northern-hemisphere-influenza-season. Accessed June 9, 2021
23. Grohskopf LA, Alyanak E, Broder KR, et al. Prevention and control of seasonal influenza with vaccines: recommendations of the Advisory Committee on Immunization Practices - United States, 2020-21 influenza season. *MMWR Recomm Rep.* 2020;69(8):1 24
24. US Food and Drug Administration. *Clinical Review: Flucelvax Quadrivalent.* Silver Spring, MD: US Department of Health and Human Services, Food and Drug Administration; 2021
25. Vesikari T, Kirstein J, Devota Go G, et al. Efficacy, immunogenicity, and safety evaluation of an MF59-adjuvanted quadrivalent influenza virus vaccine compared with non-adjuvanted influenza vaccine in children: a multicentre, randomised controlled, observer-blinded, phase 3 trial. *Lancet Respir Med.* 2018;6(5):345 356
26. US Food and Drug Administration. Fluzone quadrivalent, fluzone high-dose quadrivalent, fluzone, intradermal quadrivalent, fluzone quadrivalent southern hemisphere. 2018. Available at: https://www.fda.gov/vaccines-blood-biologics/vaccines/fluzone-quadrivalent. Accessed June 24, 2019
27. Robertson CA, Mercer M, Selmani A, Klein NP, Jeanfreau R, Greenberg DP. Safety and immunogenicity of a full-dose, split-virion, inactivated, quadrivalent influenza vaccine in healthy children 6-35 months of age: a randomized controlled clinical trial. *Pediatr Infect Dis J.* 2019;38(3):323 328
28. Halasa NB, Gerber MA, Berry AA, et al. Safety and immunogenicity of full-dose trivalent inactivated influenza vaccine (TIV) compared with half-dose TIV administered to children 6 through 35 months of age. *J Pediatric Infect Dis Soc.* 2015;4(3):214 224
29. Claeys C, Zaman K, Dbaibo G, et al; Flu4VEC Study Group. Prevention of vaccine-matched and mismatched influenza in children aged 6-35 months: a multinational randomised trial across five influenza seasons. *Lancet Child Adolesc Health.* 2018;2(5):338 349
30. Jain VK, Domachowske JB, Wang L, et al. Time to change dosing of inactivated quadrivalent influenza vaccine in young children: evidence from a phase III, randomized, controlled trial. *J Pediatric Infect Dis Soc.* 2017;6(1):9 19
31. US Food and Drug Administration. Afluria quadrivalent, Afluria quadrivalent southern hemisphere. 2018. Available at: https://www.fda.gov/vaccines-blood-biologics/vaccines/

afluria-quadrivalent. Accessed June 24, 2019

32. Duffy J, Weintraub E, Hambidge SJ, et al; Vaccine Safety Datalink. Febrile seizure risk after vaccination in children 6 to 23 months. *Pediatrics.* 2016;138(1):e20160320
33. Thompson CA. Vaccine safety signal from spontaneous system not supported by active surveillance. *Am J Health Syst Pharm.* 2014;71(17):1432–1433
34. Sentinel. Influenza vaccines and febrile seizures in the 2013-2014 and 2014-2015 influenza seasons. 2017. Available at: https://www.sentinelinitiative.org/sites/default/files/vaccines-blood-biologics/assessments/Influenza-Vaccines-Febrile-Seizures-Final-Report.pdf. Accessed June 24, 2019
35. Baker MA, Jankosky C, Yih WK, et al. The risk of febrile seizures following influenza and 13-valent pneumococcal conjugate vaccines. *Vaccine.* 2020;38(9):2166–2171
36. Walter EB, Klein NP, Wodi AP, et al. Fever after influenza, diphtheria-tetanus-acellular pertussis, and pneumococcal vaccinations. *Pediatrics.* 2020;145(3):e20191909
37. Grohskopf LA, Alyanak E, Ferdinands JM, et al. Prevention and control of seasonal influenza with vaccines: recommendations of the Advisory Committee on Immunization Practices—United States, 2021–22 influenza season. *MMWR Recomm Rep.* 2021;70(5):1–28
38. Centers for Disease Control and Prevention. Interim clinical considerations for use of COVID-19 vaccines currently authorized in the United States. Available at: https://www.cdc.gov/vaccines/covid-19/clinical-considerations/covid-19-vaccines-us.html. Accessed June 9, 2021
39. Global Advisory Committee on Vaccine Safety, June 2012. *Wkly Epidemiol Rec.* 2012;87(30):281–287
40. Grohskopf LA, Sokolow LZ, Fry AM, Walter EB, Jernigan DB. Update: ACIP recommendations for the use of quadrivalent live attenuated influenza vaccine (LAIV4) - United States, 2018-19 influenza season. *MMWR Morb Mortal Wkly Rep.* 2018;67(22):643–645
41. Mallory RM, Nyborg A, Kalyani RN, Yuan Y, Block SL, Dubovsky F. A study to evaluate the immunogenicity and shedding of live attenuated influenza vaccine strains in children 24-<48 months of age. *Vaccine.* 2020;38(5):1001–1008
42. Dawood FS, Chung JR, Kim SS, et al. Interim estimates of 2019-20 seasonal influenza vaccine effectiveness - United States, February 2020. *MMWR Morb Mortal Wkly Rep.* 2020;69(7):177–182
43. Pebody RG, Whitaker H, Ellis J, et al. End of season influenza vaccine effectiveness in primary care in adults and children in the United Kingdom in 2018/19. *Vaccine.* 2020;38(3):489–497
44. Centers for Disease Control and Prevention. US flu VE data for 2018-2019. Available at: https://www.cdc.gov/flu/vaccines-work/2018-2019.html. Accessed May 4, 2020
45. Kelso JM, Greenhawt MJ, Li JT; Joint Task Force on Practice Parameters (JTFPP). Update on influenza vaccination of egg allergic patients. *Ann Allergy Asthma Immunol.* 2013;111(4):301–302
46. Greenhawt M, Turner PJ, Kelso JM. Administration of influenza vaccines to egg allergic recipients: A practice parameter update 2017. *Ann Allergy Asthma Immunol.* 2018;120(1):49–52
47. ACOG Committee Opinion No. 732: influenza vaccination during pregnancy. *Obstet Gynecol.* 2018;131(4):e109–e114
48. Robison SG, Osborn AW. The concordance of parent and child immunization. *Pediatrics.* 2017;139(5):e20162883
49. Zaman K, Roy E, Arifeen SE, et al. Effectiveness of maternal influenza immunization in mothers and infants [published correction appears in *N Engl J Med.* 2009;360(6):648]. *N Engl J Med.* 2008;359(15):1555–1564
50. Tapia MD, Sow SO, Tamboura B, et al. Maternal immunisation with trivalent inactivated influenza vaccine for prevention of influenza in infants in Mali: a prospective, active-controlled, observer-blind, randomised phase 4 trial. *Lancet Infect Dis.* 2016;16(9):1026–1035
51. Madhi SA, Cutland CL, Kuwanda L, et al; Maternal Flu Trial (Matflu) Team. Influenza vaccination of pregnant women and protection of their infants. *N Engl J Med.* 2014;371(10):918–931
52. Steinhoff MC, Katz J, Englund JA, et al. Year-round influenza immunisation during pregnancy in Nepal: a phase 4, randomised, placebo-controlled trial. *Lancet Infect Dis.* 2017;17(9):981–989
53 Shakib JH, Korgenski K, Presson AP, et al. Influenza in infants born to women vaccinated during pregnancy. *Pediatrics.* 2016;137(6):e20152360
54. Nunes MC, Madhi SA. Influenza vaccination during pregnancy for prevention of influenza confirmed illness in the infants: a systematic review and meta-analysis. *Hum Vaccin Immunother.* 2018;14(3):758–766
55. Thompson MG, Kwong JC, Regan AK, et al; PREVENT Workgroup. Influenza vaccine effectiveness in preventing influenza-associated hospitalizations during pregnancy: a multi-country retrospective test negative design study, 2010-2016. *Clin Infect Dis.* 2019;68(9):1444–1453
56. Nunes MC, Madhi SA. Prevention of influenza-related illness in young infants by maternal vaccination during pregnancy. *F1000Res.* 2018;7:122
57. Omer SB, Clark DR, Aqil AR, et al; for BMGF Supported Maternal Influenza Immunization Trials Investigators Group. Maternal influenza immunization and prevention of severe clinical pneumonia in young infants: analysis of randomized controlled trials conducted in Nepal, Mali and South Africa. *Pediatr Infect Dis J.* 2018;37(5):436–440
58. Munoz FM, Jackson LA, Swamy GK, et al. Safety and immunogenicity of seasonal trivalent inactivated influenza vaccines in pregnant women. *Vaccine.* 2018;36(52):8054–8061
59. Sheffield JS, Greer LG, Rogers VL, et al. Effect of influenza vaccination in the first trimester of pregnancy. *Obstet Gynecol.* 2012;120(3):532–537
60. Polyzos KA, Konstantelias AA, Pitsa CE, Falagas ME. Maternal influenza vaccination and risk for congenital malformations: a systematic review and meta-analysis. *Obstet Gynecol.* 2015;126(5):1075–1084
61. Chambers CD, Johnson D, Xu R, et al; OTIS Collaborative Research Group. Risks and safety of pandemic H1N1

influenza vaccine in pregnancy: birth defects, spontaneous abortion, preterm delivery, and small for gestational age infants. *Vaccine*. 2013;31(44):5026–5032

62. Nordin JD, Kharbanda EO, Vazquez Benitez G, Lipkind H, Vellozzi C, Destefano F; Vaccine Safety Datalink. Maternal influenza vaccine and risks for preterm or small for gestational age birth. *J Pediatr*. 2014;164(5):1051–1057.e2
63. Chambers CD, Johnson DL, Xu R, et al; OTIS Collaborative Research Group. Safety of the 2010-11, 2011-12, 2012-13, and 2013-14 seasonal influenza vaccines in pregnancy: Birth defects, spontaneous abortion, preterm delivery, and small for gestational age infants, a study from the cohort arm of VAMPSS. *Vaccine*. 2016;34(37):4443–4449
64. Donahue JG, Kieke BA, King JP, et al. Association of spontaneous abortion with receipt of inactivated influenza vaccine containing H1N1pdm09 in 2010-11 and 2011-12. *Vaccine*. 2017;35(40):5314–5322

65 Donahue J, Kieke BA, King JP. Inactivated influenza vaccine and spontaneous abortion in the Vaccine Safety Datalink in 2012-13, 2013-14, and 2014-15. *Vaccine*. 2019;37(44):6673–6681

66. Schlaudecker EP, Steinhoff MC, Omer SB, et al. IgA and neutralizing antibodies to influenza a virus in human milk: a randomized trial of antenatal influenza immunization. *PLoS One*. 2013;8(8):e70867
67. American Academy of Pediatrics. AAP immunization resources storage and handling series disaster planning. Available at: https://www.aap.org/en-us/Documents/immunization_disasterplanning.pdf. Accessed July 12, 2021
68. Centers for Disease Control and Prevention. COVID data tracker. Available at: https://covid.cdc.gov/covid-data-tracker/#datatracker-home. Accessed June 9, 2021
69. Bradley JS, Blumer JL, Romero JR, et al. Intravenous zanamivir in hospitalized patients with influenza. *Pediatrics*. 2017;140(5):e20162727
70. Chan-Tack KM, Kim C, Moruf A, Birnkrant DB. Clinical experience with intravenous zanamivir under an Emergency IND program in the United States (2011-2014). *Antivir Ther*. 2015;20(5):561–564
71. Ferdinands JM, Fry AM, Reynolds S, et al. Intraseason waning of influenza vaccine protection: Evidence from the US Influenza Vaccine Effectiveness Network, 2011-12 through 2014-15. *Clin Infect Dis*. 2017;64(5):544–550
72. Castilla J, Martínez-Baz I, Martínez-Artola V, et al; Primary Health Care Sentinel Network; Network for Influenza Surveillance in Hospitals of Navarre. Decline in influenza vaccine effectiveness with time after vaccination, Navarre, Spain, season 2011/12. *Euro Surveill*. 2013;18(5):20388
73. Kissling E, Valenciano M, Larrauri A, et al. Low and decreasing vaccine effectiveness against influenza A(H3) in 2011/12 among vaccination target groups in Europe: results from the I-MOVE multicentre case-control study. *Euro Surveill*. 2013;18(5):20390
74. Belongia EA, Sundaram ME, McClure DL, Meece JK, Ferdinands J, VanWormer JJ. Waning vaccine protection against influenza A (H3N2) illness in children and older adults during a single season. *Vaccine*. 2015;33(1):246–251
75. Radin JM, Hawksworth AW, Myers CA, Ricketts MN, Hansen EA, Brice GT. Influenza vaccine effectiveness: Maintained protection throughout the duration of influenza seasons 2010-2011 through 2013-2014. *Vaccine*. 2016;34(33):3907–3912
76. Puig-Barberà J, Mira-Iglesias A, Tortajada-Girbés M, et al; Valencia Hospital Network for the Study of Influenza and other Respiratory Viruses (VAHNSI, Spain). Waning protection of influenza vaccination during four influenza seasons, 2011/2012 to 2014/2015. *Vaccine*. 2017;35(43):5799–5807
77. Ray GT, Lewis N, Klein NP, et al. Intraseason waning of influenza vaccine effectiveness. *Clin Infect Dis*. 2019;68(10):1623–1630
78. Kissling E, Nunes B, Robertson C, et al; I-MOVE case–control study team. I-MOVE multicentre case-control study 2010/11 to 2014/15: is there within-season waning of influenza type/subtype vaccine effectiveness with increasing time since vaccination? *Euro Surveill*. 2016;21(16):30201
79. Pebody R, Andrews N, McMenamin J, et al. Vaccine effectiveness of 2011/12 trivalent seasonal influenza vaccine in preventing laboratory-confirmed influenza in primary care in the United Kingdom: evidence of waning intra-seasonal protection. *Euro Surveill*. 2013;18(5):20389
80. Petrie JG, Ohmit SE, Truscon R, et al. Modest waning of influenza vaccine efficacy and antibody titers during the 2007-2008 influenza season. *J Infect Dis*. 2016;214(8):1142–1149
81. Ferdinands JM, Patel MM, Foppa IM, Fry AM. Influenza vaccine effectiveness. *Clin Infect Dis*. 2019;69(1):190–191
82. American Academy of Pediatrics. *The Business Case for Pricing Immunization Administration*. Elk Grove Village, IL: American Academy of Pediatrics; 2012
83. Lessin HR, Edwards KM; Committee on Practice and Ambulatory Medicine; Committee on Infectious Diseases. Immunizing parents and other close family contacts in the pediatric office setting. *Pediatrics*. 2012;129(1). Available at: www.pediatrics.org/cgi/content/full/129/1/e247
84. Centers for Disease Control and Prevention. Influenza vaccination coverage among health care personnel — United States, 2018–19 influenza season. Available at: https://www.cdc.gov/flu/fluvaxview/hcp-coverage_1819estimates.htm. Accessed May 4, 2020
85. US Department of Health and Human Services, Office of Disease Prevention and Health Promotion. Immunization and infectious diseases. 2019. Available at: https://www.healthypeople.gov/2020/topics-objectives/topic/immunization-and-infectious-diseases. Accessed June 9, 2021
86. Uyeki TM, Bernstein HH, Bradley JS, et al. Clinical practice guidelines by the Infectious Diseases Society of America: 2018 update on diagnosis, treatment, chemoprophylaxis, and institutional outbreak management of seasonal influenza [published

correction appears in *Clin Infect Dis.* 2019;68(10):1790]. *Clin Infect Dis.* 2019;68(6):e1–e47

87. Heo YA. Baloxavir: first global approval. *Drugs.* 2018;78(6):693–697
88. Baker J, Block SL, Matharu B, et al. Baloxavir marboxil single-dose treatment in influenza-infected children: a randomized, double-blind, active controlled phase 3 safety and efficacy trial (miniSTONE-2). *Pediatr Infect Dis J.* 2020;39(8):700–705
89. Taieb V, Ikeoka H, Wojciechowski P, et al. Efficacy and safety of baloxavir marboxil versus neuraminidase inhibitors in the treatment of influenza virus infection in high-risk and uncomplicated patients - a Bayesian network meta-analysis. *Curr Med Res Opin.* 2021;37(2):225–244
90. F. Hoffman-LaRoche Ltd. Roche announces FDA approval of Xofluza for the prevention of influenza following contact with an infected person. Available at: https://www.roche.com/media/releases/med-cor-2020-11-24.htm. Accessed June 9, 2021
91. Ikematsu H, Hayden FG, Kawaguchi K, et al. Baloxavir marboxil for prophylaxis against influenza in household contacts. *N Engl J Med.* 2020;383(4):309–320
92. Dobson J, Whitley RJ, Pocock S, Monto AS. Oseltamivir treatment for influenza in adults: a meta-analysis of randomised controlled trials. *Lancet.* 2015;385(9979):1729–1737
93. Jefferson T, Jones MA, Doshi P, et al. Neuraminidase inhibitors for preventing and treating influenza in healthy adults and children. *Cochrane Database Syst Rev.* 2014;(4):CD008965
94. Malosh RE, Martin ET, Heikkinen T, Brooks WA, Whitley RJ, Monto AS. Efficacy and safety of oseltamivir in children: systematic review and individual patient data meta-analysis of randomized controlled trials. *Clin Infect Dis.* 2018;66(10):1492–1500
95. Uyeki TM. Oseltamivir treatment of influenza in children. *Clin Infect Dis.* 2018;66(10):1501–1503
96. Wang K, Shun-Shin M, Gill P, Perera R, Harnden A. Neuraminidase inhibitors for preventing and treating influenza in children (published trials only). *Cochrane Database Syst Rev.* 2012;(4):CD002744
97. Domínguez A, Romero-Tamarit A, Soldevila N, et al; Surveillance of Hospitalized Cases of Severe Influenza in Catalonia Working Group. Effectiveness of antiviral treatment in preventing death in severe hospitalised influenza cases over six seasons. *Epidemiol Infect.* 2018;146(7):799–808
98. Hsu J, Santesso N, Mustafa R, et al. Antivirals for treatment of influenza: a systematic review and meta-analysis of observational studies. *Ann Intern Med.* 2012;156(7):512–524
99. Muthuri SG, Venkatesan S, Myles PR, et al; PRIDE Consortium Investigators. Effectiveness of neuraminidase inhibitors in reducing mortality in patients admitted to hospital with influenza A H1N1pdm09 virus infection: a meta-analysis of individual participant data. *Lancet Respir Med.* 2014;2(5):395–404
100. Venkatesan S, Myles PR, Leonardi-Bee J, et al. Impact of outpatient neuraminidase inhibitor treatment in patients infected with influenza A(H1N1)pdm09 at high risk of hospitalization: an individual participant data metaanalysis. *Clin Infect Dis.* 2017;64(10):1328–1334
101. Tejada S, Tejo AM, Pena-Lopez Y, Forero CG, Corbella X, Rello J. Neuraminidase inhibitors and single dose baloxavir are effective and safe in uncomplicated influenza: a meta-analysis of randomized controlled trials. *Exp Rev Clin Pharmacol.* 2021;14(7):901–918
102. Dawood FS, Jara J, Gonzalez R, et al. A randomized, double-blind, placebo-controlled trial evaluating the safety of early oseltamivir treatment among children 0-9 years of age hospitalized with influenza in El Salvador and Panama. *Antiviral Res.* 2016;133:85–94
103. Louie JK, Yang S, Samuel MC, Uyeki TM, Schechter R. Neuraminidase inhibitors for critically ill children with influenza. *Pediatrics.* 2013;132(6). Available at: www.pediatrics.org/cgi/content/full/132/6/e1539
104. Katzen J, Kohn R, Houk JL, Ison MG. Early oseltamivir after hospital admission is associated with shortened hospitalization: a 5-year analysis of oseltamivir timing and clinical outcomes. *Clin Infect Dis.* 2019;69(1):52–58
105. Ramirez J, Peyrani P, Wiemken T, Chaves SS, Fry AM. A randomized study evaluating the effectiveness of oseltamivir initiated at the time of hospital admission in adults hospitalized with influenza-associated lower respiratory tract infections. *Clin Infect Dis.* 2018;67(5):736–742
106. Li L, Liu J, Qin K. Comparison of double-dose vs standard-dose oseltamivir in the treatment of influenza: a systematic review and meta-analysis. *J Clin Pharm Ther.* 2020;45(5):918–926
107. Howard A, Uyeki TM, Fergie J. Influenza-associated acute necrotizing encephalopathy in siblings. *J Pediatric Infect Dis Soc.* 2018;7(3):e172–e177
108. Takeuchi S, Tetsuhashi M, Sato D. Oseltamivir phosphate-lifting the restriction on its use to treat teenagers with influenza in Japan. *Pharmacoepidemiol Drug Saf.* 2019;28(4):434–436
109. US Food and Drug Administration. FDA expands approval of influenza treatment to post-exposure prevention. 2020. Available at: https://www.fda.gov/news-events/press-announcements/fda-expands-approval-influenza-treatment-post-exposure-prevention. Accessed June 9, 2021
110. Uyeki TM, Bernstein HH, Bradley JS, et al. Clinical practice guidelines by the Infectious Diseases Society of America: 2018 update on diagnosis, treatment, chemoprophylaxis, and institutional outbreak management of seasonal influenza. *Clin Infect Dis.* 2019;68(6):895–902
111. Koszalka P, Tilmanis D, Roe M, Vijaykrishna D, Hurt AC. Baloxavir marboxil susceptibility of influenza viruses from the Asia-Pacific, 2012-2018. *Antiviral Res.* 2019;164:91–96
112. Takashita E, Kawakami C, Morita H, et al; on behalf of the Influenza Virus Surveillance Group Of Japan. Detection of influenza A(H3N2) viruses exhibiting reduced susceptibility to the novel cap-dependent endonuclease inhibitor baloxavir in Japan, December 2018. *Euro Surveill.* 2019;24(3):1800698
113. Takashita E, Kawakami C, Ogawa R, et al. Influenza A(H3N2) virus exhibiting reduced susceptibility to baloxavir

due to a polymerase acidic subunit I38T substitution detected from a hospitalised child without prior baloxavir treatment, Japan, January 2019. *Euro Surveill.* 2019;24(12):1900170

114. Hayden FG, Sugaya N, Hirotsu N, et al; Baloxavir Marboxil Investigators Group. Baloxavir marboxil for uncomplicated influenza in adults and adolescents. *N Engl J Med.* 2018;379(10):913 923

115. Omoto S, Speranzini V, Hashimoto T, et al. Characterization of influenza virus variants induced by treatment with the endonuclease inhibitor baloxavir marboxil. *Sci Rep.* 2018;8(1):9633

116. Ince WL, Smith FB, O'Rear JJ, Thomson M. Treatment-emergent influenza virus polymerase acidic substitutions independent of those at I38 associated with reduced baloxavir susceptibility and virus rebound in trials of baloxavir marboxil. *J Infect Dis.* 2020;222(6):957 961

117. Takashita E, Daniels RS, Fujisaki S, et al. Global update on the susceptibilities of human influenza viruses to neuraminidase inhibitors and the cap-dependent endonuclease inhibitor baloxavir, 2017-2018. *Antiviral Res.* 2020;175:104718

118. BioSpace. FDA accepts Genentech's new drug application for Xofluza for the treatment of influenza in children. Available at: https://www.biospace.com/article/releases/fda-accepts-genentech-s-new-drug-application-for-xofluza-for-the-treatment-of-influenza-in-children-/. Accessed July 12, 2021

119. Hart RJ, Paul RI, Levine A, Sikes K, Bryant K, Stevenson MD. Parent intent and willingness to immunize children against influenza in the pediatric emergency department. *Pediatr Emerg Care.* 2019;35(7):493 497

120. Hart RJ, Stevenson MD, Smith MJ, LaJoie AS, Cross K. Cost-effectiveness of strategies for offering influenza vaccine in the pediatric emergency department. *JAMA Pediatr.* 2018;172(1):e173879

121. National Institutes of Health. NIH launches clinical trial of universal influenza vaccine candidate. Available at: https://www.nih.gov/news-events/news-releases/nih-launches-clinical-trial-universal-influenza-vaccine-candidate. Accessed July 12, 2021

122. Miyakawa R, Barreto NB, Kato RM, Neely MN, Russell CJ. Early use of anti-influenza medications in hospitalized children with tracheostomy. *Pediatrics.* 2019;143(3):e20182608

123. Centers for Disease Control and Prevention (CDC). Deaths related to 2009 pandemic influenza A (H1N1) among American Indian/Alaska Natives - 12 states, 2009. *MMWR Morb Mortal Wkly Rep.* 2009;58(48):1341 1344

124. Dee DL, Bensyl DM, Gindler J, et al. Racial and ethnic disparities in hospitalizations and deaths associated with 2009 pandemic Influenza A (H1N1) virus infections in the United States. *Ann Epidemiol.* 2011;21(8):623 630

125. Gounder PP, Callinan LS, Holman RC, et al. Influenza hospitalizations among American Indian/Alaska native people and in the United States general population. *Open Forum Infect Dis.* 2014;1(1):ofu031

126. Hennessy TW, Bruden D, Castrodale L, et al; Investigative Team. A case-control study of risk factors for death from 2009 pandemic influenza A(H1N1): is American Indian racial status an independent risk factor? *Epidemiol Infect.* 2016;144(2):315 324

Recommended Childhood and Adolescent Immunization Schedule: United States, 2022

- *Policy Statement*

POLICY STATEMENT Organizational Principles to Guide and Define the Child Health Care System and/or Improve the Health of all Children

American Academy of Pediatrics
DEDICATED TO THE HEALTH OF ALL CHILDREN™

Recommended Childhood and Adolescent Immunization Schedule: United States, 2022

COMMITTEE ON INFECTIOUS DISEASES

The 2022 recommended childhood and adolescent immunization schedules have been approved by the Centers for Disease Control and Prevention (CDC), American Academy of Pediatrics, American Academy of Family Physicians, American College of Obstetricians and Gynecologists, American College of Nurse-Midwives, American Academy of Physician Assistants, and National Association of Pediatric Nurse Practitioners. The schedules are revised annually to reflect current recommendations for the use of vaccines licensed by the US Food and Drug Administration.

The 2022 childhood and adolescent immunization schedule has been updated to ensure consistency between the formats of the childhood and adolescent and the adult immunization schedules. Similar to last year, the cover page includes a table with an alphabetical listing of vaccines, approved abbreviations for each vaccine, and vaccine trade names.

Table 1 contains the recommended immunization schedule from birth to 18 years of age.

Table 2 is the catch-up immunization schedule for persons 4 months to 18 years of age who start late or who are more than 1 month behind the recommended age for vaccine administration.

Table 3 lists the vaccines that may be indicated for children and adolescents 18 years of age or younger on the basis of medical conditions.

Similar to the 2021 schedule, the notes are presented in alphabetical order. The following changes to individual footnotes have been made to the 2022 schedule:

DOI: https://doi.org/10.1542/peds.2021-056056

PEDIATRICS (ISSN Numbers: Print, 0031-4005; Online, 1098-4275).

To cite: AAP Committee on Infectious Diseases. Recommended Childhood and Adolescent Immunization Schedule: United States, 2022. *Pediatrics*. 2022;149(3):e2021056056

- In "Additional Information," the text in the section on COVID-19 vaccination recommendations has been updated.
- For dengue vaccination:
  - A new section has been added that contains information regarding routine recommendation for use of dengue vaccine.
- For *Haemophilus influenzae* type b (Hib) vaccination:
  - Text has been edited to include recommendations for use of Vaxelis for routine and catch-up vaccination.
- For hepatitis A vaccination:
  - The note was updated to clarify the age for routine vaccination.
- For human papillomavirus vaccination (HPV):
  - The note has been updated to clarify when an HPV series is complete, and no additional dose of HPV is recommended.
  - The Special Situations section was updated to clarify persons with immunocompromising conditions (including HIV infection) should receive 3 doses of HPV vaccine, regardless of the age at initial vaccination.
- For measles, mumps, and rubella (MMR) vaccination:
  - The section on routine vaccination was updated to include recommendations for the use of the combination measles, mumps, rubella, and varicella vaccine (MMRV).
- For meningococcal serogroup A, C, W, and Y vaccines (MenACWY):
  - Text has been added to clarify MenACWY vaccines can be simultaneously administered with serogroup B meningococcal (MenB) vaccines if indicated but at different anatomic sites, if feasible.
  - In the Special Situations section, the language for the dosing schedule for Menveo in infants was edited for clarity.

Other notable changes in the 2022 child and adolescent immunization schedule include the following:

- Cover page: Dengue vaccine (Dengvaxia) has been added to the table of vaccine abbreviations/trade names.
- Table 1 (Recommended Child and Adolescent Immunization Schedule by Age):
  - Introductory sentences: The text "School entry and adolescent vaccine age groups are shaded in gray" has been removed.
  - The colors of the age columns 4 to 6 years, 11 to 12 years, and 16 years have been changed to make similar to the other columns in the table.
  - HPV row: For the column representing ages 9 to 10 years, the color was changed from blue with an asterisk to yellow with a check mark. The legend now reads "Recommended vaccination can begin in this age group."
  - Tdap (tetanus, diphtheria, acellular pertussis) row: The overlying text "Tdap" in the column representing ages 11 to 12 years has been changed to "1 dose."
  - A new row was added for dengue vaccine.
- Table 2 (Catch-up Immunization Schedule for Persons 4 Months to 18 Years of Age):
  - *H influenzae* type b row: The text for the minimum interval between dose 2 and dose 3 has been edited to include Vaxelis and remove Comvax.
  - A new row was added for dengue vaccine.
- Table 3 (Recommended Child and Adolescent Immunization Schedule by Medical Condition):
  - HIV infection: The descriptive text for the subcolumn was edited and now reads "$<$15% or total CD4 cell count of $<200/mm^3$."
  - Legend: The text that defines the checked yellow box has been edited to include "or vaccine." The text now reads "Vaccination is recommended, and additional doses may be necessary based on medical condition or vaccine. See Notes."
  - A new row was added for dengue vaccine.

The 2022 version of Tables 1 through 3 and the notes are available on the American Academy of Pediatrics Web site (https://redbook.solutions.aap.org/SS/Immunization_Schedules.asp) and the CDC Web site (www.cdc.gov/vaccines/schedules/hcp/child-adolescent.html). A parent-friendly vaccine schedule for children and adolescents is available at www.cdc.gov/vaccines/schedules/index.html. An adult immunization schedule is published in February of each year and is available at www.cdc.gov/vaccines/schedules/hcp/adult.html.

Clinically significant adverse events that follow immunization should be reported to the Vaccine Adverse Event Reporting System. Guidance about how to obtain and complete a Vaccine Adverse Event Reporting System form can be obtained at www.vaers.hhs.gov or by calling 800-822-7967. Additional information can be found in the *Red Book* and at *Red Book Online* (https://publications.aap.org/redbook). Statements from the Advisory Committee on Immunization Practices and CDC that contain detailed recommendations for individual vaccines, including recommendations for children with high-risk conditions, are available at www.cdc.gov/vaccines/hcp/acip-recs/index.html. Information on new vaccine releases, vaccine supplies, and interim recommendations resulting from vaccine shortages and statements on specific vaccines can be found at www.aapredbook.org/news/vaccstatus.shtml.

Mary T. Caserta, MD, FAAP
Chandy C. John, MD, MS, FAAP
Jeffrey S. Gerber, MD, PhD, FAAP
Athena P. Kourtis, MD, PhD, MPH, FAAP
Adam J. Ratner, MD, MPH, FAAP
José R. Romero, MD, FAAP
Samir S. Shah, MD, MSCE, FAAP
Kenneth M. Zangwill, MD, FAAP

EX OFFICIO

David W. Kimberlin, MD, FAAP, *Red Book* Editor
Elizabeth D. Barnett MD, FAAP, *Red Book* Associate Editor
Ruth Lynfield, MD, FAAP, *Red Book* Associate Editor
Mark H. Sawyer, MD, FAAP, *Red Book* Associate Editor
Henry H. Bernstein, DO, MHCM, FAAP, *Red Book Online* Associate Editor

LIAISONS

Karen M. Farizo, MD, US Food and Drug Administration
Lisa M. Kafer, MD, FAAP, Committee on Practice Ambulatory Medicine
David Kim, MD, Department of Health and Human Services Office of Infectious Disease and HIV/AIDS Policy
Eduardo López Medina, MD, MSc, Sociedad Latinoamericana de Infectologia Pediatrica
Denee Moore, MD, FAAFP, American Academy of Family Physicians
Lakshmi Panagiotakopoulos, MD, MPH, FAAP, Centers for Disease Control and Prevention
Laura Sauvé, MD, MPH, FRCPS, Canadian Paediatric Society
Neil S. Silverman, MD, American College of Obstetricians and Gynecologists
Jeffrey R. Starke, MD, FAAP, American Thoracic Society
Kay M. Tomashek, MD, MPH, DTM, National Institutes of Health
Melinda Wharton, MD, MPH, Centers for Disease Control and Prevention

STAFF

Jennifer M. Frantz, MPH

ABBREVIATIONS

CDC: Centers for Disease Control and Prevention
HPV: human papillomavirus vaccination

RESOURCES

1. Grohskopf LA, Alyanak E, Broder KR, et al. Prevention and control of seasonal influenza with vaccines: recommendations of the Advisory Committee on Immunization Practices—United States, 2020–21 influenza season. *MMWR Recomm Rep.* 2020;69(8):1–24
2. Mbaeyi SA, Bozio CH, Duffy J, et al. Meningococcal vaccination: recommendations of the Advisory Committee on Immunization Practices, United States, 2020. *MMWR Recomm Rep.* 2020;69(9):1–41
3. Havers FP, Moro PL, Hunter P, Hariri S, Bernstein H. Use of tetanus toxoid, reduced diphtheria toxoid, and acellular pertussis vaccines: updated recommendations of the Advisory Committee on Immunization Practices—United States, 2019. *MMWR Morb Mortal Wkly Rep.* 2020;69(3):77–83

Recommended Essential Equipment for Basic Life Support and Advanced Life Support Ground Ambulances 2020: A Joint Position Statement

- *Policy Statement*

POLICY STATEMENT Organizational Principles to Guide and Define the Child Health Care System and/or Improve the Health of all Children

American Academy of Pediatrics

DEDICATED TO THE HEALTH OF ALL CHILDREN®

Recommended Essential Equipment for Basic Life Support and Advanced Life Support Ground Ambulances 2020: A Joint Position Statement

John Lyng, MD, NRP,[a] Kathleen Adelgais, MD, MPH,[b] Rachael Alter, BA,[b] Justin Beal, RN,[c] Bruce Chung, MD,[d] Toni Gross, MD,[a] Marc Minkler, NRP,[e] Brian Moore, MD,[f] Tim Stebbins, MD,[a] Sam Vance, NRP,[b] Ken Williams, MD,[e] Allen Yee, MD[a]

INTRODUCTION

The National Association of EMS Physicians, along with these coauthoring associations: American Academy of Pediatrics, American College of Surgeons Committee on Trauma, EMS for Children Innovation and Improvement Center, Emergency Nurses Association, and National Association of State EMS Officials and as also endorsed by the National Association of Emergency Medical Technicians, believes that the delivery of high-quality and effective EMS care is dependent on several factors, including but not limited to the presence of the following:

- providers who have been credentialed to ensure they demonstrate appropriate cognitive knowledge, affective ability, psychomotor skills, and critical thinking[1];
- clinical protocols or guidelines that are supported by the best available scientific evidence; and
- equipment and supplies necessary to deliver appropriate care as directed by clinical protocols and/or guidelines for patients of all ages.

Several documents, including previous versions of this joint position statement, the *National Model EMS Clinical Guidelines Version 2.2*, the *2018 National EMS Scope of Practice Model*, the *Clinical Credentialing of EMS Providers*, *Physician Oversight of Pediatric Care in Emergency Medical Services*, *Pediatric Readiness in Emergency Medical Services Systems*, and core performance measures from the US Department of Health and Human Services Health Resources and Services Administration EMS for Children (EMSC) Program have been developed to lay the foundation of several of the concepts noted above.[1–9]

Ensuring that EMS providers are properly equipped to perform their clinical duties is an important function of oversight in EMS systems. In the

[a]*National Association of EMS Physicians, Overland Park, Kansas;* [b]*Emergency Medical Services for Children Innovation and Improvement Center, Austin, Texas;* [c]*Emergency Nurses Association, Des Plaines, Illinois;* [d]*American College of Surgeons Committee on Trauma, Chicago, Illinois;* [e]*National Association of State Emergency Medical Services Officials, Falls Church, Virginia; and* [f]*American Academy of Pediatrics, Itasca, Illinois*

DOI: https://doi.org/10.1542/peds.2021-051508

Address correspondence to John Lyng, MD, NRP, National Association of EMS Physicians, 4400 College Blvd, Suite 220, Overland Park, KS 66211. E-mail: jlyngmd@gmail.com

To cite: Lyng J, Adelgais K, Alter R, et al. Recommended Essential Equipment for Basic Life Support and Advanced Life Support Ground Ambulances 2020: A Joint Position Statement. *Pediatrics.* 2021;147(6):e2021051508

past, this regulatory oversight has been based on the publication of minimum recommended equipment standards, including previous versions of this document.[2–4] These efforts have attempted to provide a listing of the minimum items recommended for basic life support (BLS) and advanced life support (ALS) ground ambulances.

The field of EMS medicine continues to evolve, and the *EMS Scope of Practice Model* continues to undergo important longitudinal revisions, reflecting ongoing improvements in clinical technology and practice. In effect, these advancements have caused many interventions, once limited to the scope of advanced providers, to begin transitioning into the scope of basic providers. Additionally, interventions that were once considered outside the scope of EMS medicine continue to find appropriate places in the EMS setting of care. These contemporary updates make the delivery of EMS-based interventions safer and easier for EMS providers to perform.

In 201 , our organizations undertook a review and revision of the 2014 version of this joint position statement. Part of this revision process also included review of equipment lists established by individual state and territory rules and statutes for all US states and territories. Our review identified that portions of either the 2014 document and/or state- and territory-level equipment lists required items that:

- are no longer clinically recommended because they have been demonstrated to be either harmful or lacking efficacy or have been replaced by clinically superior options. (eg, military antishock trousers MAST , syrup of ipecac);
- are no longer correctly dichotomized to BLS versus ALS levels of care (eg, continuous positive airway pressure CPAP , nebulized medications);
- fail to include equipment that evidence-based guidelines suggest should be available on ground ambulances (eg, commercial arterial tourniquets are currently lacking on 2 state and territory lists); and
- require arbitrary quantities of items.

Establishing recommended equipment standards has value in helping build consistency across the EMS system of care. Documents such as this can be used to help guide both agency leadership and frontline staff in evaluating whether their agency is properly equipped to provide care that meets recommended community requirements. However, the process of creating and revising rules, statutes, and other legislative mechanisms at the state level of government is often onerous and time consuming and can sometimes have unpredictable results and generate unintended consequences.

Our review of existing state and territory EMS equipment regulations revealed that 3 states and territories had statutory EMS equipment lists that were more than years old. Equipment lists should serve to facilitate advances in the delivery of quality and cost-effective EMS care, not to create a barrier to EMS system improvement and development. In light of this, we offer the following recommendation to governmental entities with jurisdiction involving the practice of EMS medicine–

Ensure that legislative and/or administrative mechanisms that establish equipment standards for ground ambulances:

- avoid requiring arbitrary minimum amounts of equipment list items;
- reflect expert and evidence-based recommendations such as those provided in this position statement;
- undergo review and updates at intervals not to exceed five years;
- do not create unnecessary barriers to implementation of new technology at the local level;
- allow for flexibility and adaptability to make rapid unplanned changes in response to unpredicted equipment or medication shortages affecting local EMS agencies; and
- reinforce that all EMS agencies should carry the age-appropriate equipment, supplies, and medications necessary for their clinical providers to effectively conduct patient care as defined by the clinical protocols and guidelines that are applicable to each agency.

It cannot be overemphasized that the mere presence of certain pieces of equipment on an ambulance does not equate to individual EMS provider competence in the use of that equipment or to an EMS program's practice of high-quality and effective EMS medicine. In addition to establishing minimum equipment standards, we also recommend that states consider establishing standards requiring local EMS agencies to demonstrate that their EMS providers are competent in their use of the equipment and supplies necessary to administer care within their scope of practice as defined or allowed by locally applicable clinical protocols or guidelines. Such assessment of provider competency in use of equipment has been established as a key component of EMS readiness in the joint position statement, "Pediatric Readiness in Emergency Medical Services Systems," and also as a core performance measure by the US Department of Health and Human Services Health Resources and Services Administration through its EMS for Children (EMSC) Program.[8,]

Furthermore, although the implementation of equipment lists at the state level is an important level of system oversight, it remains critically important that EMS agency medical directors evaluate that the equipment available on their agency's

TABLE 1 List of Recommended Essential Equipment for BLS and ALS round Ambulances, 2020

Category	BLS		ALS (All BLS Equipment Plus the Following)	
	Adult	Pediatric	Adult	Pediatric
Airway, ventilation, and oxygenation	• Oxygen supply, portable and on-board • Devices capable of delivering oxygen in a titratable manner through nasal, partial face, or full-face mask routes in sizes to fit neonates through adults • Oropharyngeal airways in sizes to fit neonates to adults • Nasopharyngeal airways in sizes to fit neonates to adults • Manual and or powered suction device(s) with rigid oral and flexible pharyngeal tracheal suction catheters in sizes to fit neonates to adults • A device capable of providing noninvasive positive pressure ventilation • Self-inflating manual ventilation devices and masks to fit neonates to adults[11,12] • Bulb suction		• Direct and or video laryngoscopy equipment appropriate for neonates to adults[a] • Magill forceps • Extraglottic airways in sizes to fit neonates to adults[b]	
Bleeding, hemorrhage control, shock management, and wound care	• Commercial arterial tourniquets • Wound-packing material[c] • auze sponges • Adhesive bandages • Adhesive tape • Fluid for irrigation of wounds • Occlusive dressing (also known as "chest seal")		• Chest decompression needles ≥1 g diameter, minimum length 3.25 in (8.25 cm) or commercial chest decompression device[13–19]	• Chest decompression needles: o 1 g diameter, maximum length 1.5 in (3.8 cm) for patients <5 in (1 cm) long[20] o 23 g diameter, maximum length 0. 5 inches (2 cm) for newborns
Cardiovascular and circulation care	• Automatic external defibrillator with adult and pediatric or combination pads		• A device capable of performing automatic and or manual defibrillation, cardiac rhythm monitoring (in at least 3 leads), 12-lead EC acquisition, and transcutaneous pacing	
Diagnostic Tools	• lucometer • Pulse oximeter with sensors to fit neonates to adults • Stethoscope • Blood pressure cuffs in sizes to fit neonates to adults • Thermometer		• Continuous waveform capnography	
Infection Control	• Items necessary for universal and standard precautions[21]: o Waterless hand cleanser o Sharps container o Supplies for collection or absorption of patient vomit, urine, and or feces o Biohazardous materials collection bags o Products appropriate for cleaning and disinfecting surfaces and equipment • Items necessary for the following transmission-based precautions[22–2]: o Contact precautions: examination gloves, eye protection, gowns o Droplet precautions: surgical masks and eye protection o Airborne precautions: N95 facemasks in provider-appropriate sizes and eye protection or powered air-purifying respirator (PAPR) • eneral trash collection bags		No additional ALS recommendations	

TABLE 1 Continued

Category	BLS		ALS (All BLS Equipment Plus the Following)	
	Adult	Pediatric	Adult	Pediatric
Medications	• Medications that are germane to approved agency BLS protocols		• Medications that are germane to approved agency ALS (and/or higher level) protocols	
Medication delivery and vascular access	• Devices and supplies needed to administer medications via routes (oral, inhaled, intramuscular, intranasal) included in locally approved scope of practice and locally applicable protocol(s) and in sizes to fit neonates to adults • Supplies for application of antiseptic to skin	• Tools that provide precalculated wt-based dosing and preclude the need for calculation by EMS providers can reduce dosing errors.[25]	• Devices and supplies needed to administer medications via routes (oral, inhaled, intramuscular, intranasal, intravenous, intraosseous) included in locally approved scope of practice and locally applicable protocol(s) in sizes to fit neonates to adults • Isotonic crystalloid fluids and administration tubing capable of adjustable fluid delivery rate • A device to provide pressure infusion of IV fluids	• A device suitable for administering a fluid bolus to pediatric patients that limits risk for inadvertent overadministration of fluid
Neonatal care		Newborn delivery supplies: • 2 umbilical cord clamps, • Tool for cutting umbilical cord, • Bulb suction, • Infant head cover, • Towels, • Blanket, • Gauze dressings, • Material or device intended to maintain body temperature	No additional ALS recommendations	
Orthopedic injury care	• Splinting material or commercial devices for immobilization of orthopedic extremity injuries including but not limited to: o Femoral splinting materials, which may include either simple nontraction devices or devices that provide femoral traction.[d,26,27] o Pelvic splinting materials, which may include either a commercial pelvic circumferential compression device (PCCD) designed specifically to splint the pelvis or a dedicated bedsheet and towel clips to perform circumferential pelvic antishock sheeting.[28–32] • Cold packs • Elastic bandages		No additional ALS recommendations	
Patient packaging, evacuation, and transport	• Extrication board or device[e,33] • Materials or devices that can be used to provide spinal motion restriction of the cervical, thoracic, and lumbar spine for neonates to adults • Portable stretcher or litter • Collapsible "stair chair" • Wheeled multilevel gurney	• Pediatric-specific restraint system or age/size-appropriate car safety seat[f,34,35]	No additional ALS recommendations	
Safety	• Fire extinguisher (5lb ABC)[36] • ANSI Class 2 or 3 reflective vest or outerwear[37] • Impact-resistant eye protection (ANSI Z87.1)[38] • Nonflammable reflective and/or illuminated roadside warning devices • Portable reusable light source		No additional ALS recommendations	

TABLE 1 Continued

Category	BLS		ALS (All BLS Equipment Plus the Following)	
	Adult	Pediatric	Adult	Pediatric
Temperature management and heat-loss prevention	• Blankets • Towels • Heat packs		No additional ALS recommendations	
Miscellaneous items	• Bandage and trauma shears • A device that allows for two-way communication between the field and EMS communications and dispatch centers, direct medical control, and receiving hospitals • Triage marking system (colored tape, tags, or other system) that is interoperable with other local health care system entities and that follows recommendations from the US Department of Health and Human Services Assistant Secretary for Preparedness and Response[39]		No additional ALS recommendations	
Items that should no longer be carried on BLS or ALS ground ambulances because of evidence of harm or proven lack of clinical efficacy: • Military antishock trousers (MAST), aka pneumatic antishock garment (PASG)[40] • Syrup of ipecac[41]				

ANSI, American National Standards Institute; ECG, electrocardiogram; IV, intravenous.

[a] Laryngoscopy equipment is included to facilitate ALS provider identification and mechanical removal of upper airway foreign bodies by using Magill forceps, regardless of whether the ALS agency includes pediatric or adult endotracheal intubation within their ALS provider scope of practice.

[b] Depending on locally approved scope of practice and locally applicable protocol(s), other invasive airways (endotracheal tubes or needle or surgical cricothyrotomy supplies) may also be carried but are not recommended to be universally required on all ALS ground ambulances.

[c] Wound-packing material may include plain gauze and/or hemostatic dressings.

[d] Traction is not a necessary or required element of prehospital stabilization of suspected femur fracture(s) and is often contraindicated.[26,27]

[e] Devices used for extrication, such as backboards, should not be used for transport. Whenever feasible, patients should be removed from extrication devices before transport. Spinal motion restriction can be maintained by securing the patient to the transport stretcher.[33]

[f] Restraint devices should meet applicable crash-testing standards as they are developed and published and should appropriately meet individual patient wt, length, and developmental status needs.[34,35]

ambulances is appropriate for the delivery of care and transport of both pediatric and adult patients in their service area. Each agency's physician medical director should have direct involvement in the selection, approval, and deployment of the devices each agency chooses to fulfill both the clinical and regulatory equipment requirements that are germane to their agency.

In continued support of establishing and maintaining a foundation for standards of care, our organizations remain committed to periodic review and revision of this position statement. This latest revision was created on the basis of a structured review of the *National Model EMS Clinical Guidelines Version 2.2* to identify the equipment items necessary to deliver the care defined by those guidelines.[6] In addition, to ensure congruity with national definitions of provider scope of practice, the list is differentiated into BLS and ALS levels of service by using the National Scope of Practice–defined levels of emergency medical responder (EMR) and emergency medical technician (EMT) as BLS and advanced emergency medical technician (AEMT) and paramedic as ALS.[5] Equipment items listed within each category were cross-checked against recommended scopes of practice for each level to ensure they were appropriately dichotomized to BLS or ALS levels of care. Some items may be considered optional at the local level, as determined by agency-defined scope of practice and applicable clinical guidelines.

In addition to the items included in this position statement, our organizations agree that, as modeled in the Iowa Administrative Code, "all EMS service programs shall carry equipment and supplies in quantities as determined by the medical director and appropriate to the agency's level of care and available certified EMS personnel and as established in the agency's approved protocols."[10]

Finally, in addition to taking steps to determine that appropriate equipment is routinely available and that EMS providers are competent in using this equipment, our organizations also recommend that all EMS agencies include in their routine quality assurance practices efforts to evaluate that:

- their EMS providers are outfitted with all of the equipment necessary for them to perform clinical care;
- all equipment and supplies undergo appropriate preventive maintenance and routine function checks; and
- malfunctioning or missing equipment issues are rapidly mitigated to preserve readiness to respond and provide patient care continuously.

LIST OF RECOMMENDED ESSENTIAL EQUIPMENT FOR BLS AND ALS GROUND AMBULANCES, 2020

General Principles:

This document is intended to represent minimum essential

equipment recommendations (Table 1) and should not be used to limit the addition of items to a service's repertoire. Carriage of items that supplement those listed herein should be based on local clinical and operational needs, including the needs of specialty transport teams, and should be left to the discretion of the physician medical director and other agency administrative and operational officers.

1. Equipment should always be appropriate for the size and age of patients. Availability and use of appropriate pediatric-sized equipment is necessary, not discretionary.
    a. Adult-sized items should not be substituted or adapted for use on pediatric patients except in cases in which available pediatric-focused equipment has malfunctioned and in which failure to provide further intervention by adapting an adult device for pediatric use would result in serious harm to the pediatric patient.
2. Several items that were included in previous versions of this list, including items previously listed as "optional," are not included in this revision. Their absence from this list demonstrates lack of sufficient evidence to support inclusion of these items universally for all BLS and/or ALS ground ambulances but should not be interpreted to mean that such items should not be carried on *any* BLS and/or ALS ground ambulance. Local clinical protocols and scope of practice may dictate that such items are prudent and proper to carry.
3. Evidence supporting inclusion of specific items in this recommended equipment list is cited where available.
4. Certain items are included in this list on the basis of sound judgment and logic (eg, "portable reusable light source") rather than on the basis of the presence of supporting evidence.
5. Several items were identified on review of existing state and territory equipment lists or in previous versions of this document that should no longer be carried on ground ambulances because of evidence of harm or proven lack of efficacy. These items have been identified in a section that is new in this revision of this joint position statement.
6. Equipment specifications exist for several items contained in this document. The sources for those specifications are cited.
7. Latex-free items should be used whenever possible and practical.
8. Specific medication recommendations have been removed from this minimum recommended equipment list because of the following:
    a. the diversity of clinical protocols across the United States, even across the same echelons of care, precludes development of an appropriately brief but comprehensive recommended medication list;
    b. the frequency and unpredictable nature of medication shortages requiring frequent and rapid revision to local medication supplies preclude the development of a recommended medication list that would remain germane on a daily basis; and
    c. the variability in the availability and use of therapeutic alternatives across EMS agencies precludes development of an appropriately brief but comprehensive recommended medication list.

ABBREVIATIONS

ALS: advanced life support
BLS: basic life support
EMS: emergency medical services

PEDIATRICS (ISSN Numbers Print, 0031-4005; Online, 10 8-4275).

FINANCIAL DISCLOSURE: The authors have indicated they have no financial relationships relevant to this article to disclose.

FUNDING: No external funding.

POTENTIAL CONFLICT OF INTEREST: The authors have indicated they have no potential conflicts of interest to disclose.

REFERENCES

1. Clinical credentialing of EMS providers. *Prehosp Emerg Care*. 2017;21(3) 3 7–3 8
2. National Association of EMS Physicians; American College of Emergency Physicians; American College of Surgeons Committee on Trauma. Equipment for ambulances a joint statement from the National Association of EMS Physicians, the American College of Emergency Physicians, and the American College of Surgeons Committee on Trauma. *Prehosp Emerg Care*. 2007;11(3) 326–32

3. American College of Surgeons Committee on Trauma; American College of Emergency Physicians; National Association of EMS Physicians; Pediatric Equipment Guidelines Committee–Emergency Medical Services for Children Partnership for Children Stakeholder Group; American Academy of Pediatrics. Equipment for ambulances. *Prehosp Emerg Care*. 2009; 13(3):364–369
4. American Academy of Pediatrics; American College of Emergency Physicians; American College of Surgeons Committee on Trauma; Emergency Medical Services for Children; Emergency Nurses Association; National Association of EMS Physicians; National Association of State EMS Officials. Equipment for ground ambulances. *Prehosp Emerg Care*. 2014; 18(1):92–97
5. National Highway Traffic Safety Administration. 2018 national EMS scope of practice model. 2018. Available at: https://nasemso.org/wp-content/uploads/Prepublication-Display-Copy-2018-National-EMS-Scope-of-Practice-Model-20180929.pdf. Accessed December 31, 2020
6. National Association of State EMS Officials. *National Model EMS Clinical Guidelines*. Falls Church, VA: National Association of State EMS Officials; 2019
7. Physician oversight of pediatric care in emergency medical services. *Prehosp Emerg Care*. 2017;21(1):88
8. Moore B, Shah MI, Owusu-Ansah S, et al.; American Academy of Pediatrics Committee on Pediatric Emergency Medicine, Section on Emergency Medicine EMS Committee and Section on Surgery; American College of Emergency Physicians Emergency Medical Services Committee; Emergency Nurses Association Pediatric Committee; National Association of Emergency Medical Services Physicians Standards and Clinical Practice Committee; National Association of Emergency Medical Technicians Emergency Pediatric Care Committee. Pediatric readiness in emergency medical services systems. *Prehosp Emerg Care*. 2020;24(2):175–179
9. National EMSC Data Analysis Resource Center, US Department of Health and Human Services. EMS for children performance measures. 2017. Available at: https://www.nedarc.org/performanceMeasures/documents/EMS%20Perf%20Measures%20Manual%20Web_0217.pdf. Accessed December 31, 2020
10. Iowa Code §641, ch 132.8(4)(b) (2016)
11. Kroll M, Das J, Siegler J. Can altering grip technique and bag size optimize volume delivered with bag-valve-mask by emergency medical service providers? *Prehosp Emerg Care*. 2019; 23(2):210–214
12. Siegler J, Kroll M, Wojcik S, Moy HP. Can EMS providers provide appropriate tidal volumes in a simulated adult-sized patient with a pediatric-sized bag-valve-mask? *Prehosp Emerg Care*. 2017;21(1): 74–78
13. Aho JM, Thiels CA, El Khatin MM, et al. Needle thoracostomy: clinical effectiveness is improved using a longer angiocatheter. *J Trauma Acute Care Surg*. 2016;80(2):272–277
14. Butler FK Jr., Holcomb JB, Shackelford S, et al. Management of suspected tension pneumothorax in tactical combat casualty care: TCCC guidelines change 17-02. *J Spec Oper Med*. 2018;18(2): 19–35
15. Harcke HT, Pearse LA, Levy AD, Getz JM, Robinson SR. Chest wall thickness in military personnel: implications for needle thoracentesis in tension pneumothorax. *Mil Med*. 2007;172(12): 1260–1263
16. Inaba K, Branco BC, Eckstein M, et al. Optimal positioning for emergent needle thoracostomy: a cadaver-based study. *J Trauma*. 2011;71(5):1099–1103; discussion 1103
17. Stevens RL, Rochester AA, Busko J, et al. Needle thoracostomy for tension pneumothorax: failure predicted by chest computed tomography. *Prehosp Emerg Care*. 2009;13(1):14–17
18. Wernick B, Hon HH, Mubang RN, et al. Complications of needle thoracostomy: a comprehensive clinical review. *Int J Crit Illn Inj Sci*. 2015;5(3):160–169
19. Zengerink I, Brink PR, Laupland KB, Raber EL, Zygun D, Kortbeek JB. Needle thoracostomy in the treatment of a tension pneumothorax in trauma patients: what size needle? *J Trauma*. 2008;64(1):111–114
20. Mandt MJ, Hayes K, Severyn F, Adelgais K. Appropriate needle length for emergent pediatric needle thoracostomy utilizing computed tomography. *Prehosp Emerg Care*. 2019; 23(5):663–671
21. US Department of Labor Occupational Safety and Health Administration. *Standard Number 1910 Subpart I: Personal Protective Equipment*. Washington, DC: US Department of Labor Occupational Safety and Health Administration
22. US Department of Labor Occupational Safety and Health Administration. *Standard Number 1910.1030: Bloodborne Pathogens*. Washington, DC: US Department of Labor Occupational Safety and Health Administration
23. US Department of Labor Occupational Safety and Health Administration. *Standard Number 1910.134: Personal Protective Equipment Respiratory Protection*. Washington, DC: US Department of Labor Occupational Safety and Health Administration
24. Siegel JD, Rhinehart E, Jackson M, Chiarello L; Healthcare Infection Control Practices Advisory Committee. 2007 guideline for isolation precautions: preventing transmission of infectious agents in healthcare settings. 2019. Available at: https://www.cdc.gov/infectioncontrol/pdf/guidelines/isolation-guidelines-H.pdf. Accessed December 31, 2020
25. Cicero MX, Adelgais K, Hoyle JD Jr., et al. Medication dosing safety for pediatric patients: recognizing gaps, safety threats, and best practices in the emergency medical services setting. A position statement and resource document from NAEMSP. *Prehosp Emerg Care*. 2021;25(2):294–306
26. Wood SP, Vrahas M, Wedel SK. Femur fracture immobilization with traction splints in multisystem trauma patients. *Prehosp Emerg Care*. 2003;7(2):241–243
27. Daugherty MC, Mehlman CT, Moody S, LeMaster T, Falcone RA Jr.. Significant rate of misuse of the Hare traction splint for children with femoral shaft fractures. *J Emerg Nurs*. 2013;39(1): 97–103
28. Pizanis A, Pohlemann T, Burkhardt M, Aghayev E, Holstein JH. Emergency stabilization of the pelvic ring: clinical

comparison between three different techniques. *Injury*. 2013;44(12): 1760–1764

29. Bakhshayesh P, Boutefnouchet T, Tötterman A. Effectiveness of non invasive external pelvic compression: a systematic review of the literature. *Scand J Trauma Resusc Emerg Med*. 2016;24:73
30. White CE, Hsu JR, Holcomb JB. Haemodynamically unstable pelvic fractures. *Injury*. 2009;40(10):1023–1030
31. van Oostendorp SE, Tan ECTH, Geeraedts LMG Jr.. Prehospital control of life-threatening truncal and junctional haemorrhage is the ultimate challenge in optimizing trauma care; a review of treatment options and their applicability in the civilian trauma setting. *Scand J Trauma Resusc Emerg Med*. 2016;24(1): 110
32. Coccolini F, Stahel PF, Montori G, et al. Pelvic trauma: WSES classification and guidelines. *World J Emerg Surg*. 2017;12:5
33. Fischer PE, Perina DG, Delbridge TR, et al. Spinal motion restriction in the trauma patient - a joint position statement. *Prehosp Emerg Care*. 2018; 22(6):659–661
34. National Association of State EMS Officials. *Safe Transport of Children by EMS: Interim Guidance*. Falls Church, VA: National Association of State EMS Officials; 2017
35. National Association of State EMS Officials. Pediatric transport products for ground ambulances V2.2, October 2020. Available at: https://nasemso.org/wp-content/uploads/Pediatric-Transport-Products-for-Ground-Ambulances_v2.2.pdf
36. National Fire Protection Association. *Standard for Automotive Ambulances 1917-2019*. Quincy, MA: National Fire Protection Association; 2019
37. American National Standards Institute/ International Safety Equipment Association. ANSI/ISEA 107-2015: American national standard for high visibility safety apparel and accessories. 2015. Available at: https://safetyequipment.org/ansiisea-107-2015/. Accessed December 31, 2020
38. American National Standards Institute/ International Safety Equipment Association. ANSI/ISEA Z87.1-2015 standard. 2015. Available at: https://safetyequipment.org/isea-standards/ansiisea-z87-accredited-standards-committee/ansiisea-z87-1-2015-standard/. Accessed December 31, 2020
39. US Department of Health and Human Services Assistant Secretary for Preparedness and Response; Technical, Resources, Assistance Center, and Information Exchange. Mass casualty trauma triage paradigms and pitfalls. 2019. Available at: https://files.asprtracie.hhs.gov/documents/aspr-tracie-mass-casualty-triage-final-508.pdf. Accessed December 31, 2020
40. Roberts I, Blackhall K, Dickinson KJ. Medical Anti-Shock Trousers (Pneumatic Anti-Shock Garments) for Circulatory Support in Patients with Trauma. In: *Cochrane Database Syst Rev*. 1999: CD001856
41. American Academy of Clinical Toxicology and European Association of Poisons Centres and Clinical Toxicologists. Position paper: ipecac syrup. [published correction appears in *J Toxicol Clin Toxicol*. 2004;42(7):1000]. *J Toxicol Clin Toxicol*. 2004;42(2):133–143

School-Based Health Centers and Pediatric Practice

- *Policy Statement*

POLICY STATEMENT Organizational Principles to Guide and Define the Child Health Care System and/or Improve the Health of all Children

American Academy of Pediatrics
DEDICATED TO THE HEALTH OF ALL CHILDREN™

School-Based Health Centers and Pediatric Practice

Chris Kjolhede, MD, MPH, FAAP,[a] April C. Lee, MD, FAAP,[b] COUNCIL ON SCHOOL HEALTH

School-based health centers (SBHCs) are unique health care settings for our nation's school-aged children and adolescents. SBHCs represent the collaboration between the health and school communities to support the health and mental health needs and the academic achievements of children and adolescents, particularly students with health disparities or poor access to health care. SBHCs improve access to health care services for students by decreasing financial, geographic, age, and cultural barriers. This policy statement provides an overview of SBHCs, including the scope of services as well as some of the documented benefits and challenges. This policy statement also reviews the role of SBHCs in working with the pediatric medical home and provides recommendations that support the coordination of SBHCs with pediatric primary care providers and the pediatric medical home.

BACKGROUND

School-based health centers (SBHCs) are unique health care settings for school-aged children and adolescents that have been proven to improve access to care, improve health outcomes, and reduce health disparities.[1,2] Conveniently located in schools or on school grounds, SBHCs provide primary care services that address the physical and mental health needs of students. SBHCs represent a collaborative commitment with the school community to support the health and academic success of children and adolescents.[3]

Significant growth in the number of SBHCs in the United States over the last 2 decades is evident in the most recent data from the National School-Based Health Care Census report conducted by the School-Based Health Alliance (SBHA) in 2016–2017.[4] According to that report, there are 2584 SBHCs that serve students and communities in 48 of 50 states and the District of Columbia and Puerto Rico.[4] The number of SBHCs has more than doubled since 1998.[4] Currently, 46% of SBHCs are in urban communities, 36% are in rural areas, and 18% are in suburban

abstract

[a]*Bassett Healthcare Network, Cooperstown, New York; and* [b]*Division of Adolescent Medicine, Department of Pediatrics, Staten Island University Hospital/Northwell Health and Zucker School of Medicine at Hofstra/Northwell, Staten Island, New York*

Drs Kjolhede and Lee were equally responsible for all aspects of revising and writing the policy statement with input from reviewers and the Board of Directors; and both authors approve the final manuscript as submitted.

DOI: https://doi.org/10.1542/peds.2021-053758

Address correspondence to Chris Kjolhede, MD, MPH. E-mail: chris.kjolhede@bassett.org

PEDIATRICS (ISSN Numbers: Print, 0031-4005; Online, 1098-4275).

FINANCIAL DISCLOSURE: The authors have indicated they have no financial relationships relevant to this article to disclose.

FUNDING: No external funding.

To cite: Kjolhede C, Lee AC; Council on School Health. School-Based Health Centers and Pediatric Practice. *Pediatrics*. 2021;148(4):e2021053758

communities.[4] The growth of SBHCs in rural and suburban areas has outpaced that in urban settings since 2008.[4] According to the 2016–2017 SBHA census report, 17% of SBHCs are located in high schools, 40% are located in elementary schools, 13% are located in middle schools, and 30% are located in schools with unique grade combinations, such as kindergarten through grade 12.[4]

SBHCs were developed as the scope of school health expanded. The Robert Wood Johnson Foundation, instrumental in the promotion of the SBHC model, continues its support today by funding the Center for Health and Health Care in Schools.[5,6] Recognizing that healthier students made better learners, pediatric and nursing health professionals initially pioneered school health services in an effort to address the unmet health care needs of schoolchildren.[7,8] As the scope of school health services expanded, schools began to provide several critical health services, including triage and management of medical emergencies; medication delivery; services for youth with special health care needs; referral for common health problems, such as injury, asthma, and mental and emotional difficulties; and health screenings.[3,9–11] SBHCs provide a "health care 'safety net' for children and adolescents who are uninsured or underinsured or represent special populations who do not regularly access health care."[3]

As SBHCs have evolved over time, the recommendations for best practices for SBHCs have also evolved. Guidelines include community needs assessment, coordination of care with the medical community, and measurement of performance indicators reflecting the effect of SBHC services on students' health and academic outcomes.[12–15]

According to the SBHA, the 7 core competencies of SBHCs are[16] as follows:

- access: the SBHC ensures students' access to health care and support services to help them thrive; SBHCs are located in schools or on school grounds and work within the school to become a part of the school;
- student focus: the SBHC team and services are organized around health issues that affect student well-being and academic success;
- school integration: the SBHC integrates the education and environment to support the school's mission of student success;
- accountability: the SBHC routinely evaluates its performance against accepted standards of quality to achieve optimal outcomes for students;
- school wellness: the SBHC promotes a culture of health across the entire school community;
- systems coordination: the SBHC coordinates across relevant systems of care that share in the well-being of its patients; and
- sustainability: the SBHC employs sound management practices to ensure a sustainable business.

ROLE OF THE S HC IN INCREASIN ACCESS TO HEALTH CARE

SBHCs serve a critical role in increasing access to quality comprehensive and coordinated primary care for children and adolescents, especially underserved, at-risk, and stressed children and adolescents.[1,2] SBHCs are health care centers for students in prekindergarten through 12th grade and are ideally located on-site in the school, thereby decreasing geographic or transportation barriers to health care.[1,2] Recently, the number of SBHCs has increased in rural areas.[4] Demonstrated to be effective in the higher-density urban community, SBHCs in rural areas face challenges because of the low population density.[17] However, for some rural communities with limited or no medical providers, SBHCs can potentially increase access to medical services for students.

SBHCs also increase access to care by addressing financial barriers.[3,17] For uninsured and underinsured students, SBHC services are available at minimal out-of-pocket cost. SBHCs help enroll these eligible students in much needed health insurance, such as Medicaid or the Children's Health Insurance Program.[3] Because SBHCs are generally located in low-income urban areas and in communities with a high proportion of historically disadvantaged populations, this source of student health care and health education may be an effective means of advancing health equity.[1,2]

SBHCs increase adolescent use of health care. Many teenagers, especially male teenagers, are reluctant to seek health care in a traditional medical setting because of cost, confidentiality concerns, and parental involvement.[18–20] By providing convenient and confidential care in a familiar setting with supportive staff, SBHCs reduce barriers to care for adolescents, particularly in the areas of sexual and reproductive health, substance use, and mental health issues.[21–26] In one study by Stone et al[27] in the San Francisco school district, SBHC users reported a caring relationship with program staff. In another study by Allison et al[28] in the Denver Public Schools area, adolescent SBHC users were more likely to have received a health maintenance visit, more likely to have received vaccines, and less likely to have used emergency care than other users. SBHC users were also less

likely than other users to be insured.[28]

SBHCs increase access to care, which is beneficial to all stakeholders. Parents and caregivers benefit with the knowledge that their child can receive health care without leaving school and that this care is covered at no or low cost. School leaders and the school community benefit because the students' health care needs are addressed on-site and there is a reduction in missed class time and absenteeism.[29,30] Employers of parents and caregivers appreciate that there are reduced employee productivity losses because of missed work time to care for sick children or transport them to medical settings.[29] SBHCs help students with special acute and chronic medical and mental health concerns, with the goal to improve their ability to academically succeed in the classroom.[31,32] SBHCs can partner with schools to improve academic outcomes by potentially reducing absenteeism and suspension with the provision of mental health and substance use services. In one urban school district study, the use of SBHCs for medical concerns was associated with an increase in attendance and the use of SBHCs for mental health concerns was associated with an increase in grade point average.[31]

SE ICES O IDED Y S HCS

The range of services provided by SBHCs is dependent on the sponsors' resources as well as the needs of the community. At the minimum, SBHCs provide health care services, which may include health maintenance supervision or well-child care, immunizations, and/or laboratory services. Some SBHCs may provide a wider range of preventive and psychosocial services, including hearing and vision screening, vision services (eg, provision of corrective lenses), reproductive health services, mental health services, social services, health education, and oral health services. Mental health services may include screening, counseling, and substance use disorder services.

Three staffing models exist in SBHCs.[3,29,33] In one model, a single clinician, such as a nurse practitioner or a physician assistant, may provide primary care services. Another staffing model includes staff who provide primary care and mental health services. Finally, a third staffing model provides medical and mental health with expanded services that involve an interdisciplinary team of social workers, health educators, and dental providers. All these SBHC models can provide age-specific and age-sensitive specialized health care for students. Sponsors independent of the school system, such as federally qualified health centers, hospitals, academic medical institutions, medical centers, or departments of health, also provide these services.[29]

Services are usually available during school hours. The majority of SBHCs (75%) are open and provide services during all regular school hours.[4] Enrollment in the SBHC generally requires parental permission.[1,29,32] Additional permission typically would be necessary for the treatment of specific conditions. The child may be able to consent for certain types of health care services, such as reproductive health, as provided by state law. Limited consents for specific types of health care services, such as reproductive health care, may be available to individual students only, again, as regulated by state and local guidelines.[1,32]

Sixty-five percent of all SBHCs provide primary care and mental health services.[4] The percentage of all SBHC sites that report expanded services is 41%.[4] Expanded services may include health education, nutritional counseling, reproductive health, and oral health.[4] Expanded specialized programs may be directed toward prevention or treatment of a specific medical condition, such as asthma or obesity, or a social determinant of health, such as food insecurity or discrimination. Expanded mental health services may include specific areas of need, such as substance use disorder treatment and comanagement with the medical provider for co-occurring medical disorders.

SBHCs serve to increase school connectedness, the concept that students believe the adults and peers in their school care about them as individuals as well as about their learning.[34,35] The staff of the SBHC serves as a resource to the entire school community and often coordinates school health services as well as assists school wellness promotion efforts. By implementing the recommendations of *Bright Futures: Guidelines for Health Supervision of Infants, Children, and Adolescents* into clinical practice for health examinations, SBHCs are better able to address the main components of health supervision (disease detection, disease prevention, health promotion, and anticipatory guidance) with the entire school community.[3,36] With this level of involvement, SBHCs also promote the principles of the Whole School, Whole Child, Whole Community model. The Whole School, Whole Child, Whole Community model has 10 components, including health education; physical education and physical activity; nutrition environment services; health services; counseling, psychological, and social services; social and emotional climate; physical environment; employee wellness;

family engagement; and community involvement. It is a coordinated school health program designed to address the health and education needs of the whole child and to promote and support healthy lifestyles for the students, teachers, staff, and community.[37–38]

EFFECTIVENESS OF SBHCS IN IMPROVING OUTCOMES

The effectiveness of SBHCs in improving health outcomes and reducing health disparities has clearly been demonstrated in the literature. Studies have demonstrated improved health outcomes with specific medical conditions and increasing access to mental health services. The literature has shown that SBHCs reduce health disparities by providing services to students from diverse racial and socioeconomic backgrounds, particularly the underinsured or uninsured child.[2,39] The Community Preventive Services Task Force, established by the US Department of Health and Human Services to identify population health interventions scientifically proven to improve the quality of life, recommends the implementation and maintenance of SBHCs in low-income communities on the basis of a systematic review of the impact of SBHCs on educational and health outcomes.[17,40]

Preventive Health Care

Studies have shown that SBHCs increase use of preventive health services. In a study comparing access and quality of health services among students attending an urban high school with an SBHC compared with students attending a high school without an SBHC, students with access to the SBHC were more likely to report having a regular health care provider, awareness of confidential services, support for health services in their school, and willingness to use those services. Users of the SBHC reported higher quality of care compared with nonusers or students in the comparison school. The presence of comprehensive health services via the SBHC led to improved access to health care and improved quality of care.[41] In another study demonstrating improved prevention services, recalling students for SBHC appointments was effective in improving immunization rates for all vaccines recommended for adolescents.[42]

Reproductive Health

The literature supports the concept that SBHCs improve access to reproductive health services and remain an important component in adolescent pregnancy prevention. A study by Minguez et al[43] demonstrated that students with access to comprehensive reproductive health services via an SBHC reported greater exposure to reproductive health education and counseling and greater use of hormonal contraception. In another study, sexually active female students received specific reproductive health care and were more likely to have used a hormonal contraceptive method if their school had an SBHC.[44] In a study comparing an SBHC that dispensed hormonal contraceptive on-site with an SBHC that referred students to an off-campus family planning clinic, the on-site SBHC dispensing hormonal contraception was associated with a lower pregnancy rate than the SBHC referring female students for hormonal contraception.[45] The availability and provision of emergency contraception in an SBHC also improves access to reproductive health services.[43–47] Provision of reproductive health services in SBHCs remains a subject of controversy in some communities. However, in one study of stakeholders, there was strong support for the inclusion of reproductive health services in SBHCs.[48]

Mental Health

Literature shows that schools are ideal settings for mental health intervention. School-based mental health interventions, including the area of substance use services, offer an opportunity to reach the greatest number of affected youth who otherwise may not receive behavioral health care.[49] A study in California comparing the mental health risk profile and health use of SBHC users and nonusers demonstrated that SBHCs play a role in identifying and addressing mental health concerns that might otherwise go unmet, especially among adolescents with public or no insurance.[50] Studies have shown that SBHCs may be important sites to address bullying, violence, and suicide prevention[51–53] and to promote mental health and overall wellness.[54] One study in Oregon schools with SBHCs showed that an increase in mental health services availability was associated with relative reductions in reported depressive episodes and suicidal ideation among adolescent students.[53]

Chronic Conditions Such as Asthma and Obesity

Literature demonstrates that SBHCs are a setting for innovative asthma quality improvement initiatives, demonstrating reduction in activity restriction attributable to asthma and a significant reduction in emergency department visits for asthma.[15] SBHCs are also ideal settings to address obesity and to initiate a weight management intervention because they are on-site and able to address and engage the student community.[55–58]

School Performance

Academic benefits include improved school performance, grade promotion, and high school completion.[2,59,60] In a study by Kerns et al,[31] SBHC use was associated with a reduction in the drop-out rate in a large urban school district, especially by students believed to be at high risk for dropping out of school. By reducing barriers to health care, SBHCs reduce school absenteeism and time missed from school.[30,32] SBHCs help to identify and support any social or emotional sources of stress that interfere with students' academic achievement.[32]

SBHCS AND THE MEDICAL HOME AND THE ROLE OF THE PEDIATRICIAN

SBHCs support the principles of the medical home model, as defined by the American Academy of Pediatrics,[61] which refers to delivery of medical care that should be accessible, continuous, comprehensive, family centered, coordinated, compassionate, and culturally effective.[32,62] In one study conducted in a large low-income urban population, SBHCs met the criteria of the medical home from adolescents' and parents' perspectives.[63] For students who do not have access to a medical home and do not have the involvement of a community pediatrician, SBHCs may indeed become the primary source of health care for youth. In other cases, the SBHC can assist in linking the student and his or her family to a medical home. For students who do have access to a medical home, pediatricians and SBHCs may collaborate and coordinate care to promote linkages so that services are provided when school is not in session and to avoid duplication or fragmentation of care.[3]

In the implementation and planning phase of an SBHC, the SBHC may conduct school community needs assessments and collaborate with a health care sponsor to address the community's documented needs and avoid duplication and fragmentation of care.[3] Sponsors have included community pediatricians who provide care to underserved children in their communities by establishing SBHCs as satellites of their practices with financial support from grants and contracts. Pediatricians, as sponsors, may partner with a school to establish the SBHC as an extension of their pediatric medical home by the provision of direct patient care or by the supervision of health care. This partnership is beneficial to the SBHC because the pediatric practice provides a continuum of access to care, especially after school hours. Using SBHCs as an extension of their pediatric practices, pediatricians can assist as the connection between the SBHC and the community.[29] Sponsors also include local hospitals that can provide prearranged after-hours and school vacation coverage and financial support for SBHCs. This arrangement can be beneficial to local hospitals because services provided in SBHCs can reduce hospital costs by preventing unnecessary emergency or urgent care visits and hospitalizations as well as by enrolling students in public forms of health insurance. As the concept of the medical home matures, the role of SBHCs can also evolve into this model as a collaborating partner or possibly as a medical home.[64] SBHC sponsors may consider engaging in a regional or formal national patient-centered medical home (PCMH) recognition process. From 2017 to 2019, the National Committee for Quality Assurance had offered a PCMH recognition process specifically for SBHCs.[65,66] During this time, SBHC sponsors were able to engage in a national PCMH recognition process. One report noted that of 1212 SBHCs reporting to the 2013–2014 National SBHA Census, 143 (12%) achieved state or regional PCMH accreditation and 203 (17%) received national PCMH accreditation from the National Committee for Quality Assurance, the Accreditation Association of Ambulatory Health Care, or The Joint Commision.[67] In another study, SBHCs were measured for PCMH attributes and were found to be doing well with implementing certain elements of the PCMH model, specifically care management, access, and quality dimensions.[68] Limited financial resources in SBHCs make applying for PCMH status a difficult prospect and may explain why more SBHCs do not apply.[68]

The involvement of community pediatric primary care providers in school health, especially in SBHCs, can be beneficial to both the school community and the medical community. Pediatricians may benefit from the collaboration with school leaders so that they may better understand their patient in the context of a school setting and may better provide health recommendations that can be adopted feasibly in the patient's natural settings, including schools. Pediatricians can provide the guidance and oversight needed in school health services and school wellness promotion efforts. The role of the pediatrician can include serving on state and district school boards, participating in local school health advisory councils, and providing direct clinical services as the school physician or through SBHCs. Pediatricians can collaborate with the advanced practice clinicians who typically staff the SBHCs and can work with SBHCs to improve communication with the primary care medical community. Pediatricians can

also provide the expertise needed to assist SBHCs in care coordination.[3,69]

OPPORTUNITIES

There are numerous opportunities in the field of school health and SBHCs. SBHCs serve as a unique educational training setting for learners such as residents and medical students.[29] It has been shown in the literature that when residents and medical students are exposed to school health during residency, there is an increased likelihood that they will be more aware of and become more involved in school health later in their practice.[70,71]

On the basis of the current SBHA census, the number of SBHCs using electronic health records (EHRs) is growing.[4] Use of an EHR will bring new opportunities (as well as challenges) and could be particularly helpful in implementing the medical home model. The use of an EHR can potentially improve accessibility and coordination of medical records outside of SBHC hours of operation. EHRs have the potential for linking SBHCs and the patients who use them to community pediatricians, to other health systems, to health information exchanges, and to other primary care providers.[33]

The expansion of telehealth technology services can help to address the geographic barriers that have limited the growth of SBHCs in rural communities. One-fifth of all SBHCs have at least one provider available through telehealth services.[4] The percentage of telehealth-exclusive SBHCs, defined as no primary care provider physically on-site, increased from 1% in 2013–2014 to 12% in 2016–2017.[4] SBHCs using telehealth technology are increasing the variety of services they provide, including mental health, nutrition services, and access to pediatric subspecialists.[64] For telehealth technology services to be effective, the telehealth presenter should be someone trained in equipment use and the regulations of the Health Insurance Portability and Accountability Act (HIPAA). The telehealth services should be affiliated with a health system, such as a pediatric office, an academic institution, or a hospital, that can provide standards and guidelines for use and expanded health services for students. The increased use of telehealth technology services remains a great opportunity for SBHCs.[64]

SBHC services complement and extend the work of the school nurses, who are responsible for the entire population of students. SBHCs provide a referral site for students without another medical home. Some SBHCs may provide primary nursing services, and other SBHCs may be integrated with school nursing services.[72] As articulated in the Whole School, Whole Child, Whole Community model, these alliances are crucial to the provision of a wide range of student health services.

CHALLENGES

There are multiple challenges facing SBHCs. One major challenge in any school health program, including SBHCs, involves the concept that health and education systems do not always share the same priorities.[3] There is a logical interface between health and education. Children cannot learn if they are not healthy, not present to receive instruction, and not connected to the school socially and emotionally. SBHC providers and community pediatricians can bring together the health and education sponsors with a common goal of better outcomes for children.[3,23,73,74]

Pediatricians dedicated to initiating a new SBHC may find barriers related to the time commitment involved in engaging appropriate stakeholders, conducting needs assessments, developing the business and/or financial plan, and identifying funding sources. Existing school health advisory councils within the majority of schools or districts can assist in these activities and reduce the burden.[3,13,73,75] Additionally, the SBHA has been a resource to pediatricians and an advocate for the implementation and ongoing operation of SBHCs.[76]

To support the medical home model, communication among the stakeholders (school, SBHCs, and community primary care providers) needs to occur from the planning stages to the operational stages.[3,12,77] Lines of communication between the SBHC and community primary care providers need to be established to discuss shared patients. Communication is equally important when an SBHC closes. To protect the students it serves, an SBHC should have a communication process to ensure continuity of care and transfer of medical records.

There is a wide range of medical and mental health services that can potentially be provided to students in an SBHC. For some SBHCs, the provision of specific health services has been restricted. Some SBHCs are prohibited from dispensing contraception.[3]

There is significant evidence in the literature that SBHCs reduce the cost to the health system by decreasing use of the emergency department and can decrease hospitalizations, reduce absenteeism, and reduce parental productivity losses.[1,2] In an economic evaluation conducted by the Community Preventive Services Task Force of the US Department of Health and Human Services, the

economic benefit of SBHCs exceeded the intervention operating cost. SBHCs have been shown to result in a net savings to Medicaid because of a reduction in emergency department use for services provided to youth with asthma.[2] Despite this economic benefit, the development of a financially sustainable business model remains an ongoing challenge for SBHCs. SBHCs generally require multiple funding sources to remain financially solvent.[4,76] Most SBHCs serve uninsured or underinsured patients, who may additionally require case management or social support that may be inadequately reimbursed by insurance.[4] With potential changes in the Patient Protection and Affordable Care Act, additional start-up and ongoing funding in addition to insurance billing and reimbursement is necessary.[3,13,76]

Confidentiality is another continuous challenge to the provision of services in an SBHC. Privacy concerns can be a barrier to communication and access to health care. Confidentiality for adolescents and health information access and transfer are challenges regulated by HIPAA and the Family Educational Rights and Privacy Act (FERPA). Since 2008, the US Department of Education and the US Department of Health and Human Services have provided guidance in the implementation of HIPAA and FERPA privacy laws.[78] As the use of EHRs and other clinical applications increase in SBHCs, HIPAA and FERPA privacy laws introduce complexity as the need to safeguard protected health information is balanced with the need to increase access to care and increase communication. The SBHA and American School Health Association have developed guidelines and recommendations in the area of confidentiality.[3,16,33,79]

RECOMMENDATIONS

To achieve the best health and educational outcomes for school-aged children and adolescents, pediatricians remain a key role in SBHCs in the following areas:

1. Medical home model: Pediatricians involved with the development and management of SBHCs should recommend care coordination practices that promote patient access to a medical home, with attention to communication between health care providers across settings. Pediatricians should share their expertise to assist not already PCMH-accredited SBHCs to adopt practice changes in support of the medical home model.
2. Coordination of care: SBHCs and community primary care providers should be in communication to facilitate coordination of care and to avoid duplication and fragmentation of care. Use of an EHR-compatible form or a paper form, such as the American Academy of Pediatrics emergency information form for children with special health care needs,[80] should be used, with the goal of strengthening communication. Communication between the community-based pediatric practices and the SBHC is essential in the provision of high-quality, safe, and effective health care, especially in the areas of urgent care and referrals.
3. Clinical services: Pediatricians can support SBHCs and community schools by increased involvement, including providing clinical services, supervising trainees, serving as the SBHC's consultant or medical director, or serving as an SBHC sponsor.
4. School health advisory councils: Pediatricians can advocate for the development of school health advisory councils or participate on established school health advisory councils. These school health advisory councils provide a setting for analyzing and discussing newly emerging trends in health and social behavior and community conditions that might influence student health and academic success and for planning, developing, and monitoring school health services, including SBHCs. Pediatricians remain an essential voice in these school health advisory councils to advocate for best outcomes for the children and adolescents in their community.
5. Funding: With limited financial resources, SBHCs help address the health inequities of underinsured and uninsured children and adolescents. Pediatricians have a unique voice and perspective to advocate for funding for SBHCs from national, state, and local entities so that SBHCs may continue to reduce health inequities and expand services in support of the medical home model.
6. Advocacy: Pediatricians have a responsibility to advocate for programs that reduce health disparities and advance health equities for children and adolescents. Because SBHCs help pediatricians address health inequities attributable to poverty and racial and/or ethnic bias in their local communities, it is important for pediatricians to advocate for legislation that supports SBHCs to maintain them and keep them operational.

Lead Authors

Chris Kjolhede, MD, MPH, FAAP
April C. Lee, MD, FAAP

Council on School Health Executive Committee, 2019–2020

Cheryl Duncan De Pinto, MD, MPH, FAAP, Chairperson

Sonja C. O'Leary, MD, FAAP, Chairperson Elect
Marti Baum, MD, FAAP
Nathaniel Savio Beers, MD, MPA, FAAP
Sara Moran Bode, MD, FAAP
Erica J. Gibson, MD, FAAP
Peter Gorski, MD, MPA, FAAP
Viju Jacob, MD, FAAP
Marian Larkin, MD, FAAP
Ryan Christopher Padrez, MD, FAAP
Heidi Schumacher, MD, FAAP

Former Executive Committee Members

Marc Lerner, MD, FAAP, Chairperson
Elliott Attisha, DO, FAAP
Chris Kjolhede, MD, MPH, FAAP
Adrienne Weiss-Harrison, MD, FAAP

Liaisons

Susan Hocevar Adkins, MD, FAAP – *Centers for Disease Control and Prevention Division of Adolescent and School Health*
Shashank Joshi, MD, FAAP – *American Academy of Child and Adolescent Psychiatry*
Linda Mendonca, RN, MSN, PHNA-BC, NCSN, FNASN – *National Association of School Nurses*

Former Liaisons

Laurie Combe, MN, RN, NCSN – *National Association of School Nurses*
Delaney Gracy, MD, FAAP – *School-Based Health Alliance*
Veda Charmaine Johnson, MD, FAAP – *School-Based Health Alliance*

Staff

Stephanie Domain, MS

ABBREVIATIONS

EHR: electronic health record
FERPA: Family Educational Rights and Privacy Act
HIPAA: Health Insurance Portability and Accountability Act
PCMH: patient-centered medical home
SBHA: School-Based Health Alliance
SBHC: school-based health center

PEDIATRICS (ISSN Numbers: Print, 0031-4005; Online, 1098-4275).

POTENTIAL CONFLICT OF INTEREST: The authors have indicated they have no potential conflicts of interest to disclose.

REFERENCES

1. Knopf JA, Finnie RK, Peng Y, et al; Community Preventive Services Task Force. School-based health centers to advance health equity: a community guide systematic review. *Am J Prev Med.* 2016;51(1):114–126
2. Ran T, Chattopadhyay SK, Hahn RA; Community Preventive Services Task Force. Economic evaluation of school-based health centers: a community guide systematic review. *Am J Prev Med.* 2016;51(1):129–138
3. Council on School Health. School-based health centers and pediatric practice. [published correction appears in *Pediatrics*. 2012;129(5):993]. *Pediatrics.* 2012;129(2):387–393
4. Love H, Soleimanpour S, Panchal N, Schlitt J, Behr C, Even M. 2016-17 national school-based health care census report. 2018. Available at: https://www.sbh4all.org/wp-content/uploads/2019/05/2016-17-Census-Report-Final.pdf. Accessed June 25, 2020
5. Morone JA, Kilbreth EH, Langwell KM. Back to school: a health care strategy for youth. *Health Aff (Millwood).* 2001; 20(1):122–136
6. The Center for Health and Health Care in Schools. Our funders. 2019. Available at: http://healthinschools.org/about/our-funders/#sthash.VZtaj6ug.dpbs. Accessed October 20, 2019
7. Kort M. The delivery of primary health care in American public schools, 1890-1980. *J Sch Health.* 1984;54(11):453–457
8. Lear JG. School-based health centers: a long road to travel. *Arch Pediatr Adolesc Med.* 2003;157(2):118–119
9. Duncan P, Igoe J. School health services. In: Marx E, Wooley S, Northrop D, eds. *Health Is Academic.* New York, NY: Teachers College Press; 1998:169–194
10. Brener ND, Wheeler L, Wolfe LC, Vernon-Smiley M, Caldart-Olson L. Health services: results from the School Health Policies and Programs Study 2006. *J Sch Health.* 2007;77(8):464–485
11. Brener ND, Weist M, Adelman H, Taylor L, Vernon-Smiley M. Mental health and social services: results from the School Health Policies and Programs Study 2006. *J Sch Health.* 2007;77(8):486–499
12. American Academy of Pediatrics Task Force on Integrated School Health Services. Integrated school health services. *Pediatrics.* 1994;94(3):400–402
13. Barnett S, Niebuhr V, Baldwin C. Principles for developing interdisciplinary school-based primary care centers. *J Sch Health.* 1998;68(3):99–105
14. Booker JM, Schluter JA, Carrillo K, McGrath J. Quality improvement initiative in school-based health centers across new Mexico. *J Sch Health.* 2011;81(1):42–48
15. Mansour ME, Rose B, Toole K, Luzader CP, Atherton HD. Pursuing perfection: an asthma quality improvement initiative in school-based health centers with community partners. *Public Health Rep.* 2008;123(6):717–730
16. School-Based Health Alliance. Core competencies. 2019. Available at: www.sbh4all.org/resources/core-competencies/. Accessed October 20, 2019
17. Community Preventive Services Task Force. School-based health centers to promote health equity: recommendation of the community preventive services task force. *Am J Prev Med.* 2016;51(1):127–128
18. Marcell AV, Klein JD, Fischer I, Allan MJ, Kokotailo PK. Male adolescent use of health care services: where are the boys? *J Adolesc Health.* 2002;30(1):35–43

19. Brindis CD, Klein J, Schlitt J, Santelli J, Juszczak L, Nystrom RJ. School-based health centers: accessibility and accountability. *J Adolesc Health.* 2003;32(6, suppl): 98–107

20. Juszczak L, Ammerman A. Reaching adolescent males through school-based health centers. *J Adolesc Health.* 2011;48(6):538–539

21. Juszczak L, Melinkovich P, Kaplan D. Use of health and mental health services by adolescents across multiple delivery sites. *J Adolesc Health.* 2003;32(6, suppl):108–118

22. Soleimanpour S, Geierstanger SP, Kaller S, McCarter V, Brindis CD. The role of school health centers in health care access and client outcomes. *Am J Public Health.* 2010;100(9):1597–1603

23. Braun RA, Provost JM. Bridging the gap: using school-based health services to improve chlamydia screening among young women. *Am J Public Health.* 2010;100(9):1624–1629

24. Pastore DR, Juszczak L, Fisher MM, Friedman SB. School-based health center utilization: a survey of users and nonusers. *Arch Pediatr Adolesc Med.* 1998;152(8):763–767

25. Riggs S, Cheng T. Adolescents' willingness to use a school-based clinic in view of expressed health concerns. *J Adolesc Health Care.* 1988;9(3):208–213

26. Anglin TM, Naylor KE, Kaplan DW. Comprehensive school-based health care: high school students' use of medical, mental health, and substance abuse services. *Pediatrics.* 1996;97(3):318–330

27. Stone S, Whitaker K, Anyon Y, Shields JP. The relationship between use of school-based health centers and student-reported school assets. *J Adolesc Health.* 2013;53(4):526–532

28. Allison MA, Crane LA, Beaty BL, Davidson AJ, Melinkovich P, Kempe A. School-based health centers: improving access and quality of care for low-income adolescents. *Pediatrics.* 2007;120(4). Available at: www.pediatrics.org/cgi/content/full/120/4/e887

29. Johnson VC, Okuizumi-Wu Y. School-based health centers. In: Gereige RS, Zenni EA, eds. *School Health Policy and Practice.* 7th ed. Elk Grove, IL: American Academy of Pediatrics; 2016:47–58

30. Van Cura M. The relationship between school-based health centers, rates of early dismissal from school, and loss of seat time. *J Sch Health.* 2010;80(8):371–377

31. Kerns SE, Pullmann MD, Walker SC, Lyon AR, Cosgrove TJ, Bruns EJ. Adolescent use of school-based health centers and high school dropout. *Arch Pediatr Adolesc Med.* 2011;165(7):617–623

32. Keeton V, Soleimanpour S, Brindis CD. School-based health centers in an era of health care reform: building on history. *Curr Probl Pediatr Adolesc Health Care.* 2012;42(6):132–156; discussion 157–158

33. Price OA. *School-Centered Approaches to Improve Community Health: Lessons Learned From School-Based Health Centers.* Washington, DC: Brookings Institution Press; 2016

34. Center for Disease Control and Prevention Division of Adolescent and School Health. Fostering school connectedness. 2009. Available at: https://www.cdc.gov/healthyyouth/protective/pdf/connectedness_administrators.pdf. Accessed October 20, 2019

35. Center for Disease Control and Prevention Division of Adolescent and School Health. School connectedness. 2018. Available at: https://www.cdc.gov/healthyyouth/protective/school_connectedness.htm. Accessed October 20, 2019

36. Hagan JF, Shaw JS, Duncan PM, eds. *Bright Futures: Guidelines for Health Supervision of Infants, Children, and Adolescents.* 4th ed. Elk Grove Village, IL: American Academy of Pediatrics; 2017

37. Center for Disease Control and Prevention Division of Adolescent and School Health. The Whole School, Whole Community, Whole Child model. Available at: https://www.cdc.gov/healthyyouth/wscc/model.htm. Accessed October 20, 2019

38. Lewallen TC, Hunt H, Potts-Datema W, Zaza S, Giles W. The Whole School, Whole Community, Whole Child model: a new approach for improving educational attainment and healthy development for students. *J Sch Health.* 2015;85(11):729–739

39. Koenig KT, Ramos MM, Fowler TT, Oreskovich K, McGrath J, Fairbrother G. A statewide profile of frequent users of school-based health centers: implications for adolescent health care. *J Sch Health.* 2016;86(4):250–257

40. The Community Guide. What is the CPSTF? Available at: https://www.thecommunityguide.org/task-force/what-task-force. Accessed October 20, 2019

41. Gibson EJ, Santelli JS, Minguez M, Lord A, Schuyler AC. Measuring school health center impact on access to and quality of primary care. *J Adolesc Health.* 2013;53(6):699–705

42. Kempe A, Barrow J, Stokley S, et al. Effectiveness and cost of immunization recall at school-based health centers. *Pediatrics.* 2012;129(6). Available at: www.pediatrics.org/cgi/content/full/129/6/e1446

43. Minguez M, Santelli JS, Gibson E, Orr M, Samant S. Reproductive health impact of a school health center. *J Adolesc Health.* 2015;56(3):338–344

44. Ethier KA, Dittus PJ, DeRosa CJ, Chung EQ, Martinez E, Kerndt PR. School-based health center access, reproductive health care, and contraceptive use among sexually experienced high school students. *J Adolesc Health.* 2011;48(6):562–565

45. Smith P, Novello G, Chacko MR. Does immediate access to birth control help prevent pregnancy? A comparison of onsite provision versus off campus referral for contraception at two school-based clinics. *J Appl Res Child.* 2011;2(2):8

46. Fink GN, Dean G, Nucci-Sack A, Arden M, Lunde B. Emergency contraception use in school-based health centers: a qualitative study. *J Pediatr Adolesc Gynecol.* 2019;32(2):175–181

47. Fisher R, Danza P, McCarthy J, Tiezzi L. Provision of contraception in New York City school-based health centers: impact on teenage pregnancy and avoided costs, 2008-2017. *Perspect Sex Reprod Health.* 2019;51(4):201–209

48. Herrman JW. Stakeholder perceptions of the provision of reproductive health services by school-based health centers as they may inform public policy. *Policy Polit Nurs Pract.* 2015;16(1–2):51–62

49. Benningfield MM. Meeting youth where they are: substance use disorder treatment in schools. *Child Adolesc Psychiatr Clin N Am.* 2016;25(4):661–668

50. Amaral G, Geierstanger S, Soleimanpour S, Brindis C. Mental health characteristics and health-seeking behaviors of adolescent school-based health center users and nonusers. *J Sch Health.* 2011;81(3):138–145
51. Lewis C, Deardorff J, Lahiff M, Soleimanpour S, Sakashita K, Brindis CD. High school students' experiences of bullying and victimization and the association with school health center use. *J Sch Health.* 2015;85(5):318–326
52. Miller E, Goldstein S, McCauley HL, et al. A school health center intervention for abusive adolescent relationships: a cluster RCT. *Pediatrics.* 2015;135(1):76–85
53. Paschall MJ, Bersamin M. School-based health centers, depression, and suicide risk among adolescents. *Am J Prev Med.* 2018;54(1):44–50
54. Mason-Jones AJ, Crisp C, Momberg M, Koech J, De Koker P, Mathews C. A systematic review of the role of school-based healthcare in adolescent sexual, reproductive, and mental health. *Syst Rev.* 2012;1:49
55. Kong AS, Sussman AL, Yahne C, Skipper BJ, Burge MR, Davis SM. School-based health center intervention improves body mass index in overweight and obese adolescents. *J Obes.* 2013;2013:575016
56. Love-Osborne K, Fortune R, Sheeder J, Federico S, Haemer MA. School-based health center-based treatment for obese adolescents: feasibility and body mass index effects. *Child Obes.* 2014;10(5):424–431
57. Sussman AL, Montoya C, Werder O, Davis S, Wallerstein N, Kong AS. An adaptive CBPR approach to create weight management materials for a school-based health center intervention. *J Obes.* 2013;2013:978482
58. Aldrich H, Gance-Cleveland B, Schmiege S, Dandreaux D. Identification and assessment of childhood obesity by school-based health center providers. *J Pediatr Health Care.* 2014;28(6):526–533
59. Bersamin M, Garbers S, Gaarde J, Santelli J. Assessing the impact of school-based health centers on academic achievement and college preparation efforts: using propensity score matching to assess school-level data in California. *J Sch Nurs.* 2016;32(4):241–245
60. Walker SC, Kerns SE, Lyon AR, Bruns EJ, Cosgrove TJ. Impact of school-based health center use on academic outcomes. *J Adolesc Health.* 2010;46(3):251–257
61. American Academy of Pediatrics. Medical home. Available at: https://www.aap.org/en-us/professional-resources/practice-transformation/medicalhome/Pages/home.aspx. Accessed October 20, 2019
62. Medical Home Initiatives for Children With Special Needs Project Advisory Committee. The medical home. *Pediatrics.* 2004;113(suppl 4):1545–1547
63. O'Leary ST, Lee M, Federico S, et al. School-based health centers as patient-centered medical homes. *Pediatrics.* 2014;134(5):957–964
64. North SW, McElligot J, Douglas G, Martin A. Improving access to care through the patient-centered medical home. *Pediatr Ann.* 2014;43(2):e33–e38
65. National Committee for Quality Assurance. Announcing the nation's first school-based medical home recognition program. 2017. Available at: https://www.ncqa.org/news/announcing-the-nations-first-school-based-medical-home-recognition-program/. Accessed June 11, 2020
66. National Committee for Quality Assurance. School-based medical home recognition: program retirement. 2019. Available at: https://www.ncqa.org/programs/health-care-providers-practices/school-based-medical-home-recognition/school-based-medical-home-recognition-program-retirement/. Accessed June 11, 2020
67. Gregg A, Chen LW, Kim J. Correlates of patient-centered medical home recognition in school-based health centers. *J Sch Health.* 2018;88(11):830–838
68. Gregg A, Chen LW, Kim J, Tak HJ, Tibbits M. Patient-centered medical home measurement in school-based health centers. *J Sch Nurs.* 2019;35(3):189–202
69. Weinstein J. School-based health centers and the primary care physician: an opportunity for collaborative care. *Prim Care.* 2006;33(2):305–315
70. Nader PR, Broyles SL, Brennan J, Taras H. Two national surveys on pediatric training and activities in school health: 1991 and 2001. *Pediatrics.* 2003;111(4 pt 1):730–734
71. Kalet AL, Juszczak L, Pastore D, et al. Medical training in school-based health centers: a collaboration among five medical schools. *Acad Med.* 2007;82(5):458–464
72. Bannister A, Gibbons L, Tiedeman C. NASN position statement: health care reform. *NASN Sch Nurse.* 2011;26(3):194–195
73. Bellian C; American Cancer Society. *Improving School Health: A Guide to School Health Councils.* Atlanta, GA: American Cancer Society; 1998
74. Basch CE. Healthier students are better learners: a missing link in school reforms to close the achievement gap. *J Sch Health.* 2011;81(10):593–598
75. Shirer K. *Promoting Healthy Youth, Schools, and Communities: A Guide to Community-School Health Councils.* Atlanta, GA: American Cancer Society; 2003
76. School-Based Health Alliance. SBHC sustainability. 2019. Available at: www.sbh4all.org/resources/sbhc-sustainability/. Accessed October 20, 2019
77. American Academy of Pediatrics Committee on School Health. School health centers and other integrated school health services. *Pediatrics.* 2001;107(1):198–201
78. US Department of Education; US Department of Health and Human Services. Joint guidance on the application of the Family Educational Rights and Privacy Act (FERPA) and the Health Insurance Portability and Accountability Act of 1996 (HIPPA) to student health records. Available at: https://www.hhs.gov/sites/default/files/2019-hipaa-ferpa-joint-guidance-508.pdf. Accessed June 26, 2020
79. Schwab N, Rubin M, Jea M. *Protecting and Disclosing Student Health Information: How to Develop School District Policies and Procedures.* Kent, OH: American School Health Association; 2005
80. American Academy of Pediatrics Committee on Pediatric Emergency Medicine and Council on Clinical Information Technology; American College of Emergency Physicians; Pediatric Emergency Medicine Committee. Policy statement emergency information forms and emergency preparedness for children with special health care needs. *Pediatrics.* 2010;125(4):829–837

Sudden Death in the Young: Information for the Primary Care Provider

- *Policy Statement*

POLICY STATEMENT Organizational Principles to Guide and Define the Child Health Care System and/or Improve the Health of all Children

American Academy of Pediatrics
DEDICATED TO THE HEALTH OF ALL CHILDREN™

Sudden Death in the Young: Information for the Primary Care Provider

Christopher C. Erickson, MD, FAAP,[a,b] Jack C. Salerno, MD,[c] Stuart Berger, MD, FAAP,[d] Robert Campbell, MD, FAAP,[e] Bryan Cannon, MD,[f] James Christiansen, MD,[c] Kody Moffatt, MD, MS, FAAP,[a] Andreas Pflaumer, MD,[g] Christopher S. Snyder, MD, FAAP,[h] Chandra Srinivasan, MD,[i] Santiago O. Valdes, MD, FAAP,[j] Victoria L. Vetter, MD, MPH, FAAP,[k] Frank Zimmerman, MD,[l] SECTION ON CARDIOLOGY AND CARDIAC SURGERY, PEDIATRIC AND CONGENITAL ELECTROPHYSIOLOGY SOCIETY (PACES) TASK FORCE ON PREVENTION OF SUDDEN DEATH IN THE YOUNG

There are multiple conditions that can make children prone to having a sudden cardiac arrest (SCA) or sudden cardiac death (SCD). Efforts have been made by multiple organizations to screen children for cardiac conditions, but the emphasis has been on screening before athletic competition. This article is an update of the previous American Academy of Pediatrics policy statement of 2012 that addresses prevention of SCA and SCD. This update includes a comprehensive review of conditions that should prompt more attention and cardiology evaluation. The role of the primary care provider is of paramount importance in the evaluation of children, particularly as they enter middle school or junior high. There is discussion about whether screening should find any cardiac condition or just those that are associated with SCA and SCD. This update reviews the 4 main screening questions that are recommended, not just for athletes, but for all children. There is also discussion about how to handle post-SCA and SCD situations as well as discussion about genetic testing. It is the goal of this policy statement update to provide the primary care provider more assistance in how to screen for life-threatening conditions, regardless of athletic status.

INTRODUCTION

There is a growing movement to identify pediatric and young adult athletes who may be at risk for sudden cardiac arrest (SCA) or sudden cardiac death (SCD) during sports participation.[1–5] The sudden death of a young athlete is always tragic for the family and community. However, the sudden death of a young nonathlete is no less tragic. In today's society, the nonathlete is much less visible because of the great attention paid to athletics in the lay press, which creates the perception that only athletes have an increased risk of sudden cardiac events. SCA and SCD in young people have been addressed in several articles that have focused efforts toward disease recognition as well as

abstract

[a]*Children's Specialty Physicians, University of Nebraska Medical Center, University of Nebraska, Omaha, Nebraska;* [b]*Creighton University Medical Center, Creighton University, Omaha, Nebraska;* [c]*Seattle Children's Hospital and the University of Washington School of Medicine, Seattle, Washington;* [d]*Lurie Children's Hospital and Northwestern University, Chicago, Illinois;* [e]*Children's Healthcare of Atlanta Sibley Heart Center and School of Medicine, Emory University, Atlanta, Georgia;* [f]*Mayo Clinic, Rochester, Minnesota;* [g]*The Royal Children's Hospital and University of Melbourne, Melbourne, Australia;* [h]*Rainbow Babies and Children's Hospital and Case Western Reserve University, Cleveland, Ohio;* [i]*McGovern Medical School, The University of Texas and The University of Texas Health Science Center, Houston, Texas;* [j]*Lillie Frank Abercrombie Section of Pediatric Cardiology, Texas Children's Hospital and Baylor College of Medicine, Houston, Texas;* [k]*Children's Hospital of Philadelphia and University of Pennsylvania, Philadelphia, Pennsylvania; and* [l]*Advocate Heart Institute for Children and University of Chicago, Oak Lawn, Illinois*

Drs Erickson and Salerno each drafted half of the initial manuscript and coordinated coauthors, collated edits and additions from the coauthors, and approved the final manuscript; Drs Berger, Campbell, Cannon, Christiansen, Moffatt, Pflaumer, Snyder, Srinivasan, Valdes, Vetter, Zimmerman reviewed and revised the manuscript; and all authors approved the final manuscript as submitted.

To cite: Erickson CC, Salerno JC, Berger S, et al; AAP SECTION ON CARDIOLOGY AND CARDIAC SURGERY, PEDIATRIC AND CONGENITAL ELECTROPHYSIOLOGY SOCIETY (PACES) TASK FORCE ON PREVENTION OF SUDDEN DEATH IN THE YOUNG. Sudden Death in the Young: Information for the Primary Care Provider. *Pediatrics*. 2021;148(1):e2021052044

prevention.[6–11] There have been numerous studies addressing preparticipation screening, including whether electrocardiography (ECG) or other noninvasive tests should be added.[2–4,12,13] Currently, several groups are studying the question of the use of preparticipation ECG; to date, none have published conclusive data on its overall effectiveness, practicality of implementation, or cost.[14]

One of the most important people in both primary and secondary prevention models is the primary care provider (PCP), who manages children from infancy into late teenage years or even young adulthood and has a long-standing relationship with the child, family, and community at large. PCPs are involved with school preparticipation screening and are often the first called when a cardiac symptom or cardiac arrest occurs.

The purpose of this article is to provide PCPs with a strategy for screening, evaluation, and management of risk of SCA and SCD in the young with practical and updated information.

As in the 2012 policy statement, "evidence-based recommendations frequently are designated as class I, II, or III, indicating the supporting level of evidence. For pediatric SCA, the level of evidence does not permit a meaningful use of this terminology."[8]

STRATEGY FOR SUDDEN DEATH PREVENTION

This policy statement proposes that the same screening detail that is used for athletes should also be applied to the nonathlete.

Figure 1 demonstrates an encounter of a pediatric patient with the PCP for a routine visit or for new, concerning symptoms.

The PCP encounter should ultimately separate patients into 2 basic groups, those with identifiable or suspicious risk factors for SCA or SCD, to be discussed in a later section, and those without risk factors. For those with risk factors, referral to a pediatric cardiologist or electrophysiologist is the next appropriate step to initiate a comprehensive cardiovascular evaluation appropriate for the presenting risk factors. There are patients who, despite the best screening efforts, could still experience a SCA; therefore, a secondary prevention plan is important.

Multiple studies have led to current resuscitation methods, such as the American Heart Association (AHA)'s Basic Life Support, Pediatric Advanced Life Support, and Advanced Cardiac Life Support, featuring the "chain of survival," with revisions made every few years.[15] Although out-of-hospital cardiac arrest survival statistics remain dismal, there has been improvement in survival, most likely a result of an increase in lay rescuer cardiopulmonary resuscitation (CPR) education, an increase in recognition of cardiac arrest, and an increase in willingness to intervene by lay rescuers who have learned to perform high-quality CPR and automated external defibrillator (AED) use, assisted by an increase in public access to AEDs.[16] The number of lay people with life support training generally remains low.[17] This highlights the important role for the PCP to be a community advocate for more Basic Life Support training.

THE PCP'S ROLE IN PRIMARY PREVENTION

The difficult task of identifying those at risk for cardiac events often begins with the PCP, including physicians, physician assistants, and nurse practitioners, via routine physical examination or when addressing specific symptoms. Although there is no one-size-fits-all screening method to identify those at risk, it is helpful for the PCP to have an understanding of the common conditions that put young patients at risk for SCA and SCD.

Cardiomyopathies

A primary cardiomyopathy is usually associated with an anatomically normal heart with abnormal myocardial cellular structure or function that can affect both systolic and/or diastolic function. The World Health Organization and International Society and Federation of Cardiology Task Force recognize 5 basic forms of cardiomyopathy[18]:

1. Dilated cardiomyopathy: enlarged, dilated left and/or right ventricle with or without decreased systolic function.
2. Hypertrophic cardiomyopathy (HCM): abnormally thickened ventricular myocardium without cause (eg, hypertension, coarctation, aortic stenosis, etc). HCM is reported as the most common cause of SCA and SCD in young athletes.[19]
3. Restrictive cardiomyopathy: normal to thickened ventricular walls and normal ventricular size with impaired diastolic function and often with dilated atria.
4. Arrhythmogenic cardiomyopathy (includes arrhythmogenic right ventricular cardiomyopathy [ACM]): enlarged, dilated right ventricle with orwithout decreased systolic function often associated with frequent arrhythmias (can be seen in the leftventricle as well).
5. Unclassified cardiomyopathies: this includes left ventricular noncompaction (the left ventricular myocardium is abnormal with hypertrabeculation and crypt

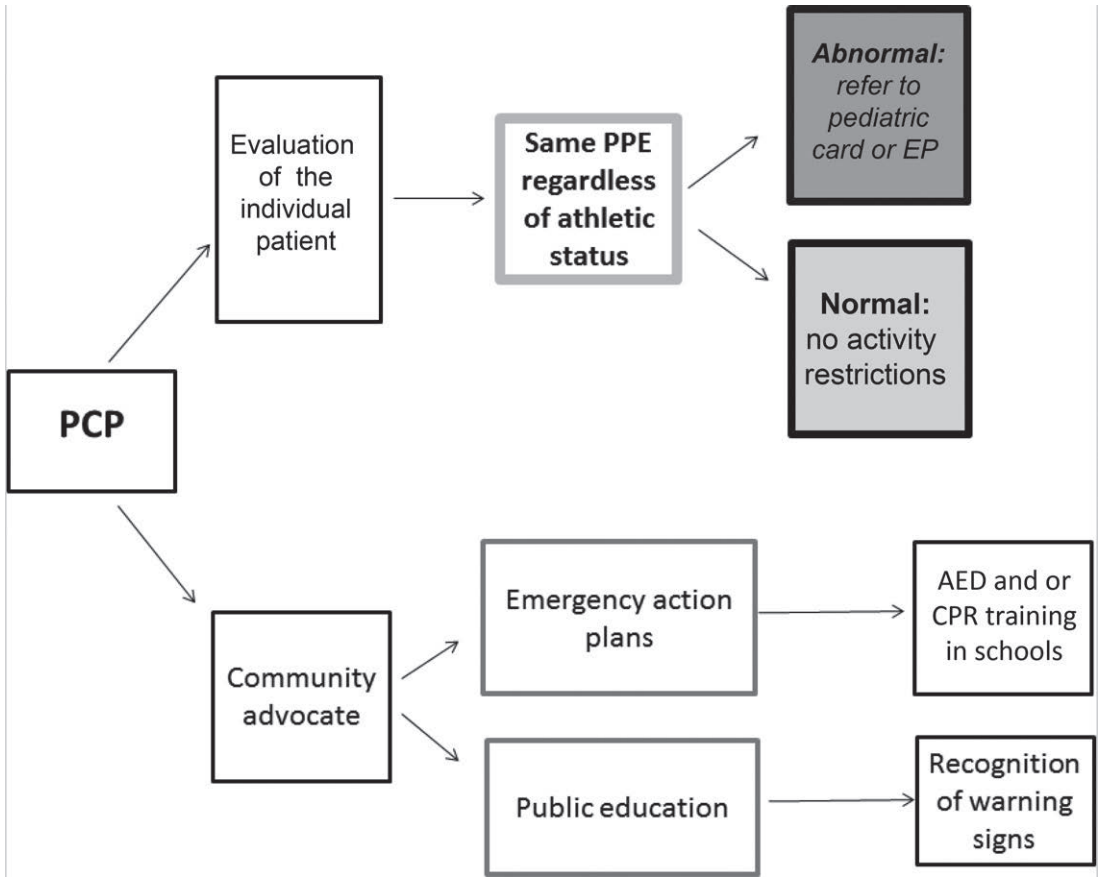


FIGURE 1 Flowchart revealing ideal role of the PCP in prevention of SCD in the young. EP, electrophysiologist.

formation of the left ventricular wall with thickened, normal, or thinned and dilated myocardium with or without impaired systolic function).

The clinical features of each type of cardiomyopathy are displayed in Table 1. Morphologic differences are significant between each type of cardiomyopathy, and, therefore, imaging (echocardiography, MRI, etc) is advised. The potential for life-threatening arrhythmias is a unifying factor for all these cardiomyopathies.

Channelopathies

Channelopathies are generally identified in patients who otherwise have normal cardiac anatomy and function. The defect involves the ion channels in the cardiac cell membrane or in intracellular proteins that interact with ion transport and may result in identifiable abnormalities on the ECG. Imaging is not helpful in diagnosing a channelopathy except to exclude cardiomyopathy as an etiology for a cardiac event. The primary channelopathies include the following:

1. Long QT syndrome (LQTS): prolongation of the corrected QT interval (QTc) with abnormalities in T-wave morphology, some of which are associated with specific genotypes. Sudden infant death syndrome (SIDS) may be attributable to LQTS in approximately 10% of cases.[20]
2. Short QT syndrome: extremely rare condition with abnormal shortening of the QTc with prominent and peaked T waves.
3. Brugada syndrome (BrS): associated with a coved and elevated ST elevation in ECG leads V1 and V2. Specific Brugada T-wave morphologies may indicate an elevated risk of cardiac arrest.
4. Catecholaminergic polymorphic ventricular tachycardia (CPVT): resting ECGs in these patients are almost always normal. CPVT is mostly identified with exercise testing that results in increased ventricular ectopy and even polymorphic ventricular tachycardia (VT).
5. Idiopathic ventricular fibrillation (IVF): patients presenting with ventricular fibrillation (VF) in whom known cardiac, respiratory, metabolic, and toxicological

TABLE 1 Listing of the 5 Classification Groups and Clinical Features of Cardiomyopathies According to the World Health Organization

Cardiomyopathy Class	Age at Presentation	Presentation	Family History	Genetic Inheritance	ECG	Echocardiogram Findings	MRI Findings	Making the Diagnosis	Risk for SCA or SCD
DCM	Any age, including fetal	Can be incidental finding; heart failure; poor cardiac output; failure to thrive; arrhythmias; LMNA mutation-associated DCM can also present with conduction disease.[67]	Inherited DCM can exist in ~50% of those presenting before 18 y of age.[67]	For most familial DCM, inheritance is AD, but X-linked inheritance is also common.[67] LMNA-positive patients have autosomal dominant inheritance. Pediatric patients have a higher incidence of mitochondrial or metabolic-based DCM that are autosomal recessive.	Can be normal; AV block; BBB; atrial or ventricular ectopy; low-voltage QRS.	Dilated LV with mildly to severely reduced function: mitral regurgitation.	Consistent with echocardiogram findings.	Clinical symptoms and/or echocardiogram findings of LV dilation with reduced function; genetic testing is helpful when the family history suggests familial DCM.	Variable depending on genetic mutation (higher with LMNA mutation), degree of myocardial involvement, and presence of arrhythmias; lower incidence of SCD than other cardiomyopathy forms[68]: higher risk with poorer LV function.
HCM	Any age, including fetal	Incidental; heart murmur; anginal chest pain; cardiac arrest.	Often others in family have known HCM or will subsequently be found to have HCM.	For all sarcomeric forms of HCM, inheritance is AD; Danon syndrome (storage disease phenocopy) is X linked.	Can be normal; usually has LVH and/or RVH, sometimes with very large R or S waves; LAD: ventricular arrhythmias.	LV wall thickness >14 mm or 2 SDs for wt; reduced LV cavity size; longer-than-normal anterior mitral valve leaflet; abnormal papillary muscles; resting and/or dynamic LVOT obstruction; MR.	Consistent with echocardiogram findings but can reveal mitral valve morphology more precisely and can be used for detecting late gadolinium enhancement that is associated with ventricular arrhythmias.[69–72]	Echocardiogram and/or MRI findings consistent with HCM; genetics are helpful to identify sarcomeric from other forms including storage disease; can help with prognosis and can help with identification of family members.	In adults, risk is based on established risk factors, including previous SCA, LV thickness ≥30 mm, abnormal BP response to exercise; family history of SCA; LGE >15%; VT on Holter. In children, risk factors include those presenting in infancy or with inborn errors of metabolism[73]; restrictive physiology increases risk of death or transplant; increased LV thickness and LGE correlates with VT.[71]
RCM	Any age	Heart failure; poor cardiac output; fatigue.	Less than half have family history, although there can be some crossover with family members with HCM.	Shares some similar gene mutations as HCM; inheritance is AD.	Can have findings similar to HCM but may be normal as well.	Normal ventricular systolic function with dilated atrial; some hypertrophy may be present.	Evidence of diastolic dysfunction.	Echo criteria indicating abnormal diastolic function along with symptoms of heart failure; some HCM patients have RCM features. Genetic testing can be supportive. Several HCM gene mutations can be seen with RCM.	Significant with generally poor prognosis; two-year survival of <50%.[74]

TABLE 1 Continued

Cardiomyopathy Class	Age at Presentation	Presentation	Family History	Genetic Inheritance	ECG	Echocardiogram Findings	MRI Findings	Making the Diagnosis	Risk for SCA or SCD
ACM	Preadolescence[75]	Incidental; syncope, palpitations, SCA.	Possible to have other family members with the same diagnosis.	Nearly all are AD.	Inverted T waves in the right precordial leads beyond V1; ε waves; LBBB PVCs or VT; Prolonged S waves in V1-V3.	Often normal but may reveal dilated RV, abnormal aneurysmal areas of RV; MRI often reveals more detail.	Fibrofatty replacement of ventricular myocardium; aneurysmal areas of free wall; possible LV involvement.	Needs to meet specific diagnostic criteria per ACM task force[76]; MRI alone will not satisfy task force criteria; genetic testing is helpful when positive.	Significant, even in children; disease is progressive and VT from multiple foci can develop.
LV Noncompaction (LVNC)	Any age including fetal	Incidental; murmur on examination; heart failure; SCA.	Present in 30% of first-degree relatives of index cases.[77]	For identified gene mutations inheritance is autosomal dominant; yield on genetic testing is currently low.	Usually abnormal with LVH, T-wave abnormalities, QT prolongation, or preexcitation[77]; arrhythmias more common with decreased LV function.	Key finding is the spongy appearance of highly trabeculated myocardium with crypts in between trabeculae[78]; LV dimensions and function can be assessed as well as valve function; identification of thrombi in LV; multiple forms described.[78]	Consistent with echo findings, the noncompaction-to-compaction ratio of the LV myocardium should be ≥2.3:1; LV function can be assessed.[79]	Fulfillment of echo and/or MRI criteria; genetic testing when results are positive is helpful but negative-result genetic testing does not diminish diagnosis from task force criteria.	In part dependent on LV function but SD has been reported with normal LV function.[80,81]
Normal variant: Athlete's heart	Teenage and up; has been reported in preadolescent age as well[82]	During screening evaluation or for evaluation of potential cardiac symptoms.	None.	None.	Some benign ECG changes can be seen. Criteria have been modified for use in the athlete. Changes can include sinus brady, first-degree AV block, early repolarization, isolated voltage criteria for LVH, LAE, RAE, LAD, RAD.[83]	LV cavity dilation, normal diastolic properties, wall thickness up to 14 in male individuals (with rare exception in African Americans); female individuals with athlete's heart never have wall thickness >11 mm; rowing and cycling athletes tend to have thicker LV dimensions.[84]	Similar to echo dimensions with LV dilation and limits on LV wall thickness; will not see late gadolinium enhancement.	ECG and echo criteria have been established to help differentiate HCM from athlete's heart. In borderline cases, a period of 3-6 mo of deconditioning may be needed. Those with athlete's heart will have significant return toward normal dimensions, whereas HCM patients will not.[85]	For true athlete's heart that has excluded HCM, no increased risk above the general population.

AD, autosomal dominant; AV, atrioventricular; BBB, bundle branch block; BP, blood pressure; DCM, dilated cardiomyopathy; RCM, restrictive cardiomyopathy; LAD, left axis deviation; LAE, left atrial enlargement; LBBB, left bundle branch block; LGE, late gadolinium enhancement; LMNA, lamin A/C gene; LVOT, left ventricular outflow tract; LV, left ventricle; LVH, left ventricular hypertrophy; MR, mitral regurgitation; MRI, magnetic resonance imaging; PVC, premature ventricular contraction; RAD, right axis deviation; RAE, right atrial enlargement; RV, right ventricle; RVH, right ventricular hypertrophy.

etiologies have been excluded through clinical evaluation. The term IVF is used when the cardiac arrest remains unexplained despite this investigation.

Table 2 demonstrates the features of the most common channelopathies to help discern the characteristics of each. When LQTS or BrS have been diagnosed or suspected, it is important that any new medications, such as antibiotics, antifungal agents, or stimulants for attention-deficit/hyperactivity disorder be checked for potential contraindications in these disorders (for LQTS, use https://Crediblemeds.org, and for BrS, use www.brugadadrugs.org/avoid/). The PCP should be aware that, for patients with BrS, fever can trigger cardiac events.

Congenital Heart Disease

Patients with congenital heart defects, including those that have been surgically repaired or palliated, are at risk for arrhythmias. Risk factors in this population are often a result of scarring from surgery, ongoing hemodynamic abnormalities, residual lesions, or decreased ventricular function.[21,22] The most common association of SCA and congenital heart disease is VT. However, atrial arrhythmias can also cause SCA or SCD if the tachycardia rate is fast enough and rapid atrioventricular conduction occurs.

Wolff-Parkinson-White Syndrome

Wolff-Parkinson-White syndrome (ventricular preexcitation) on the ECG indicates there is at least 1 accessory pathway that conducts antegrade from atrium to ventricle. These pathways are most commonly noted for causing supraventricular tachycardia. Rarely, atrial fibrillation in the presence of Wolff-Parkinson-White syndrome can result in VF as a result of rapid conduction of atrial impulses down the accessory pathway to the ventricles. Criteria based on adult studies define pathways as high risk depending on how rapidly the pathway can conduct.[23–26]

The previous theory that patients with intermittent preexcitation on ECG would be at low risk for SCA or SCD does not seem to hold true for symptomatic pediatric patients.[27] Consultation with a pediatric electrophysiologist should be considered in all cases of Wolff-Parkinson-White pattern on an ECG, regardless of the presence or absence of symptoms, to aid in risk stratification and potentially consider a curative ablation procedure.

Commotio Cordis

Commotio cordis is the term applied to a sudden impact to the chest that causes VF and results in SCA or SCD without evidence of cardiac damage.[28] Commotio cordis is, perhaps, one of the most concerning of all sudden death conditions because it occurs in children with completely normal hearts from both a structural and molecular or ion channel standpoint. The impact is most often from a blunt object such as a ball, fist, elbow, or helmet.

Baseball is the sport with the highest frequency of commotio cordis events. For primary prevention, there is some evidence that some chest protectors may reduce the incidence of commotio cordis.[29] If no cardiac disease is identified in survivors of commotio cordis after a full cardiac evaluation, they can return to sports participation.[30] Prompt recognition of commotio cordis with initiation of CPR and defibrillation is important for survival, although some commotio cordis victims do not survive despite prompt initiation of resuscitation.

Anomalous Coronary Arteries

In multiple studies of the causes of sudden death, an anomalous coronary artery is second only to HCM.[19] Outside the neonatal period, when anomalous left coronary artery from the pulmonary artery is usually identified, detection of an anomalous coronary artery can be difficult because it is rare and often has no symptoms until presenting with SCA, usually in the teenage years. A high index of suspicion is advised for patients with syncope or atypical chest pain (Table 3). Typical pediatric chest pain most commonly represents musculoskeletal pain. Atypical chest pain is pain that raises alarm for an underlying cardiac cause and is not the usual or typical pain.

Echocardiography can often be used to identify the abnormal origins or course of the proximal coronary arteries, but computed tomography scan, MRI, or coronary angiography may be more definitive. ECG in a neonate with anomalous left coronary artery from the pulmonary artery will usually have deep and wide Q waves in leads I and aVL. For other coronary anomalies, the ECG is typically normal at rest. Treatment is surgical unroofing or reimplantation of the anomalous coronary.

Aortopathies

Patients with aortopathies, such as Marfan syndrome, familial thoracic aortic aneurysm and dissection, bicuspid aortic valve with aortic dilation, Loeys-Dietz syndrome, and Ehler-Danlos syndrome are at increased risk of aortic dilation and dissection. Patients frequently have no symptoms, but often there is a family history of aortic dilation or dissection. Aortic rupture or dissection accounts for 2% of sudden deaths in athletes.[13] There is evidence that isometric exercise, exercise that uses Valsalva maneuver, or sudden increases in blood pressure place an extraordinary wall stress on the aorta

TABLE 2 Listing of Common Channelopathic Conditions and Clinical Features

Channelopathy	Age at Presentation	Presentation	Family History	Genetic Inheritance	ECG or Holter	Echocardiogram Findings	Stress Test Findings	Making the Diagnosis	Risk for SCA or SCD
L TS	Any, including fetal.	Incidental detection on ECG; syncope; atypical seizures; cardiac arrest.	Variable penetrance; first-degree relatives tend to have shorter Tcs and possibly less risk of events.[86]	Mostly autosomal dominant; penetrance is variable.	Prolonged Tc >460–470 in male individuals and >470–480 in female individuals with abnormal T waves; T-wave morphology can be dependent on genotype. Tc can be variable on multiple ECGs in the same patient and may have atrial arrhythmias, including atrial fibrillation.	Normal.	Some differences by genotype; long T 1 shows Tc prolongation with exercise that sustains into recovery, whereas L T2 shows an abnormal shortening at peak exercise, followed by abnormally long Tc in recovery.[87] L TS patients may not always achieve the predicted maximum heart rate.	A single ECG cannot always rule in or out L TS. Often, multiple ECGs or stress testing + or − epinephrine challenge are needed. Holter monitoring is not ideal for diagnosis but can be supportive for obvious Tc prolongation and/or the presence of ventricular ectopy. Sinus brady can also be present.	(1) Related to Tc duration, genotype, past history of symptoms, and sex of the individual, with male individuals at greater risk when young and female individuals at greater risk after teenage years.[88,89]; (2) Risk of positive-genotype patients with normal Tc is significantly lower, but higher than genotype-negative family members.[90] Caution is needed in prescribing medicine that could prolong the Tc; (3) SIDS cases attributable to L TS ∼10 .[20]; (4) Previous syncopal event is associated with increased risk.[91]
Short T syndrome	Rare condition; presents at any age including infancy[91]; most common in adolescence to 30s.[92]	Most common presentation is cardiac arrest or syncope.[92] Significant recurrence rate in those already with SCA or syncope.	Present in 44 of familial kindreds.[92]	Autosomal dominant; penetrance favors male individuals.[92]	Short Tc ≤340 ms with tall peaked T waves or <360 ms with pathogenic mutation, family history of S TS, family history of SD in age ≤40, survival of VT or VF[92]; may	Normal anatomy; decreased LV function reported in S TS patients.[93]	Maximum HR may be less than normal. Tc does not shorten and approaches normal at peak exercise.[91]	Gollob S TS Diagnostic Criteria Score: high probability for score ≥4.[94]	Significant for Gollob score >5. Risk is 2.6-fold greater for Tc <300.[95] Reliability of Gollob score in uestion based

TABLE 2 Continued

Channelopathy	Age at Presentation	Presentation	Family History	Genetic Inheritance	ECG or Holter	Echocardiogram Findings	Stress Test Findings	Making the Diagnosis	Risk for SCA or SCD
		Incidental detection on ECG is common.			have atrial arrhythmias including atrial fibrillation.				on report by Mazzanti.[92]
BrS	Predominance in male individuals; prevalence is high in Southeastern Asia; can be at any age but typically in the 4th or 5th decades.[96]	Cardiac arrest at night is common.[96] Syncope; can be asymptomatic with incidental discovery. Nocturnal agonal respiration; chest discomfort; fever can induce Brugada ECG changes and cardiac arrest.[97,98]	History of SCD in 26% of affected patients with BrS. For asymptomatic patients, a type 1 spontaneous ECG pattern was seen in 19%.[99]	Mostly autosomal dominant penetrance favors male individuals. There are 23 susceptibility genes associated with BrS but genetic testing yield remains low.[100]	ST elevation in V1-V2 classified into classes I, II, or III; may have sinus node dysfunction and atrial arrhythmias.[96]	Normal.	Exercise effects in BrS are uncertain. Stress testing of patients with BrS revealed VT, PVCs, and ST elevation in 57% with 5 revealing BrS ECG pattern.[101]	BrS diagnostic criteria based on ECG ST segment morphology. Drug challenge to induce type 1 pattern.	Risk is highest in those with spontaneous type I BrS pattern on ECG and syncope (10% of patients with BrS).[99,102] Fever increases risk of SCA.[98] Antipyretics are indicated and an important treatment in patients with BrS.
CPVT	Mostly children and adolescents but can be any age.	Often can be delayed because of normal ECG[103]; can present with cardiac arrest as the first symptom in 33% to 38% of patients.[104]	Variable penetrance with 50% of family relatives with the CPVT phenotype.[105] Prediction difficult; medical treatment of asymptomatic gene-positive patients may be recommended.	Autosomal dominant for RYR2 and KCNJ2 mutations (60% and 2%, respectively, of CPVT) and autosomal recessive for CASQ2 (2%).[106,107]	Normal baseline ECG; Holter can reveal ventricular arrhythmias, including bidirectional VT; which may have atrial arrhythmias.[104]	Normal.	Induction of ventricular arrhythmias, including PVCs, ventricular couplets, and/or nonsustained VT in 77%.[108]	Stress testing and Holter monitor will frequently reveal increased ventricular ectopy or even VT with increased sinus rate; the presence of bidirectional VT is consistent with CPVT. Sinus bradycardia can also be present.	Significant; initial presentation is cardiac arrest in 33% to 38% of patients.[104]
IVF	Average age reported as 35-40 y[109] but can occur in younger patients[110] and even infants.[111]	Syncope or cardiac arrest; frequently during athletic activity[112]; may be difficult to differentiate from CPVT.	van der Werf revealed 20 relatives of 83 IVF probands (4.9%) of first-degree relatives of IVF patients died, but only 2 were <50 y old.[113]	Limited data but appears genetic related; RYR2 implicated as autosomal dominant.[112]	Normal.	Normal.	Normal.	Difficult but mostly diagnosis of exclusion after documented VF in absence of other channelopathies in the presence of normal cardiac anatomy and function.	Limited in pediatric age; Stefanelli et al[110] reported 1 in 4 surviving IVF patients with appropriate shocks from an ICD.

HR, heart rate; LQT2, long QT 2; LV, left ventricle; PVC, premature ventricular contraction; SQTS, short QT syndrome.

TABLE 3 List of Symptoms Differentiating Between Typical (Benign) Chest Pain and Atypical Chest Pain

Features of "Typical" Chest Pain	Features of "Atypical" Chest Pain
Sharp	Pressure in sternum or left chest
Focal "it hurts right here!"	May radiate to neck or left arm
Brief	Associated diaphoresis
Changes with position	Associated dyspnea
Right sided (could be on left)	Associated nausea
Changes with breathing	Associated syncope
Tenderness can be elicited with palpation or pressure over the area	Onset with exercise, straining, or stress (unless features of typical chest pain are present)

and should be avoided.[31] Collision sports are to be avoided.

WHAT IS THE GOAL OF CARDIAC SCREENING?

The goals of any screening program need to be clarified as to whether they are expected to identify any heart condition, regardless of how significant, or only target those defects associated with SCA and SCD. A thorough personal history, family history, and physical examination are the cornerstone for screening for all children and youth. The AHA recommends a 14-point history and physical screening for athletic participation commonly known as the preparticipation evaluation (PPE) (Table 4).

A positive response to any of the 14 points may prompt the need for cardiovascular evaluation at the discretion of the PCP. This screening has a tendency to detect cardiac problems regardless of their significance. ECG screening has been shown to detect some cardiac lesions that pose a risk for SCA and SCD as well as others that do not pose a risk of SCA and SCD or require restriction from athletic participation.[32,33] There are still limitations because normal resting ECGs would also fail to detect life-threatening cardiac conditions, such as CPVT.

It Is Recommended That the Focus of Screening Should Be on Sudden Death Prevention and Identification of Those at Risk for SCA and SCD

In a 2012 policy statement, the American Academy of Pediatrics (AAP) recommended 4 questions directed toward SCA and SCD detection for which a positive response suggested an increased risk for SCA and SCD.[8] Similar to the AHA screening question tool, the 4 questions in the AAP policy statement are based on expert opinion. In contrast to the AHA tool, the AAP tool is intended to be used in all children regardless of athletic participation. Modifications have been made to these 4 questions with wording that can be directly applied to a family questionnaire. PCPs, at their discretion, may find a positive response to be a significant cue to perform a cardiovascular evaluation. The fifth edition of the AAP publication *Preparticipation Physical Evaluation* noted the AAP recommends an annual comprehensive health supervision visit from ages 6 to 21 years by physicians, nurse practitioners, or physician assistants with the clinical training outlined by state law. The goal of integrating the PPE into the health care home may be more easily achieved if the PPE portion of the examination is addressed every 2 to 3 years, rather than annually, to allow a different focus for evolving child and adolescent risk at each visit.[34] It is recommended that SCA and SCD screening should be performed for all children (athlete or not) at the same time as the PPE examination or at a minimum of every 3 years or on entry into middle or junior high school and into high school. Depending on family and PCP concerns, more frequent screening may be appropriate. The modified 4 questions, also based on expert opinion, are as follows:

1. Have you ever fainted, passed out, or had an unexplained seizure suddenly and without warning, especially during exercise or in response to sudden loud noises, such as doorbells, alarm clocks, and ringing telephones?
2. Have you ever had exercise-related chest pain or shortness of breath?
3. Has anyone in your immediate family (parents, grandparents, siblings) or other, more distant relatives (aunts, uncles, cousins) died of heart problems or had an unexpected sudden death before age 50? This would include unexpected drownings, unexplained auto crashes in which the relative was driving, or SIDS.
4. Are you related to anyone with HCM or hypertrophic obstructive cardiomyopathy, Marfan syndrome, ACM, LQTS, short QT syndrome, BrS, or CPVT or anyone younger than 50 years with a pacemaker or implantable defibrillator?

What Should Be Done With the Child Who Has a Positive Finding on a Screening Examination or Whose Parents Sought ECG Screening and Were Found to Have an ECG Abnormality?

A positive response from the 4 questions above or an abnormal

TABLE 4 Adapted From the AHA's Recommended 14-point Screen for Cardiovascular Disease

AHA's 14-Point PPE
Personal history
1. Chest pain, discomfort, tightness, or pressure related to exertion
2. Unexplained syncope or near-syncope not felt to be vasovagal or neurocardiogenic in origin
3. Excessive and unexplained dyspnea or fatigue or palpitations associated with exercise
4. Previous recognition of a heart murmur
5. Elevated systemic blood pressure
6. Previous restriction from participation in sports
7. Previous testing for the heart, ordered by a physician
8. Family history of premature death (sudden and unexpected or otherwise) before 50 y of age attributable to heart disease in ≥1 relative
9. Disability from heart disease in close relative <50 y of age
10. Hypertrophic or dilated cardiomyopathy, LQTS, or other ion channelopathies, Marfan syndrome, or clinically significant arrhythmias; specific knowledge of genetic cardiac conditions in family members
Physical Examination
11. Heart murmur, not felt to be innocent
12. Femoral pulses to exclude aortic coarctation
13. Physical stigmata of Marfan syndrome
14. Brachial artery blood pressure (sitting position), preferably taken in both arms

Adapted from Maron BJ, Friedman RA, Kligfield P, et al; American Heart Association Council on Clinical Cardiology; Advocacy Coordinating Committee; Council on Cardiovascular Disease in the Young; Council on Cardiovascular Surgery and Anesthesia; Council on Epidemiology and Prevention; Council on Functional Genomics and Translational Biology; Council on Quality of Care and Outcomes Research, and American College of Cardiology. Assessment of the 12-lead electrocardiogram as a screening test for detection of cardiovascular disease in healthy general populations of young people (12–25 years of age): a scientific statement from the American Heart Association and the American College of Cardiology. *J Am Coll Cardiol.* 2014;64(14):1479–1514.

ECG should prompt further investigation that may include referral to a pediatric cardiologist or pediatric electrophysiologist. A pediatric electrophysiologist will have better insight for suspected channelopathies or arrhythmia issues and will recommend studies as needed. Ideally, the child with a positive response to these questions should be held out of athletic participation until the cardiovascular evaluation is complete.

THE PRIMARY CARE PHYSICIAN'S ROLE IN SECONDARY PREVENTION

What to Do When a Child Has a Cardiac Arrest

When a child has a cardiac arrest, secondary prevention efforts, including resuscitation, are required. Prompt recognition of cardiac arrest with high-quality CPR and early defibrillation are the major determinants of survival, with survival decreasing by 10% with every minute delay in CPR and AED administration.[35] The AAP and AHA support efforts to improve survival by early symptom recognition, the use of 911 or emergency medical services (EMS), effective bystander CPR, and deployment and use of AEDs in the community. Bystander CPR improves the response time to defibrillation, can more than double the survival to hospital discharge, and leads to improved neurologic outcome.[36] Unfortunately, only 20% to 30% of people who experience a cardiac arrest outside of the hospital receive bystander CPR or defibrillation, and the CPR performed by bystanders may be suboptimal.[37] Annual rates of CPR training in the United States are low, with only 4% of the US population being trained.[17] CPR and AED training is recommended as a high school graduation requirement. To support this effort, there are school-based CPR training programs available from the World Health Organization and the AHA.[38,39]

Evaluation of the Victim or Survivor of Cardiac Arrest

A comprehensive evaluation of the survivor of cardiac arrest should be undertaken at the direction of a cardiologist with expertise in conditions associated with SCA and SCD.

Important elements in the evaluation of SCA include the following:

1. careful review of the medical history and event, including pre-event symptoms;
2. a multigenerational family history;
3. ECG;
4. exercise stress test (some primary arrhythmias are only seen with or immediately after physical exertion);
5. echocardiography to identify structural defects and abnormal cardiac function; and
6. additional testing as needed, including cardiac MRI, computed tomography, electrophysiology testing, and/or provocative drug testing.

If a clinical phenotype is suspected or proven, targeted genetic testing may be indicated. In the survivor of SCA, genetic testing should be guided by the results of medical evaluation. Results may be used for individual diagnosis, treatment, and screening of at-risk family members for subclinical disease.[40] Genetic testing results should be interpreted in consultation with a physician specializing in inherited arrhythmia conditions, a

physician specializing in genetics, and/or a genetic counselor.

What to Do When a Child Cannot Be Resuscitated

SCD occurs in approximately 2000 patients younger than 25 years (excluding SIDS deaths) every year in the United States.[41] Autopsy studies of young individuals who have suffered SCD have shown that a structural cardiac cause (HCM, congenital heart anomalies, and myocarditis) is present in the majority of the patients; however, the cause remains unexplained in a significant proportion (6% to 40%).[42–45] Unexplained SCD is often attributed to cardiac arrhythmia caused by cardiac ion channel dysfunction, which is undetectable in a conventional autopsy. Diagnostic yield in families is 4 times higher when there is a survivor of SCA compared with those in whom there was an SCD.[46] When SCD occurs, assessment of the cardiac anatomy by a skilled medical examiner at the time of autopsy is important. For individuals who do not survive and have no apparent previously identified cause or diagnosis on conventional autopsy, especially if clinical evidence points toward a diagnosis of LQTS or CPVT, a targeted molecular autopsy is recommended[47] (Table 5). Genetic testing results should be interpreted in consultation with a physician specializing in inherited arrhythmia conditions, a physician specializing in genetics, and/or a genetic counselor.

The etiologies of SIDS are varied, with the majority of cases attributable to noncardiac causes. Therefore, victims of SIDS do not necessarily require a rigorous cardiac genetic evaluation unless the circumstances at the time of death or family history are suggestive of an arrhythmic death.

COMMUNICATION AND BEREAVEMENT

After a cardiac arrest, communication between the health care team and the family can have a significant effect on the grief response. The initial reaction is frequently shock, followed by other emotional reactions, including anger, guilt, depression, rage, apathy, and loneliness.[48] Preparing the family for the process that follows death is important (postmortem examination, referral to the medical examiner or coroner, registering the death).[49] Asking questions and receiving information about the cause of death is important to families.[48] Blaming oneself for not saving the life of the family member is common, and therefore, reassurance is key in alleviating the guilt.[48] Survivors of SCA are at risk for posttraumatic stress disorder.[50] Providing information on bereavement support groups can be helpful. The HeartRescue Project's Life After SCA initiative provides resources to help survivors and their loved ones return to living happy, healthy, and fulfilled lives.[51] Parent Heart Watch is a national group of parents whose children have experienced SCA and can provide unique support to bereaved families.

EVALUATION OF REMAINING FAMILY MEMBERS

Many of the cardiovascular diseases that put young individuals at risk for sudden death have a familial inheritance pattern. Screening relatives provides the opportunity to identify at-risk individuals and initiate management.[40] Importantly, in the absence of a diagnosis in the affected individual, cascade screening of first-degree relatives has improved the diagnostic yield of testing. Detailed cardiovascular evaluation of first-degree SCA and SCD relatives has shown that 22% to 30% of these families had evidence of inherited cardiac disease.[52,53] Steinberg et al reported that 18% of surviving relatives of unexplained SCA and SCD victims reported one or more cardiac symptoms in a first-degree relative of the proband.[52] Consistent with these findings, it has been recommended that first-

TABLE 5 Recommendations From the National Association of Medical Examiners for Autopsy Evaluation of Young Sudden Death Victims

Recommendations From Medical Examiner
1. At a minimum, samples should be saved from individuals aged ≤40 y who die suddenly and unexpectedly and whose deaths remain unexplained at the completion of the autopsy.
2. Circumstances that should be considered suspicious for a possible genetic etiology include, but are not limited to, the following:
a. Drowning, particularly in the case of a sober or experienced swimmer;
b. Single motor auto crashes when no mitigating factors are present (eg, toxicology results negative, favorable road conditions);
c. An unexplained seizure;
d. An unexplained death of an individual with a family history of sudden death or inherited heart disease, such as a cardiomyopathy, thoracic aneurysm, or known genetic cardiac diagnosis;
e. All deaths that are sudden and unexplained for which cause of death is not clear at autopsy.
2 For the purpose of potential genetic testing and/or DNA banking, an appropriate sample is 5–10 mL of blood collected at autopsy or as part of an external examination that is preserved with K2 EDTA (usually a purple top tube).[48]

Adapted from Middleton O, Baxter S, Demo E, et al. National Association of Medical Examiners Position Paper: Retaining Postmortem Samples for Genetic Testing. Acad Forensic Pathol. 2013;3(2):191–194.

degree family members of patients with SCA and SCD be informed of the potentially increased risk. An assessment should be offered at a center with experience in the diagnosis and management of inherited cardiac diseases.[40] The initial battery of tests for first-degree relatives usually includes a visit to a pediatric cardiologist or electrophysiologist, an ECG, an exercise stress test (if old enough to exercise), and an echocardiogram. It is reasonable to order molecular genetic testing from the victim after SCA. If a disease-causing variant is identified in the victim, cascade molecular and clinical screening of family members is indicated.[40] Cascade screening means evaluation beginning with first-degree relatives of the SCA victim. Depending on the results of those screening tests, other family members may need testing as well.

UNDERSTANDING IMPLANTABLE CARDIOVASCULAR DEVICES

Cardiovascular implantable electronic devices can store substantial amounts of diagnostic data related to arrhythmia documentation.[54]

- Pacemakers are electronic devices that stimulate the heart with electrical impulses to maintain or restore a normal rhythm in people with slow heart rhythms. Pacemakers can be programmed to record abnormal rhythms but cannot provide a shock to restore sinus rhythm during an arrhythmia.
- Implantable cardioverter-defibrillators (ICDs) have pacemaker functions but are also capable of providing therapy for tachyarrhythmias, including VT and VF. Therapy can involve either overdrive pacing or a shock that restores sinus rhythm. Interrogation of an ICD is important after a delivered shock because the arrhythmia that was treated will be recorded along with the therapy and the post-shock rhythm.
- An implantable loop recorder (ILR) is a small device implanted under the skin that can store ECG recordings of the heart rhythm. An ILR can be programmed to record automatically when the patient's heart rate deviates outside the range that is chosen by the physician. An ILR can also be activated by the patient to record during symptoms. ILRs cannot pace or provide therapy.

AED AND CPR

AEDs can accurately detect VF in children of all ages and differentiate shockable from nonshockable rhythms with a high degree of sensitivity and specificity.[55] For children from birth to 8 years of age, it is reasonable to use an AED pediatric dose-attenuator system and a pediatric pad to reduce delivered energy if one is available; if not, the rescuer should use a standard AED.[55] Current AHA guidelines do not recommend compression-only CPR for young children.[56]

CARDIAC EMERGENCY RESPONSE PLANS AND THE PCP AS ADVOCATE

On any given day, as many as 20% of the combined US adult and child population can be found in schools. Therefore, school nurses, athletic trainers, and teachers are often required to provide emergency care during the school day and for extracurricular activities, including sports.[57] A cardiac emergency response plan (CERP) is needed to facilitate an efficient and structured response to SCA. Essential elements of a CERP include the following:

1. establishing an effective communication system;
2. training of anticipated responders in CPR and AED use;
3. access to an AED for early defibrillation;
4. acquisition of necessary emergency equipment;
5. coordination and integration of on-site responder and AED programs with the local EMS system; and
6. practice and review of the response plan.[58]

This plan should target a collapse-to-EMS call time of $<$1 minute, provision of first aid and CPR when appropriate, and a collapse-to-first shock time of $<$3 minutes for SCA if an AED is on-site. It is recommended that at least 10% of staff and 50% of physical education staff should have current CPR and AED certification.[59] At least 2 successful emergency response drills should be conducted every year.[59]

The PCP and pediatric cardiologist can have a major impact in advocating for schools and school districts not only to have a sufficient number of AEDs but also that the staff is continually well trained, the equipment is maintained, and a CERP is in place. Many states have passed legislation requiring CPR or AED training for students to graduate from high school or as part of the health curriculum.[60] The task force supports efforts through either legislation or local or statewide high school associations to make CPR and/or AED training a requirement for students to graduate from high school.

ROLE OF THE LICENSED ATHLETIC TRAINER

Licensed athletic trainers (LATs) are school-based health care professionals who collaborate with the health care team. The services LATs provide include prevention, emergency care, and therapeutic

intervention.[61] The LAT needs to be able to determine an athlete's readiness to participate and, if necessary, consult with the supervising team physician and/or treating physician. They also play an important role in identifying unsafe facilities or playing environments as well as developing and implementing an emergency action plan in collaboration with supervising team physicians.[61] LATs can be important advocates for CPR and AED use training and for AED placement in public areas, including schools, athletic fields, and arenas.

RETURN TO ACTIVITY AFTER CARDIAC ARREST

The AHA and others have issued recommendations for aerobic and resistance training in children and adolescents.[62] These recommendations are based on findings that regular physical activity reduces the risk of long-term adverse health outcomes. There is evidence that childhood levels of cardiovascular risk factors predict early subclinical atherosclerosis and cardiac pathology and adult morbidity and mortality.[63] Encouraging patients who have suffered cardiac arrest to have a healthy lifestyle including exercise may be beneficial. Exercise restriction needs to be balanced with the potential for lifelong risk of SCA and SCD and the development of other conditions associated with cardiovascular risk. To facilitate a safe return to exercise, these patients may benefit from a medically supervised cardiac rehabilitation program. Any patients, including athletes, who have suffered a cardiac arrest from VT or VF from a cause that cannot be reversed or well-managed with other means (eg, medication) should undergo a thorough evaluation with strong consideration of ICD placement.[64] There are specific recommendations for those desiring athletic participation with ICDs under advisement by the patient's pediatric electrophysiologist. Recommendations include returning to low-level dynamic and static activities (eg, golf, bowling, etc) after 3 months of being free of VT or VF requiring device therapy.[65] Higher-intensity activities can also be considered in discussion with the patient and family in a shared risk arrangement after 3 months without device therapy for VT or VF.[65] The patient should be counseled on the increased risk of ICD shocks as well as device-related trauma when participating in activities that have a risk of affecting the device.[65]

Patients who have suffered a cardiac arrest from a reversible cause, such as myocarditis or electrolyte abnormality, will often not have an ICD implanted. The most recent recommendations suggest refraining from athletic participation until cleared at a 3-month reevaluation and on the advice of the pediatric cardiologist or electrophysiologist. If the condition causing the cardiac arrest has completely resolved, the athlete may then return to competition.[65]

RECOMMENDATIONS AND PRIMARY TAKEAWAY POINTS FROM THIS POLICY STATEMENT

PCPs, as the preeminent providers of health care to children, should be aware of the features of the clinical history, family history, and physical examination suggestive of a risk for SCA and SCD.

1. All children should be evaluated for conditions predisposing to SCA and SCD in the course of routine health care.[14]
2. A thorough and detailed history, family history, and physical examination are necessary to begin assessing SCA and SCD risk.
3. The ECG should be the first test ordered when there is concern for SCA risk. The ECG should be interpreted by a physician trained in recognizing electrical heart disease (ie, a pediatric cardiologist or pediatric electrophysiologist).
   a. To provide optimal care, ECGs should not be performed in isolation without clinical history; referral to a specialist should be considered.
4. Do not trust the computer interpretation of the ECG.

Recognizing that no single screening strategy will be able to detect all the conditions associated with SCA (primary prevention), it is important to advocate for emergency action plans (secondary prevention) and CPR training in the community. CPR and AEDs are effective for secondary SCA prevention.

Survivors of SCA (and family members of SCA or SCD victims) should have a thorough evaluation to assess the potential of a genetic etiology. Some facilities have specialized centers for SCA. A pediatric SCA center is a children's multispecialty medical facility with expertise in pediatric electrophysiology and inherited channelopathies and cardiomyopathies. This evaluation includes not only molecular genetic testing but also genetic counseling for identifying others who may be at risk.[66]

SUMMARY

The strategy put forth in this policy statement emphasizes the importance of sudden death awareness and prevention that is inclusive of all young people regardless of athletic status. The emphasis shifts from focusing on a single group to expanding the primary and secondary

prevention concepts to a broader group who may achieve similar benefits. There have been many efforts made and published on ways to identify those at risk for SCA and SCD, including clinical (history and physical examination), genetic, and ECG screening. Many SCA and SCD victims cannot be identified before their event, even with testing. Therefore, secondary prevention efforts must not be overlooked by those evaluating large numbers of pediatric patients. Although focusing on prevention efforts in all children may seem to create a burden on PCPs by extending the screening program to more patients, simplification to the aforementioned 4 questions can allow this screening to become incorporated into the routine visit at a minimum of every 3 years. This strategy is intended to increase awareness of SCD prevention in young people and will allow for a healthy lifestyle and reduce the risks of SCA and SCD.

LEAD AUTHORS

Christopher C. Erickson, MD, FAAP
Jack C. Salerno, MD

COAUTHORS

Stuart Berger, MD, FAAP
Robert Campbell, MD, FAAP
Bryan Cannon, MD
James Christiansen, MD
Kody Moffatt, MD, MS, FAAP
Andreas Pflaumer, MD
Christopher S. Snyder, MD, FAAP
Chandra Srinivasan, MD
Santiago Valdes, MD, FAAP
Victoria L. Vetter, MD, MPH, FAAP
Frank Zimmerman, MD

SECTION ON CARDIOLOGY AND CARDIAC SURGERY EXECUTIVE COMMITTEE, 2021–2022

Stuart Berger, MD, FAAP, Chairperson
Christopher Snyder, MD, FAAP, Past Chairperson
Laurie Bertanyi Armsby, MD, FAAP
Antonio Gabriel Cabrera, MD, FAAP
Daphne T. Hsu, MD, FAAP
Robert Douglas Benjamin Jaquiss, MD, FAAP
Jonathan Johnson, MD, FAAP
Ritu Sachdeva, MD, FAAP
Juan Villafane, Jr, MD, FAAP

STAFF

Vivian Thorne

ACKNOWLEDGMENTS

The Pediatric and Congenital Electrophysiology Society Task Force consists mainly of physicians and allied health professionals practicing electrophysiology in children and in congenital heart disease patients of all ages, with a charge to review and provide guidance on sudden death in young people and adults.

We acknowledge Rebecca Carl, MD, FAAP; Kent Kronberg, MD, FAAP; Shen Nagel, MD; and Erik Frandsen, MD, who reviewed the article.

ABBREVIATIONS

AAP: American Academy of Pediatrics
ACM: arrhythmogenic right ventricular cardiomyopathy
AED: automated external defibrillator
AHA: American Heart Association
BrS: Brugada syndrome
CERP: cardiac emergency response plan
CPR: cardiopulmonary resuscitation
CPVT: catecholaminergic polymorphic ventricular tachycardia
ECG: electrocardiography
EMS: emergency medical services
HCM: hypertrophic cardiomyopathy
ICD: implantable cardioverter-defibrillator
ILR: implantable loop recorder
IVF: idiopathic ventricular fibrillation
LAT: licensed athletic trainer
LQTS: long QT syndrome
PCP: primary care provider
PPE: preparticipation evaluation
QTc: corrected QT interval
SCA: sudden cardiac arrest
SCD: sudden cardiac death
SIDS: sudden infant death syndrome
VF: ventricular fibrillation
VT: ventricular tachycardia

DOI: https://doi.org/10.1542/peds.2021-052044

Address correspondence to Christopher C. Erickson, MD, FAAP. E-mail: cerickson@childrensomaha.org

PEDIATRICS (ISSN Numbers: Print 0031-4005; Online, 1098-4275).

FINANCIAL DISCLOSURE: The authors have indicated they have no financial relationships relevant to this article to disclose.

FUNDING: No external funding.

POTENTIAL CONFLICT OF INTEREST: The authors have no potential conflicts of interest relevant to this article to disclose.

REFERENCES

1. Corrado D, Basso C, Schiavon M, Thiene G. Screening for hypertrophic cardiomyopathy in young athletes. *N Engl J Med.* 1998;339(6):364–369
2. Corrado D, Basso C, Schiavon M, Pelliccia A, Thiene G. Pre-participation screening of young competitive athletes for prevention of sudden cardiac death. *J Am Coll Cardiol.* 2008;52(24):1981–1989
3. Thompson PD. Preparticipation screening of competitive athletes: seeking simple solutions to a complex problem. *Circulation.* 2009;119(8):1072–1074
4. Steriotis AK, Nava A, Rigato I, et al. Noninvasive cardiac screening in young athletes with ventricular arrhythmias. *Am J Cardiol.* 2013;111(4):557–562
5. Toresdahl BG, Rao AL, Harmon KG, Drezner JA. Incidence of sudden cardiac arrest in high school student athletes on school campus. *Heart Rhythm.* 2014;11(7):1190–1194
6. Berger S, Utech L, Fran Hazinski M. Sudden death in children and adolescents. *Pediatr Clin North Am.* 2004;51(6):1653–1677
7. Kaltman JR, Thompson PD, Lantos J, et al. Screening for sudden cardiac death in the young: report from a national heart, lung, and blood institute working group. *Circulation.* 2011;123(17):1911–1918
8. Section on Cardiology and Cardiac Surgery. Pediatric sudden cardiac arrest. *Pediatrics.* 2012;129(4):e1094–e1102
9. Fish FA, Kannankeril PJ. Diagnosis and management of sudden death in children. *Curr Opin Pediatr.* 2012;24(5):592–602
10. Semsarian C, Sweeting J, Ackerman MJ. Sudden cardiac death in athletes. *BMJ.* 2015;350:h1218
11. Ackerman M, Atkins DL, Triedman JK. Sudden cardiac death in the young. *Circulation.* 2016;133(10):1006–1026
12. Steinvil A, Chundadze T. Zeltser D, et al; Mandatory electrocardiographic screening of athletes to reduce their risk for sudden death proven fact or wishful thinking? *J Am Coll Cardiol.* 2011;57(11):1291–1296
13. Maron BJ, Doerer JJ, Haas TS, Tierney DM, Mueller FO. Sudden deaths in young competitive athletes: analysis of 1866 deaths in the United States, 1980-2006. *Circulation.* 2009;119(8):1085–1092
14. Maron BJ, Friedman RA, Kligfield P, et al; American Heart Association Council on Clinical Cardiology; Advocacy Coordinating Committee; Council on Cardiovascular Disease in the Young; Council on Cardiovascular Surgery and Anesthesia; Council on Epidemiology and Prevention; Council on Functional Genomics and Translational Biology; Council on Quality of Care and Outcomes Research, and American College of Cardiology. Assessment of the 12-lead electrocardiogram as a screening test for detection of cardiovascular disease in healthy general populations of young people (12-25 years of age): a scientific statement from the American Heart Association and the American College of Cardiology. *J Am Coll Cardiol.* 2014;64(14):1479–1514
15. Hazinski MF, Nolan JP, Aickin R. Part 1: executive summary. 2015 international consensus on cardiopulmonary resuscitation and emergency cardiovascular care science with treatment recommendations. *Circulation.* 2015;132(16 suppl 1):S2–S39
16. Graham R, McCoy M, Schultz A; Committee on the Treatment of Cardiac Arrest: Current Status and Future Directions; Board on Health Sciences Policy; Institute of Medicine. *Strategies to Improve Cardiac Arrest Survival: A Time to Act.* Washington, DC: National Academies Press; 2015
17. Anderson ML, Cox M, Al-Khatib SM, et al. Rates of cardiopulmonary resuscitation training in the United States. *JAMA Intern Med.* 2014;174(2):194–201
18. Richardson P, McKenna W, Bristow M, et al. Report of the 1995 World Health Organization/International Society and Federation of Cardiology Task Force on the Definition and Classification of cardiomyopathies. *Circulation.* 1996;93(5):841–842
19. Maron BJ, Haas TS, Murphy CJ, Ahluwalia A, Rutten-Ramos S. Incidence and causes of sudden death in U.S. college athletes. *J Am Coll Cardiol.* 2014;63(16):1636–1643
20. Arnestad M, Crotti L, Rognum TO, et al. Prevalence of long-QT syndrome gene variants in sudden infant death syndrome. *Circulation.* 2007;115(3):361–367
21. Khairy P, Landzberg MJ, Gatzoulis MA, et al. Value of programmed ventricular stimulation after tetralogy of fallot repair: a multicenter study. *Circulation.* 2004;109(16):1994–2000
22. Khairy P, Aboulhosn J, Gurvitz MZ, et al; Alliance for Adult Research in Congenital Cardiology (AARCC). Arrhythmia burden in adults with surgically repaired tetralogy of Fallot: a multi-institutional study. *Circulation.* 2010;122(9):868–875
23. Klein GJ, Bashore TM, Sellers TD, Pritchett EL, Smith WM, Gallagher JJ. Ventricular fibrillation in the Wolff-Parkinson-White syndrome. *N Engl J Med.* 1979;301(20):1080–1085
24. Klein GJ, Prystowsky EN, Yee R, Sharma AD, Laupacis A. Asymptomatic Wolff-Parkinson-White. Should we intervene? *Circulation.* 1989;80(6):1902–1905
25. Leitch JW, Klein GJ, Yee R, Murdock C. Prognostic value of electrophysiology testing in asymptomatic patients with Wolff-Parkinson-White pattern [published correction appears in Circulation. 1991;83(3):1124]. *Circulation.* 1990;82(5):1718–1723
26. Cohen MI, Triedman JK, Cannon BC, et al; Pediatric and Congenital Electrophysiology Society (PACES); Heart Rhythm Society (HRS); American College of Cardiology Foundation (ACCF); American Heart Association (AHA); American Academy of Pediatrics (AAP); Canadian Heart Rhythm Society (CHRS). PACES/HRS expert consensus statement on the management of the asymptomatic young patient with a Wolff-Parkinson-White (WPW, ventricular preexcitation) electrocardiographic pattern: developed in partnership between the Pediatric and Congenital Electrophysiology Society (PACES) and the Heart Rhythm Society (HRS). Endorsed by the governing bodies of PACES, HRS, the American College of Cardiology Foundation (ACCF), the American Heart Association (AHA), the American Academy of Pediatrics (AAP), and the Canadian Heart Rhythm Society (CHRS). *Heart Rhythm.* 2012;9(6):1006–1024
27. Shwayder M, Escudero C, Etheridge SP. *To Fibrillate or Not: What Should We*

Measure in the Electrophysiology Lab for Wolff-Parkinson-White Risk Stratification? Heart Rhythm Society Scientific Sessions; 2016; San Francisco, CA

28. Link MS. Commotio cordis: ventricular fibrillation triggered by chest impact-induced abnormalities in repolarization. *Circ Arrhythm Electrophysiol.* 2012;5(2):425–432
29. Kumar K, Mandleywala SN, Gannon MP, Estes NAM III, Weinstock J, Link MS. Development of a chest wall protector effective in preventing sudden cardiac death by chest wall impact (commotio cordis). *Clin J Sport Med.* 2017;27(1): 26–30
30. Link MS, Estes NAM III, Maron BJ. Eligibility and disqualification recommendations for competitive athletes with cardiovascular abnormalities: task force 13: commotio cordis: a scientific statement from the American Heart Association and American College of Cardiology. *J Am Coll Cardiol.* 2015; 66(21):2439–2443
31. Cheng A, Owens D. Marfan syndrome, inherited aortopathies and exercise: what is the right answer? *Heart.* 2015;101(10):752–757
32. Fuller CM. Cost effectiveness analysis of screening of high school athletes for risk of sudden cardiac death. *Med Sci Sports Exerc.* 2000;32(5):887–890
33. Price DE, McWilliams A, Asif IM, et al. Electrocardiography-inclusive screening strategies for detection of cardiovascular abnormalities in high school athletes. *Heart Rhythm.* 2014;11(3): 442–449
34. American Academy of Pediatrics. Timing, setting, and structure. In: Bernhardt DT, Roberts WO, eds. *Preparticipation Physical Evaluation.* 5th ed. Itasca, IL: American Academy of Pediatrics; 2019:17
35. Larsen MP, Eisenberg MS, Cummins RO, Hallstrom AP. Predicting survival from out-of-hospital cardiac arrest: a graphic model. *Ann Emerg Med.* 1993;22(11):1652–1658
36. Naim MY, Burke RV, McNally BF, et al. Association of bystander cardiopulmonary resuscitation with overall and neurologically favorable survival after pediatric out-of-hospital cardiac arrest in the United States: a report from the Cardiac Arrest Registry to Enhance Survival Surveillance Registry. *JAMA Pediatr.* 2017;171(2): 133–141
37. Stiell IG, Brown SP, Christenson J, et al; Resuscitation Outcomes Consortium (ROC) Investigators. What is the role of chest compression depth during out-of-hospital cardiac arrest resuscitation? *Crit Care Med.* 2012;40(4): 1192–1198
38. Böttiger BW, Van Aken H. Kids save lives–training school children in cardiopulmonary resuscitation worldwide is now endorsed by the World Health Organization (WHO). *Resuscitation.* 2015;94:A5–A7
39. Cave DM, Aufderheide TP, Beeson J, et al; American Heart Association Emergency Cardiovascular Care Committee; Council on Cardiopulmonary, Critical Care, Perioperative and Resuscitation; Council on Cardiovascular Diseases in the Young; Council on Cardiovascular Nursing; Council on Clinical Cardiology, and Advocacy Coordinating Committee. Importance and implementation of training in cardiopulmonary resuscitation and automated external defibrillation in schools: a science advisory from the American Heart Association. *Circulation.* 2011;123(6):691–706
40. Ackerman MJ, Priori SG, Willems S, et al. HRS/EHRA expert consensus statement on the state of genetic testing for the channelopathies and cardiomyopathies this document was developed as a partnership between the Heart Rhythm Society (HRS) and the European Heart Rhythm Association (EHRA). *Heart Rhythm.* 2011;8(8):1308–1339
41. Kung HC, Hoyert DL, Xu J, Murphy SL. Deaths: final data for 2005. *Natl Vital Stat Rep.* 2008;56(10):1–120
42. Priori SG, Wilde AA, Horie M, et al. HRS/EHRA/APHRS expert consensus statement on the diagnosis and management of patients with inherited primary arrhythmia syndromes: document endorsed by HRS, EHRA, and APHRS in May 2013 and by ACCF, AHA, PACES, and AEPC in June 2013. *Heart Rhythm.* 2013;10(12):1932–1963
43. Bagnall RD, Weintraub RG, Ingles J, et al. A prospective study of sudden cardiac death among children and young adults. *N Engl J Med.* 2016;374(25): 2441–2452
44. Puranik R, Chow CK, Duflou JA, Kilborn MJ, McGuire MA. Sudden death in the young. *Heart Rhythm.* 2005;2(12): 1277–1282
45. Eckart RE, Scoville SL, Campbell CL, et al. Sudden death in young adults: a 25-year review of autopsies in military recruits. *Ann Intern Med.* 2004;141(11):829–834
46. Kumar S, Peters S, Thompson T, et al. Familial cardiological and targeted genetic evaluation: low yield in sudden unexplained death and high yield in unexplained cardiac arrest syndromes. *Heart Rhythm.* 2013;10(11):1653–1660
47. Tester DJ, Medeiros-Domingo A, Will ML, Haglund CM, Ackerman MJ. Cardiac channel molecular autopsy: insights from 173 consecutive cases of autopsy-negative sudden unexplained death referred for postmortem genetic testing. *Mayo Clin Proc.* 2012;87(6): 524–539
48. Mayer DDM, Rosenfeld AG, Gilbert K. Lives forever changed: family bereavement experiences after sudden cardiac death. *Appl Nurs Res.* 2013;26(4): 168–173
49. Cook P, White DK, Ross-Russell RI. Bereavement support following sudden and unexpected death: guidelines for care. *Arch Dis Child.* 2002;87(1):36–38
50. Rosman L, Ford J, Whited A, et al. Compound risk: History of traumatic stress predicts posttraumatic stress disorder symptoms and severity in sudden cardiac arrest survivors. *Eur J Cardiovasc Nurs.* 2016;15(5):372–379
51. Project HeartRescue. Resources for survivors. Available at: www.lifeaftersca.org/resources-for-survivors. Accessed May 24, 2021
52. Steinberg C, Padfield GJ, Champagne J, et al. Cardiac abnormalities in first-degree relatives of unexplained cardiac arrest victims: a report from the cardiac arrest survivors with preserved ejection fraction registry. *Circ Arrhythm Electrophysiol.* 2016;9(9): e004274
53. Tan HL, Hofman N, van Langen IM, van der Wal AC, Wilde AAM. Sudden unexplained death: heritability and diagnostic yield of cardiological and genetic

examination in surviving relatives. *Circulation.* 2005;112(2):207–213

54. Wilkoff BL, Auricchio A, Brugada J, et al; Heart Rhythm Society; European Heart Rhythm Association; American College of Cardiology; American Heart Association; European Society of Cardiology; Heart Failure Association of ESC; Heart Failure Society of America. HRS/EHRA expert consensus on the monitoring of cardiovascular implantable electronic devices (CIEDs): description of techniques, indications, personnel, frequency and ethical considerations. *Heart Rhythm.* 2008;5(6):907–925
55. Link MS, Atkins DL, Passman RS, et al. Part 6: electrical therapies: automated external defibrillators, defibrillation, cardioversion, and pacing: 2010 American Heart Association Guidelines for Cardiopulmonary Resuscitation and Emergency Cardiovascular Care. *Circulation.* 2010;122(18 Suppl 3):S706–S719
56. Atkins DL, de Caen AR, Berger S, et al. 2017 American Heart Association focused update on pediatric basic life support and cardiopulmonary resuscitation quality: an update to the American Heart Association guidelines for cardiopulmonary resuscitation and emergency cardiovascular care. *Circulation.* 2018;137(1):e1–e6
57. Hazinski MF, Markenson D, Neish S, et al; American Heart Association; American Academy of Pediatrics; American College of Emergency Physicians; American National Red Cross; National Association of School Nurses; National Association of State EMS Directors; National Association of EMS Physicians; National Association of Emergency Medical Technicians; Program for School Preparedness and Planning; National Center for Disaster Preparedness; Columbia University Mailman School of Public Health. Response to cardiac arrest and selected life-threatening medical emergencies: the medical emergency response plan for schools: A statement for healthcare providers, policymakers, school administrators, and community leaders. *Circulation.* 2004;109(2):278–291
58. Drezner JA, Courson RW, Roberts WO, Mosesso VN Jr, Link MS, Maron BJ; Inter-Association Task Force. Inter-association task force recommendations on emergency preparedness and management of sudden cardiac arrest in high school and college athletic programs: a consensus statement. *Heart Rhythm.* 2007;4(4):549–565
59. American Heart Association. Cardiac emergency response plan. Available at: www.heart.org/CERP. 2016. Accessed May 24, 2021
60. American Heart Association. CPR in Schools Legislation Map. Available at: https://ahainstructornetwork.americanheart.org/AHAECC/CPRAndECC/Programs/CPRInSchools/UCM_475820_CPR-in-Schools-Legislation-Map.jsp. Accessed May 24, 2021
61. Casa DJ, Almquist J, Anderson SA, et al. The inter-association task force for preventing sudden death in secondary school athletics programs: best-practices recommendations. *J Athl Train.* 2013;48(4):546–553
62. US Department of Health and Human Services. 2008 physical activity guidelines for Americans: be active, healthy, and happy! Available at: https://health.gov/paguidelines/pdf/paguide.pdf. 2008. Accessed May 24, 2021
63. Steinberger J, Daniels SR, Hagberg N, et al; American Heart Association Atherosclerosis, Hypertension, and Obesity in the Young Committee of the Council on Cardiovascular Disease in the Young; Council on Cardiovascular and Stroke Nursing; Council on Epidemiology and Prevention; Council on Functional Genomics and Translational Biology; and Stroke Council. Cardiovascular health promotion in children: challenges and opportunities for 2020 and beyond: a scientific statement from the American Heart Association. *Circulation.* 2016;134(12):e236–e255
64. Epstein AE, DiMarco JP, Ellenbogen KA, et al; American College of Cardiology Foundation; American Heart Association Task Force on Practice Guidelines; Heart Rhythm Society. 2012 ACCF/AHA/HRS focused update incorporated into the ACCF/AHA/HRS 2008 guidelines for device-based therapy of cardiac rhythm abnormalities: a report of the American College of Cardiology Foundation/American Heart Association Task Force on Practice Guidelines and the Heart Rhythm Society. *J Am Coll Cardiol.* 2013;61(3):e6–e75
65. Maron BJ, Zipes DP, Kovacs RJ; American Heart Association Electrocardiography and Arrhythmias Committee of Council on Clinical Cardiology, Council on Cardiovascular Disease in Young, Council on Cardiovascular and Stroke Nursing, Council on Functional Genomics and Translational Biology, and American College of Cardiology. Eligibility and Disqualification Recommendations for Competitive Athletes With Cardiovascular Abnormalities: Preamble, Principles, and General Considerations: A Scientific Statement From the American Heart Association and American College of Cardiology. *Circulation.* 2015;132(22):e256–e261
66. Abrams DJ. How to develop a clinic for sudden cardiac arrest survivors and families of non-survivors. *Cardiol Young.* 2017;27(S1):S3–S9
67. Hershberger RE, Lindenfeld J, Mestroni L, Seidman CE, Taylor MRG, Towbin JA; Heart Failure Society of America. Genetic evaluation of cardiomyopathy–a Heart Failure Society of America practice guideline. *J Card Fail.* 2009;15(2):83–97
68. Bharucha T, Lee KJ, Daubeney PEF, et al; NACCS (National Australian Childhood Cardiomyopathy Study) Investigators. Sudden death in childhood cardiomyopathy: results from a long-term national population-based study. *J Am Coll Cardiol.* 2015;65(21):2302–2310
69. Adabag AS, Maron BJ, Appelbaum E, et al. Occurrence and frequency of arrhythmias in hypertrophic cardiomyopathy in relation to delayed enhancement on cardiovascular magnetic resonance. *J Am Coll Cardiol.* 2008;51(14):1369–1374
70. Appelbaum E, Maron BJ, Adabag S, et al. Intermediate-signal-intensity late gadolinium enhancement predicts ventricular tachyarrhythmias in patients with hypertrophic cardiomyopathy. *Circ Cardiovasc Imaging.* 2012;5(1):78–85
71. Green JJ, Berger JS, Kramer CM, Salerno M. Prognostic value of late gadolinium enhancement in clinical outcomes for hypertrophic cardiomyopathy. *JACC Cardiovasc Imaging.* 2012;5(4):370–377

72. Spinner JA, Noel CV, Denfield SW, et al. Association of late gadolinium enhancement and degree of left ventricular hypertrophy assessed on cardiac magnetic resonance imaging with ventricular tachycardia in children with hypertrophic cardiomyopathy. *Am J Cardiol.* 2016;117(8):1342–1348

73. Lipshultz SE, Orav EJ, Wilkinson JD, et al; Pediatric Cardiomyopathy Registry Study Group. Risk stratification at diagnosis for children with hypertrophic cardiomyopathy: an analysis of data from the Pediatric Cardiomyopathy Registry. *Lancet.* 2013;382(9908):1889–1897

74. Webber SA, Lipshultz SE, Sleeper LA, et al; Pediatric Cardiomyopathy Registry Investigators. Outcomes of restrictive cardiomyopathy in childhood and the influence of phenotype: a report from the Pediatric Cardiomyopathy Registry. *Circulation.* 2012;126(10):1237–1244

75. Hamilton RM. Arrhythmogenic right ventricular cardiomyopathy. *Pacing Clin Electrophysiol.* 2009;32(Suppl 2):S44–S51

76. Marcus FI, McKenna WJ, Sherrill D, et al. Diagnosis of arrhythmogenic right ventricular cardiomyopathy/dysplasia: proposed modification of the Task Force Criteria. *Eur Heart J.* 2010;31(7):806–814

77. Towbin JA, Lorts A, Jefferies JL. Left ventricular non-compaction cardiomyopathy. *Lancet.* 2015;386(9995):813–825

78. Jenni R, Oechslin E, Schneider J, Attenhofer Jost C, Kaufmann PA. Echocardiographic and pathoanatomical characteristics of isolated left ventricular non-compaction: a step towards classification as a distinct cardiomyopathy. *Heart.* 2001;86(6):666–671

79. Petersen SE, Selvanayagam JB, Wiesmann F, et al. Left ventricular non-compaction: insights from cardiovascular magnetic resonance imaging. *J Am Coll Cardiol.* 2005;46(1):101–105

80. Czosek RJ, Spar DS, Khoury PR, et al. Outcomes, arrhythmic burden and ambulatory monitoring of pediatric patients with left ventricular noncompaction and preserved left ventricular function. *Am J Cardiol.* 2015;115(7):962–966

81. Brescia ST, Rossano JW, Pignatelli R, et al. Mortality and sudden death in pediatric left ventricular noncompaction in a tertiary referral center. *Circulation.* 2013;127(22):2202–2208

82. Rowland T. Morphologic features of the "athlete's heart" in children: a contemporary review. *Pediatr Exerc Sci.* 2016;28(3):345–352

83. Sheikh N, Papadakis M, Ghani S, et al. Comparison of electrocardiographic criteria for the detection of cardiac abnormalities in elite black and white athletes. *Circulation.* 2014;129(16):1637–1649

84. Sharma S, Maron BJ, Whyte G, Firoozi S, Elliott PM, McKenna WJ. Physiologic limits of left ventricular hypertrophy in elite junior athletes: relevance to differential diagnosis of athlete's heart and hypertrophic cardiomyopathy. *J Am Coll Cardiol.* 2002;40(8):1431–1436

85. Pelliccia A, Maron BJ, De Luca R, Di Paolo FM, Spataro A, Culasso F. Remodeling of left ventricular hypertrophy in elite athletes after long-term deconditioning. *Circulation.* 2002;105(8):944–949

86. Petko C, Bradley DJ, Tristani-Firouzi M, et al. Congenital long QT syndrome in children identified by family screening. *Am J Cardiol.* 2008;101(12):1756–1758

87. Aziz PF, Wieand TS, Ganley J, et al. Genotype- and mutation site-specific QT adaptation during exercise, recovery, and postural changes in children with long-QT syndrome. *Circ Arrhythm Electrophysiol.* 2011;4(6):867–873

88. Priori SG, Schwartz PJ, Napolitano C, et al. Risk stratification in the long-QT syndrome. *N Engl J Med.* 2003;348(19):1866–1874

89. Goldenberg I, Moss AJ, Peterson DR, et al. Risk factors for aborted cardiac arrest and sudden cardiac death in children with the congenital long-QT syndrome. *Circulation.* 2008;117(17):2184–2191

90. Goldenberg I, Horr S, Moss AJ, et al. Risk for life-threatening cardiac events in patients with genotype-confirmed long-QT syndrome and normal-range corrected QT intervals. *J Am Coll Cardiol.* 2011;57(1):51–59

91. Giustetto C, Di Monte F, Wolpert C, et al. Short QT syndrome: clinical findings and diagnostic-therapeutic implications. *Eur Heart J.* 2006;27(20):2440–2447

92. Mazzanti A, Kanthan A, Monteforte N, et al. Novel insight into the natural history of short QT syndrome. *J Am Coll Cardiol.* 2014;63(13):1300–1308

93. Frea S, Giustetto C, Capriolo M, et al. New echocardiographic insights in short QT syndrome: More than a channelopathy? *Heart Rhythm.* 2015;12(10):2096–2105

94. Gollob MH, Redpath CJ, Roberts JD. The short QT syndrome: proposed diagnostic criteria. *J Am Coll Cardiol.* 2011;57(7):802–812

95. Iribarren C, Round AD, Peng JA, et al. Short QT in a cohort of 1.7 million persons: prevalence, correlates, and prognosis. *Ann Noninvasive Electrocardiol.* 2014;19(5):490–500

96. Gonzalez Corcia MC, de Asmundis C, Chierchia GB, Brugada P. Brugada syndrome in the paediatric population: a comprehensive approach to clinical manifestations, diagnosis, and management. *Cardiol Young.* 2016;26(6):1044–1055

97. Amin AS, Meregalli PG, Bardai A, Wilde AAM, Tan HL. Fever increases the risk for cardiac arrest in the Brugada syndrome. *Ann Intern Med.* 2008;149(3):216–218

98. Kumar V, Patel N, Van Houzen N, Saini N. Brugada-type electrocardiographic changes induced by fever. *Circulation.* 2013;127(21):2145–2146

99. Probst V, Veltmann C, Eckardt L, et al. Long-term prognosis of patients diagnosed with Brugada syndrome: Results from the FINGER Brugada Syndrome Registry. *Circulation.* 2010;121(5):635–643

100. Gourraud JB, Barc J, Thollet A, et al. The Brugada syndrome: A rare arrhythmia disorder with complex inheritance. *Front Cardiovasc Med.* 2016;3:9

101. Masrur S, Memon S, Thompson PD. Brugada syndrome, exercise, and exercise testing. *Clin Cardiol.* 2015;38(5):323–326

102. Priori SG, Napolitano C, Gasparini M, et al. Natural history of Brugada syndrome: insights for risk stratification

and management. *Circulation.* 2002;105(11):1342–1347

103. Roston TM, Vinocur JM, Maginot KR, et al. Catecholaminergic polymorphic ventricular tachycardia in children: analysis of therapeutic strategies and outcomes from an international multicenter registry. *Circ Arrhythm Electrophysiol.* 2015;8(3):633–642
104. Behere SP, Weindling SN. Catecholaminergic polymorphic ventricular tachycardia: An exciting new era. *Ann Pediatr Cardiol.* 2016;9(2):137–146
105. van der Werf C, Nederend I, Hofman N, et al. Familial evaluation in catecholaminergic polymorphic ventricular tachycardia: disease penetrance and expression in cardiac ryanodine receptor mutation-carrying relatives. *Circ Arrhythm Electrophysiol.* 2012;5(4):748–756
106. De Ferrari GM, Dusi V, Spazzolini C, et al. Clinical management of catecholaminergic polymorphic ventricular tachycardia: the role of left cardiac sympathetic denervation. *Circulation.* 2015;131(25):2185–2193
107. Kawamura M, Ohno S, Naiki N, et al. Genetic background of catecholaminergic polymorphic ventricular tachycardia in Japan. *Circ J.* 2013;77(7):1705–1713
108. Haugaa KH, Leren IS, Berge KE, et al. High prevalence of exercise-induced arrhythmias in catecholaminergic polymorphic ventricular tachycardia mutation-positive family members diagnosed by cascade genetic screening. *Europace.* 2010;12(3):417–423
109. Marcus FI. Idiopathic ventricular fibrillation. *J Cardiovasc Electrophysiol.* 1997;8(9):1075–1083
110. Stefanelli CB, Bradley DJ, Leroy S, Dick M II, Serwer GA, Fischbach PS. Implantable cardioverter defibrillator therapy for life-threatening arrhythmias in young patients. *J Interv Card Electrophysiol.* 2002;6(3):235–244
111. Miyake CY, Davis AM, Motonaga KS, Dubin AM, Berul CI, Cecchin F. Infant ventricular fibrillation after ST-segment changes and QRS widening: a new cause of sudden infant death? *Circ Arrhythm Electrophysiol.* 2013;6(4):712–718
112. Paech C, Gebauer RA, Karstedt J, Marschall C, Bollmann A, Husser D. Ryanodine receptor mutations presenting as idiopathic ventricular fibrillation: a report on two novel familial compound mutations, c.6224T>C and c.13781A>G, with the clinical presentation of idiopathic ventricular fibrillation. *Pediatr Cardiol.* 2014;35(8):1437–1441
113. van der Werf C, Stiekema L, Tan HL, et al. Low rate of cardiac events in first-degree relatives of diagnosis-negative young sudden unexplained death syndrome victims during follow-up. *Heart Rhythm.* 2014;11(10):1728–1732

Telehealth: Improving Access to and Quality of Pediatric Health Care

- *Policy Statement*

POLICY STATEMENT Organizational Principles to Guide and Define the Child Health Care System and/or Improve the Health of all Children

American Academy of Pediatrics
DEDICATED TO THE HEALTH OF ALL CHILDREN™

Telehealth: Improving Access to and Quality of Pediatric Health Care

Alison L. Curfman MD, MBA, FAAP,[a] Jesse M. Hackell MD, FAAP,[b] Neil E. Herendeen MD, MS, FAAP,[c] Joshua J. Alexander MD, FAAP,[d] James P. Marcin MD, MPH, FAAP,[e] William B. Moskowitz MD, FAAP,[f] Chelsea E. F. Bodnar MD, MPhil, FAAP,[g] Harold K. Simon MD, MBA, FAAP,[h] S. David McSwain MD, FAAP,[i]
SECTION ON TELEHEALTH CARE, COMMITTEE ON PRACTICE AND AMBULATORY MEDICINE, COMMITTEE ON PEDIATRIC WORKFORCE

All children and adolescents deserve access to quality health care regardless of their race/ethnicity, health conditions, financial resources, or geographic location. Despite improvements over the past decades, severe disparities in the availability and access to high-quality health care for children and adolescents continue to exist throughout the United States. Economic and racial factors, geographic maldistribution of primary care pediatricians, and limited availability of pediatric medical subspecialists and pediatric surgical specialists all contribute to inequitable access to pediatric care. Robust, comprehensive telehealth coverage is critical to improving pediatric access and quality of care and services, particularly for under-resourced populations.

INTRODUCTION

The growth and development of telehealth, or the provision of health services remotely, reflects the evolution of health care delivery systems to adapt to new technology and the needs of the population. The exponential growth in the adoption and use of telehealth services during health care disruptions, such as the coronavirus disease 2019 (COVID-19) pandemic, highlights the need to clarify the goals and best practices for using telehealth in child health. This policy statement addresses how telehealth and telehealth policy can increase patient access to primary care and subspecialty pediatric expertise, support care coordinated within the medical home, and enhance communication and collaboration among clinicians and other stakeholders, resulting in cost-efficient, equitable, high-quality care. A forthcoming technical report will provide in-depth discussion of these issues as well as the limitations of telehealth care.

TELEHEALTH IN THE MEDICAL HOME

The pediatric medical home provides a centralized hub for a child's health care to ensure continuity and coordination of care.[1,2]

abstract

[a]Department of Pediatrics, Mercy Clinic, St Louis Missouri; [b]Department of Pediatrics, New York Medical College and Boston Children's Health Physicians, Pomona, New York; [c]Department of Pediatrics, Golisano Children's Hospital, University of Rochester Medical Center, Rochester, New York; [d]Departments of Physical Medicine and Rehabilitation and Pediatrics, School of Medicine, University of North Carolina, Chapel Hill, North Carolina; [e]Division of Pediatric Critical Care Medicine, Department of Pediatrics, University of California Davis and University of California Davis Children's Hospital, Sacramento, California; [f]Division of Pediatric Cardiology, Department of Pediatrics, Children's of Mississippi and University of Mississippi Medical Center, Jackson, Mississippi; [g]Robert Wood Johnson Foundation Clinical Scholars Program, University of Montana, Missoula, Montana; [h]Departments of Pediatrics and Emergency Medicine, School of Medicine, Emory University and Children's Healthcare of Atlanta, Atlanta, Georgia; and [i]Department of Pediatrics, Medical University of South Carolina, Charleston, South Carolina

Dr Curfman conceptualized, drafted, and critically revised the manuscript; Drs Hackell, Herendeen, Alexander, Marcin, Moskowitz, Simon, Bodnar, and McSwain drafted and critically revised the manuscript; and all authors approved the final manuscript as submitted and agree to be accountable for all aspects of the work.

Policy statements from the American Academy of Pediatrics benefit from expertise and resources of liaisons and internal (AAP) and

To cite: Curfman AL, Hackell JM, Herendeen NE, et al; AAP Section on Telehealth Care, Committee on Practice and Ambulatory Medicine, Committee on Pediatric Workforce. Telehealth: Improving Access to and Quality of Pediatric Health Care. *Pediatrics*. 2021;148(3):e2021053129

Telehealth is a critical infrastructure to efficiently implement the medical home model of care and provide high-value, coordinated, and unfragmented health care. Telehealth coordinated within the medical home will promote continuity of care in a cost-efficient manner and can reduce the risk of potential fraud and abuse from expansion of telehealth coverage.

Pediatric subspecialty care delivered remotely is important for evaluation, preoperative and postoperative surgical care, consultation, and management of complex conditions, especially when in-person care is limited by distance, specialist availability, or travel restrictions.[3,4] Telehealth can involve both the primary care and specialist physicians in care episodes to improve communications and care coordination.[5–7] Physician-to-physician consultation via telehealth can serve as both a consultative and an educational interaction, again increasing the access to specialist input for all caregivers.

These services include a continuum of remote and in-person care options, such as audiovisual, audio only (telephone), store and forward, portal interactions, and remote patient monitoring (particularly for children with complex or chronic illness). Telehealth is particularly important for children and youth with special health care needs who experience significant barriers to receiving necessary care.[8–11] Mental and behavioral health services are especially amenable to remote care and can also be provided as an extension of the medical home. Each of these modalities provides necessary care when the physician and patient cannot meet in person, or they can be used as an adjunct to in-person services.

IMPACT OF THE COVID-19 NATIONAL HEALTH EMERGENCY ON TELEHEALTH

When the health care system is disrupted, as during the COVID-19 pandemic, disparities in access to care can become even more problematic. Disruptions can result in neglect of serious medical conditions, as well as forgoing needed preventive care and immunizations. Missed opportunities for care can have serious immediate and long-term consequences for children's health, development, and welfare that are more severe for populations of children affected by inequities based on race and/or ethnicity, disability, geography, socioeconomic status, and payer policies.[3,12–16] For several years, telehealth has enabled pediatric medical and surgical specialists to offer consultative services to some patients who could not travel to access in-person care, but payment for telehealth services and adoption of these methods have been limited.

In 2020, public health mitigation measures to limit the spread of COVID-19 led to widespread disruptions of services, including pediatric health care. Changes in telehealth policy allowed children with acute and chronic illnesses to connect to their usual and familiar care sources for management of both acute illnesses and chronic diseases and disabilities. In many cases, preventive care was allowed and could be provided via a hybrid model that included a combination of virtual and in-person visits. Telehealth implementation was rapid and widespread. The adoption was made possible by policy changes supporting operations and payment for telehealth care at parity with in-person services, which were promoted by the Centers for Medicare and Medicaid Services, state governments, private payers, and Medicaid (including the Children's Health Insurance Program). The availability of telehealth care enabled greater access to care for many children and adolescents, but gaps in digital infrastructure continue to persist because of poverty, systemic racism, and other inequities, which were a barrier to equitable technology-enabled care.[3,8,10,12,13] The public health emergency led to significant reductions in inpatient, outpatient, and emergency department use, and telehealth played a key role in maintaining care for children and families who chose not to seek in-person care during this time.

PAYMENT FOR TELEHEALTH SERVICES

Recent telehealth payment policies, which were often proposed as temporary enhancements, may not persist in the future because payers who have expressed concerns about the potential for fraud, abuse, and overuse seek to return to previous policies requiring an in-person visit for payment of services. If payment for telehealth is denied because of restrictions on the location of the patient (for example, previous rules did not allow the patient to be located at home) or there is a lack of payment parity, use of these services will decrease over time, reducing access to necessary pediatric health services. The delivery of care determines the value of services provided, whether this delivery occurs by telehealth or in person. Telehealth is foundational to creating efficient, innovative, high-value care models in which patients get the right care at the right place at the right time, as well as investing in preventive care to reduce costly emergency department and hospital visits, all of which benefit all stakeholders in the health care system.

Evaluation and management coding guidelines determine the value of these health care services, and these guidelines apply equally to in-

person and remote care.[17] The time, effort, and medical decision-making required for a patient visit, as well as the associated malpractice risk and documentation requirements, are largely unchanged whether care is delivered virtually or in person. Telehealth visits that require conversion to an in-person evaluation because of the nature of the condition or limitations of the remote evaluation are currently paid as a single visit, which prevents duplicate expense for payers. However, use of telehealth in a traditional practice setting does not reduce the need for office overhead expenses and can increase costs associated with technology.

Remote care coordinated by the medical home can improve access to both primary and specialty care for children when an in-person visit is not possible. In the subspecialty care setting, follow-up care and monitoring of chronic conditions can increase the reach of pediatric medical subspecialists and surgical specialists, especially for children who were not able to access care in the past or who have difficulty visiting a care site because of distance or travel issues. Children with special health care needs have additional challenges receiving primary care, subspecialty care, home health, palliative and/or hospice care, education services, transition to adult care, and developmental and habilitative services, many of which can be improved with the integration of telehealth in the medical home.[18–20] Under-resourced communities can also have improved access to pediatric care, which requires adequate resource support for infrastructure to allow for equitable implementation.

Pediatricians providing remote care will be best able to ensure that these services meet the same standards of care as the services that they provide in person. Telehealth can help reduce inequities and improve children's overall health and well-being by expanding the reach of the medical home, particularly for children with special health care needs and children who have not had access to high-quality care in the past. Adequate payment for these services is necessary to ensure that they will continue to be available to children.

RECOMMENDATIONS

1. Health equity: Inequity in access to health care services for children is discriminatory and unacceptable because it results in unequal care and worse outcomes for children without access. Telehealth can decrease disparities in access to care by extending pediatric expertise and best practices to children no matter where they are located. Addressing barriers, such as language, digital literacy, disability, and access to and payment for technology infrastructure, is required to avoid furthering disparities.
2. Access to pediatric care: Telehealth can expand the footprint and breadth of pediatric medical and surgical specialties by bringing expertise to remote and under-resourced areas and efficiently directing patients to the most appropriate care settings. Appropriate payment for services that enhance the value of pediatric care through timely implementation of best practices and facilitating appropriate dispositions will further the implementation of these services. Including stakeholders across the continuum of care, including families, public health agencies such as the Maternal and Child Health Bureau, state and Title V agencies, and schools in the design of telehealth systems, will ensure that the impact of these systems will benefit all parties.
3. Payment reform:
   a. Payment for telehealth services at parity with the equivalent services provided in person by private insurers, Medicare, and Medicaid and/or Children's Health Insurance Program, including managed care arrangements, will allow the use of the most appropriate place of service for each encounter, as will inclusion of telehealth among the medically necessary services covered under the treatment provisions of Medicaid's Early and Periodic Screening, Diagnostic and Treatment law.
   b. Incentivizing and encouraging private insurance plans, including fully insured plans, Marketplace plans, and those covered by the Employee Retirement Income Security Act, to pay for telehealth services at parity with the equivalent in-person services will support broad use of telehealth care when appropriate, but state mandates may be required to ensure compliance.
   c. Technology can, in many situations, remove perceptions of a difference in value between services provided remotely and those provided in person and can provide greater value with the use of remote patient monitoring by preventing unnecessary emergency department and hospital use, especially in children and youth with special health care needs.
   d. Telehealth policy is a potent tool in reducing inequities in access to health care. Adequate and appropriate payment for remote services based on current and future payment models, including

fee-for-service, capitation, and value-based plans, will affect the potential impact of the use of telehealth services.

e. Children and youth with special health care needs, including those with mental and/or behavioral conditions and medical complexity, will require additional consideration for developing innovative payment structures that promote care integrated across settings that maximize value. Investment in telehealth and remote monitoring infrastructure, including devices and connectivity, for such populations is critical to providing equity in access to pediatric services. Medicaid payment structures (such as waivers and Health Homes), which are used to pay for services for specific populations, can also cover telehealth services in these populations.

4. Care within the medical home: Support for the use of telehealth within the medical home recognizes that the medical home offers continuity and the prudent use of health care resources, avoiding fragmented and episodic care delivered without such coordination.
5. Standards of quality care: All standards of quality apply equally to any patient encounter, whether remote or in person, including high-quality interpretation in the patient and family's preferred language. Adhering to quality standards also includes understanding of the situations when the necessary evaluation is not possible remotely, and an in-person visit is required, so that technical limitations of remote care do not compromise quality of care. National metrics of quality for telehealth, especially in linking to payment, are essential. Pediatricians are key stakeholders in developing these metrics for children.
6. Reduction of barriers: Geographical, economic, and administrative barriers to telehealth care, such as interstate licensure issues, may prevent physicians from providing care to their patients who may be temporarily located in a state in which the physician is not licensed, which may reduce access to and continuity of care.
7. Infrastructure: Lack of high-speed broadband Internet access and limited access to adequate technology impede the delivery of services via telehealth and further inequity in access to care. Every individual, especially those in under-resourced areas of the country, both urban and rural, deserves availability of and support for a reliable technology and telecommunications infrastructure, such as the Lifeline program,[16] to avoid furthering health care disparities.[15,21,22]
8. Federal research funding: Creation of an evidence base to address best practices, workforce needs, patient access to care, quality of care, reduction of health care costs, and patient and/or family and clinician satisfaction will enable future research to improve the function of and access to pediatric care via telehealth, including the impact of alternative payment and care delivery models that use telehealth and remote monitoring for children with special needs to integrate care across settings most effectively.

LEAD AUTHORS

Alison L. Curfman, MD, MBA, FAAP
Jesse M. Hackell, MD, FAAP
Neil E. Herendeen, MD, MS, FAAP
Joshua J. Alexander, MD, FAAP
James P. Marcin, MD, MPH, FAAP
William B. Moskowitz, MD, FAAP
Chelsea E.F. Bodnar, MD, MPhil, FAAP
Harold K. Simon, MD, MBA, FAAP
S. David McSwain, MD, FAAP

COMMITTEE ON PEDIATRIC WORKFORCE, 2019–2020

Harold K. Simon, MD, MBA, FAAP, Chairperson
Julie S. Byerley, MD, MPH, FAAP
Nancy A. Dodson, MD, FAAP
Eric N. Horowitz, MD, FAAP
Thomas W. Pendergrass, MD, MSPH, FAAP
Edward A. Pont, MD, FAAP
Kristin N. Ray, MD, FAAP
William B. Moskowitz, MD, FAAP, Immediate Past Chairperson

LIAISONS

Laurel K. Leslie, MD, MPH, FAAP – *American Board of Pediatrics*
Michelle M. Macias, MD, FAAP – *Section Forum Management Committee*

STAFF

Lauren F. Barone, MPH

SECTION ON TELEHEALTH CARE EXECUTIVE COMMITTEE, 2019–2020

S. David McSwain, MD, MPH, FAAP, Chairperson
Alison L. Curfman, MD, FAAP
Chelsea E.F. Bodnar, MD, MPhil, FAAP
Neal E. Herendeen, MD, FAAP
Jennifer L. Fang, MD, FAAP
Alison S. Brent, MD, FAAP

STAFF

Trisha M. Calabrese, MPH

COMMITTEE ON PRACTICE AND AMBULATORY MEDICINE, 2019–2020

Julia Richerson, MD, FAAP, Chairperson
Joseph J. Abularrage, MD, MPH, MPhil, FAAP
Yvette Almendarez, MD, FAAP

Alexy D. Arauz Boudreau, MD, MPH, FAAP
Abeba M. Berhane MD, FAAP
Patricia E Cantrell MD, FAAP
Jesse M. Hackell, MD, FAAP
Lisa M. Kafer, MD, FAAP
Robin Warner, MD, FAAP

FAMILY LIAISON

Alisa Skatrud

STAFF

Elisha Ferguson

ABBREVIATION

COVID-19: coronavirus disease 2019

FUNDING: Supported in part by the National Institutes of Health (NIH)/National Center for Advancing Translational Sciences–Supporting Pediatric Research on Outcomes and Utilization of Telehealth Clinical and Translation Science Awards Collaborative Telehealth Network grant U01TR002626. The content is solely the responsibility of the authors and does not necessarily represent the official views of the NIH. Funded by the National Institutes of Health (NIH).

Dr Curfman conceptualized, drafted, and critically revised the manuscript; Drs Hackell, Herendeen, Alexander, Marcin, Moskowitz, Simon, Bodnar, and McSwain drafted and critically revised the manuscript; and all authors approved the final manuscript as submitted and agree to be accountable for all aspects of the work.

DOI: https://doi.org/10.1542/peds.2021-053129

Address correspondence to Alison Curfman, MD, MBA, FAAP. E-mail: alison.curfman@mercy.net

PEDIATRICS (ISSN Numbers: Print, 0031-4005; Online, 1098-4275).

FINANCIAL DISCLOSURES: The authors have indicated they have no financial relationships relevant to this article to disclose.

FUNDING: Supported in part by the National Institutes of Health (NIH)/National Center for Advancing Translational Sciences–Supporting Pediatric Research on Outcomes and Utilization of Telehealth Clinical and Translation Science Awards Collaborative Telehealth Network grant U01TR002626. The content is solely the responsibility of the authors and does not necessarily represent the official views of the NIH. Funded by the National Institutes of Health (NIH).

POTENTIAL CONFLICTS OF INTEREST: Dr Hackell is an expert reviewer and provides testimony to various law firms; the other authors have indicated they have no potential conflicts of interest to disclose.

REFERENCES

1. Medical Home Initiatives for Children With Special Needs Project Advisory Committee. American Academy of Pediatrics. The medical home. *Pediatrics*. 2002;110(1 Pt 1):184–186
2. Conners GP, Kressly SJ, Perrin JM, Richerson JE, Sankrithi UM; COMMITTEE ON PRACTICE AND AMBULATORY MEDICINE; COMMITTEE ON PEDIATRIC EMERGENCY MEDICINE; SECTION ON TELEHEALTH CARE; SECTION ON EMERGENCY MEDICINE; SUBCOMMITTEE ON URGENT CARE; TASK FORCE ON PEDIATRIC PRACTICE CHANGE. Nonemergency acute care: when it's not the medical home. *Pediatrics*. 2017;139(5):e20170629
3. Curfman AL, Marcin JP. Pediatric emergency and critical care telemedicine. In: Rheuban KS, Krupinsky EA, eds. *Understanding Telehealth*. McGraw Hill Education: 2018. Available at: https://accessmedicine.mhmedical.com/content.aspx?bookid=2217§ionid=187795268. Accessed July 27, 2021
4. Olson CA, McSwain SD, Curfman AL, Chuo J. The current pediatric telehealth landscape. *Pediatrics*. 2018;141(3):e20172334 10.1542/peds.2017-2334
5. Satou GM, Rheuban K, Alverson D, et al; American Heart Association Congenital Cardiac Disease Committee of the Council on Cardiovascular Disease in the Young and Council on Quality Care and Outcomes Research. Telemedicine in pediatric cardiology: a scientific statement from the American Heart Association. *Circulation*. 2017;135(11):e648–e678
6. Shook LM, Farrell CB, Kalinyak KA, et al. Translating sickle cell guidelines into practice for primary care providers with Project ECHO. *Med Educ Online*. 2016;21:33616
7. Wood CL, Clements SA, McFann K, Slover R, Thomas JF, Wadwa RP. Use of telemedicine to improve adherence to American Diabetes Association standards in pediatric type I diabetes. *Diabetes Technol Ther*. 2016;18(1):7–14
8. Skinner AC, Slifkin RT. Rural/urban differences in barriers to and burden of care for children with special health care needs. *J Rural Health*. 2007;23(2):150–157
9. Herendeen N, Deshpande P. Telemedicine and the patient-centered medical home. *Pediatr Ann*. 2014;43(2):e28–e32
10. Marcin JP, Shaikh U, Steinhorn RH. Addressing health disparities in rural communities using telehealth. *Pediatr Res*. 2016;79(1-2):169–176
11. North SW, McElligot J, Douglas G, Martin A. Improving access to care through the patient-centered medical home. *Pediatr Ann*. 2014;43(2):e33–e38

12. França UL, McManus ML. Availability of definitive hospital care for children. *JAMA Pediatr.* 2017;171(9):e171096

13. França UL, McManus ML. Trends in regionalization of hospital care for common pediatric conditions. *Pediatrics.* 2018;141(1):e20171940

14. Lame M, Leyden D, Platt SL. Geocode maps spotlight disparities in telehealth utilization during the COVID-19 pandemic in New York City. *Telemed J E Health.* 2021;27(3):251–253

15. Nouri S, Khoong E, Lyles C, Karliner L. Addressing equity in telemedicine for chronic disease management during the Covid-19 pandemic. *NEJM Catalyst.* May 4, 2020. Available at: https://catalyst.nejm.org/doi/full/10.1056/CAT.20.0123. Accessed February 28, 2021

16. Patel SY, Mehrotra A, Huskamp HA, Uscher-Pines L, Ganguli I, Barnett ML. Variation in telemedicine use and outpatient care during the COVID-19 pandemic in the United States. *Health Aff (Millwood).* 2021;40(2):349–358

17. Centers for Medicare and Medicaid Services. Evaluation and management services guide. 2021. Available at: https://www.cms.gov/outreach-and-education/medicare-learning-network-mln/mlnproducts/downloads/eval-mgmt-serv-guide-icn006764.pdf. Accessed April 22, 2021

18. Hooshmand M, Yao K. Challenges facing children with special healthcare needs and their families: telemedicine as a bridge to care. *Telemed J E Health.* 2017;23(1):18–24

19. Boudreau AA, Perrin JM, Goodman E, Kurowski D, Cooley WC, Kuhlthau K. Care coordination and unmet specialty care among children with special health care needs. *Pediatrics.* 2014;133(6):1046–1053

20. Mosquera RA, Avritscher EB, Samuels CL, et al. Effect of an enhanced medical home on serious illness and cost of care among high-risk children with chronic illness: a randomized clinical trial. *JAMA.* 2014;312(24):2640–2648

21. Federal Communications Commission. Lifeline program for low-income consumers. Available at: https://www.fcc.gov/general/lifeline-program-low-income-consumers. Accessed March 2, 2021

22. Cahan EM, Mittal V, Shah NR, Thadaney-Israni S. Achieving a quintuple aim for telehealth in pediatrics. *Pediatr Clin North Am.* 2020;67(4):683–705

Topical Nasal Decongestant Oxymetazoline: Safety Considerations for Perioperative Pediatric Use

- *Clinical Report*

CLINICAL REPORT Guidance for the Clinician in Rendering Pediatric Care

American Academy of Pediatrics

DEDICATED TO THE HEALTH OF ALL CHILDREN™

Topical Nasal Decongestant Oxymetazoline: Safety Considerations for Perioperative Pediatric Use

Richard Cartabuke, MD, FAAP,[a] Joseph D. Tobias, MD, FAAP,[b] Kris R. Jatana, MD, FAAP[c]
SECTION ON ANESTHESIOLOGY AND PAIN MEDICINE, SECTION ON OTOLARYNGOLOGY–HEAD AND NECK SURGERY

The over-the-counter nasal decongestant oxymetazoline (eg, Afrin) is used in the pediatric population for a variety of conditions in the operating room setting. Given its vasoconstrictive properties, it can have cardiovascular adverse effects when systemically absorbed. There have been several reports of cardiac and respiratory complications related to use of oxymetazoline in the pediatric population. Current US Food and Drug Administration approval for oxymetazoline is for patients ≥6 years of age, but medical professionals may elect to use it short-term and off label for younger children in particular clinical scenarios in which the potential benefit may outweigh risks (eg, active bleeding, acute respiratory distress from nasal obstruction, acute complicated sinusitis, improved surgical visualization, nasal decongestion for scope examination, other conditions, etc). To date, there have not been adequate pediatric pharmacokinetic studies of oxymetazoline, so caution should be exercised with both the quantity of dosing and the technique of administration. In the urgent care setting, emergency department, or inpatient setting, to avoid excessive administration of the medication, medical professionals should use the spray bottle in an upright position with the child upright. In addition, in the operating room setting, both monitoring the quantity used and effective communication between the surgeon and anesthesia team are important. Further studies are needed to understand the systemic absorption and effects in children in both nonsurgical and surgical nasal use of oxymetazoline.

STATEMENT OF THE PROBLEM

To date, there are limited objective pediatric data on the safety and specific dosing of topical oxymetazoline (eg, Afrin), and an excessive

abstract

[a]Outpatient Anesthesia Services, [b]Department of Anesthesiology and Pain Medicine, Nationwide Children's Hospital and Department of Anesthesiology and Pain Medicine, The Ohio State University, Columbus, Ohio; and [c]Department of Pediatric Otolaryngology, Nationwide Children's Hospital and Department of Otolaryngology - Head and Neck Surgery, The Ohio State University, Columbus, Ohio

DOI: https://doi.org/10.1542/peds.2021-054271

Address correspondence to Richard Cartabuke, MD. Email: Richard.Cartabuke@Nationwidechildrens.org

To cite: Cartabuke R, Tobias JD, Jatana KR; AAP Section on Anesthesiology and Pain Medicine, Section on Otolaryngology–Head and Neck Surgery. Topical Nasal Decongestant Oxymetazoline: Safety Considerations for Perioperative Pediatric Use. *Pediatrics*. 2021;148(5):e2021054271

unmonitored volume of nasal use could lead to serious adverse effects in children.

BACKGROUND

Oxymetazoline hydrochloride 0.05% is the active ingredient in over-the-counter (OTC) nasal spray decongestants (eg, Afrin; Merck Schering-Plough Pharmaceuticals, North Wales, PA). It was first sold as a prescription medication in 1966 and then became available as an OTC medication in 1975. It is currently approved by the US Food and Drug Administration (FDA) for use in patients ≥6 years of age. Oxymetazoline is an α-adrenergic agonist with greater activity at the α2 versus α1 adrenergic receptor.[1] Its action at the peripheral α2-adrenergic receptor on the smooth muscle of the vasculature results in vasoconstriction, thereby defining its clinical utility as both a decongestant and a topical hemostatic agent. It is used off label in the operating room to prepare the nasal passages during nasal intubation and during ear, nose, and throat (ENT) surgery to improve visualization of the airway and to minimize intraoperative or postoperative bleeding.[2,3]

A superior efficacy and safety profile of oxymetazoline has been demonstrated when compared with other topical agents with vasoconstrictive properties, such as phenylephrine, epinephrine, or cocaine.[2–5] Riegle et al[3] compared the topical nasal mucosal applications of oxymetazoline (0.05%), phenylephrine (0.25%), and cocaine (4%) during functional endoscopic sinus surgery in children. Phenylephrine was associated with an increase in blood pressure (BP), and subjective evaluation of bleeding and surgical visualization was best with oxymetazoline. The authors concluded that oxymetazoline was the preferred vasoconstrictor in children. Higgins et al[4] reviewed the use of topical vasoconstrictors during ENT surgery. They compared the efficacy against the risks associated with the topical use of phenylephrine, cocaine, and oxymetazoline and proposed recommendations to reduce the incidence of systemic complications caused by these agents in the operating room. These authors recommended the use of 0.05% oxymetazoline as the initial vasoconstrictor in patients <12 years of age. Their protocol did not include a recommendation for the maximum volume of oxymetazoline.

Despite a long history of use and its potential advantages over other agents, data seem to be limited regarding the pharmacokinetics of oxymetazoline, including uptake when applied to mucosal membranes or the end-organ effects when used in average concentration and volume during the perioperative period. Although the package insert, anecdotal case reports, and various Web-based programs clearly outline the potential for hypertension and cardiac effects related to the use of this product, the authors of this report believe that there has not been effective emphasis placed on such information in the medical literature. Adverse effects may occur not only with excessive dosing but also when oxymetazoline is used within recommended guidelines. Furthermore, delivery from the commercially available bottle may be variable depending on the position of the bottle and the force with which it is squeezed.

Recently, there have been 2 case reports published regarding significant cardiovascular effects related to the routine perioperative use of this medication in healthy children.[6,7] Latham and Jardine[6] reported adverse effects of topical nasal oxymetazoline in a 14-kg 4-year-old boy during dental restoration. After anesthetic induction and before nasal intubation, both nares were sprayed with oxymetazoline 0.05%. The exact number of sprays was not clarified (merely, both nares were treated with oxymetazoline nasal spray). Approximately 5 minutes after endotracheal intubation, the child's BP, measured by a noninvasive BP cuff, increased from 110/52 to 170/110 mm Hg, with a decrease in heart rate from 118 to 65 beats per minute. The hypertension was treated by increasing the sevoflurane concentration; however, the BP remained elevated for up to 60 minutes, with the diastolic BP above 100 mm Hg for 30 minutes. Ramesh et al[7] reported a similar case that involved postoperative hypertension. The patient was a 14-kg 3-year-old boy who presented with chronic nasal obstruction secondary to inferior turbinate and adenoidal hypertrophy. After the induction of general anesthesia and endotracheal intubation for bilateral inferior turbinate reduction with out-fracturing of the turbinate, oxymetazoline-soaked pledgets were placed in both nares. Adenoidectomy was performed by using electrocautery, and hemostasis was augmented with topical application of oxymetazoline at the termination of the operation. The volume of oxymetazoline was not measured. At the completion of the procedure, the child was then transferred to the postanesthesia care unit (PACU). At the time of arrival to the PACU, bradycardia was noted with a heart rate of 48 beats per minute. The BP was 106/84 mm Hg. Bilateral breath sounds were confirmed by auscultation. Atropine (0.1 mg) was administered intravenously, after which the heart rate increased to 135 beats per minute and the BP increased to 166/129 mm Hg. The

oxymetazoline-soaked nasal pledgets were removed immediately, and 10 mg of propofol was administered. Hypertension persisted, and propofol was administered in incremental doses of 10 mg each. Because no direct-acting vasodilators (hydralazine) were immediately available in the freestanding outpatient surgery center, labetalol was administered intravenously in 1-mg increments to a total of 2 mg. The BP and heart rate remained elevated, but at a lower range. During the next hour, the heart rate and BP gradually normalized to their baseline values. No further hypertension was noted during this patient's PACU stay or after discharge during follow-up with his pediatrician.

These 2 case reports and others from the literature demonstrate the potential toxicity from OTC oxymetazoline, which may be dosed without attention to the volume administered. These concerns are not limited to its perioperative administration because toxicity has been reported with its use for routine indications, including as a nasal decongestant. Although used for its topical effects, vascular absorption of oxymetazoline can have profound systemic effects (most commonly, hypertension related to its action on the α2-adrenergic receptors of the smooth muscle of the vasculature). When used in even larger doses in young children, oxymetazoline can activate central adrenergic receptors and lead to serious adverse effects, including cardiovascular instability, respiratory depression, and sedation, which may be potentially life-threatening.[8–11] In 2012, similar adverse events, secondary to accidental ingestion by children 5 years and younger, were reviewed by the FDA, and the FDA included a list of products like oxymetazoline that should be stored out of the reach and out of sight of children at all times.[12] In these reported cases, children were found to be chewing or sucking on the medication bottle or were found to have an empty bottle next to them.[12]

Imidazole derivatives, such as oxymetazoline, are rapidly absorbed across mucosal membranes in children. Hence, toxicity generally develops within minutes, but resolution may take up to 24 hours.[9,10] Exposure to different imidazoline derivatives was reviewed in 72 children between 2 months and 13 years of age, and most children who had adverse effects were younger than 3 years of age.[13] Giannakopoulos et al[14] studied the cardiovascular effects and pharmacokinetics of an intranasal 3% tetracaine and 0.05% oxymetazoline spray at 2 different dose levels in adult dental patients. The authors administered what they considered to be the maximum recommended dose (MRD) of 18 mg of tetracaine and 0.3 mg of oxymetazoline to 12 volunteers. The medication was sprayed onto the nasal mucosa. One to 3 weeks later, twice the dose (36 mg of tetracaine and 0.6 mg of oxymetazoline) was administered. Physiologic measures remained fairly stable throughout the 2-hour period, with no clinical concerns in the patients and no clinically significant differences between the 2 groups. However, the medications were administered over 8 minutes and 20 minutes in the group that received the MRD and the group that received twice the MRD, respectively, rather than the short-term instillation period typically used for ENT surgery, which may explain the lack of changes in BP and heart rate. Tetracaine plasma levels were undetectable in the majority of the participants, but concentrations of oxymetazoline in the group that received twice the MRD were approximately 50% greater than those in the group that received the MRD. The plasma half-life of oxymetazoline was reported to vary from 1.72 to 2.32 hours. However, there are limited pharmacokinetic data in the pediatric population. In a recent prospective pharmacokinetic study of 27 pediatric patients, researchers measured serum concentrations after administration using soaked cotton pledgets during sinus surgery, adenoidectomy, and turbinate reduction. The authors noted lower systemic absorption than that reported with administration from the bottle (spray technique). No significant hemodynamic changes were noted, and no correlation of hemodynamic changes with serum concentrations was noted. Although preliminary, the authors suggest that the extreme systemic effects that have been reported may be related to variable systemic absorption rates and serum concentrations when oxymetazoline is applied in a more diffuse spray technique compared with soaked cotton pledgets, or it is possible that these responses are idiosyncratic and unrelated to delivery techniques and serum concentrations.[15] Additional research is needed to further delineate these factors.

Various studies have demonstrated alarming information regarding alteration of the delivery of oxymetazoline depending on the position of the bottle. The first of these reports, by Latham and Jardine,[6] demonstrated a fact that had previously received no attention in the literature. There was up to a 75-fold increase in the volume of medication administered when the bottle was held inverted. Given the supine position of patients on the operating room table, it is common practice to hold the bottle inverted and squeeze it. Although squeezing the bottle in the upright position

resulted in a mist with the delivery of 28.9 ± 6.8 μL of fluid, the average volume delivered with the bottle inverted was 1037 ± 527 μL (range 473–2196 μL). With the bottle upright, the amount delivered is effort independent; however, it becomes effort dependent when the bottle is inverted and squeezed. Latham and Jardine[6] also demonstrated that each surgical pledget could hold a significant vol (1511 ± 184 μL), a fact that may further increase delivery during ENT surgery. Two additional sets of investigators have confirmed these findings and have also demonstrated significant interindividual variability in the amount delivered based on effort.[16,17] Oxymetazoline is only intended for short-term use of $<$5 days' duration because the medication can cause rebound nasal congestion and lead to rhinitis medicamentosa with long-term use. In addition, systemic side effects and end-organ injury are unknown with long-term use because only animal studies are available at this time.[18] Given the recent reports in the literature, it seems that the time has come to develop guidelines for the dosing of oxymetazoline in children, especially infants and toddlers.[19–22]

EXISTING GUIDELINES AND JOINT COMMISSION RECOMMENDATIONS

To the authors' knowledge, no published sources of formal practice guidelines or recommendations currently exist for nasal use of topical oxymetazoline. From a Joint Commission general medication standpoint, hospitals, including operating rooms, are required to document the safe administration of medications in the medical record, which includes verification of correct patient, strength, dose, route, labeling, date, and time.[23]

REVIEW OF EVIDENCE

Unfortunately, pediatric pharmacokinetic data on which to base guidelines for use of topical nasal oxymetazoline are limited. The package inserts recommend 2 to 3 sprays into each nostril for patients $\geq$6 years of age. On the basis of data from Latham and Jardine,[6] which demonstrate that each upright spray delivers 30 μL, this would be a total maximum dose of 180 μL, which is far less than the amount held by 1 pledget or the amount delivered by a single spray from an inverted bottle (1 ± 0.5 mL).

Because topical nasal decongestant oxymetazoline is an OTC medication, pediatric complications related to its use may be underappreciated. Given its nasal delivery via a spray mechanism or soaked cotton pledgets, attention to exact dosing or a process to monitor the dose of oxymetazoline given is frequently absent. There are several reports of morbidity, and until additional pediatric data are available, it appears that it is essential to establish a general consensus for responsible use.

CONCLUSIONS

The American Academy of Pediatrics recommends the following for short-term pediatric topical nasal oxymetazoline use:

General Considerations

1. Because limited data exist, remind pediatricians, advanced practice providers, anesthesiologists, and surgeons of the limited available data for use of OTC oxymetazoline in patients $<$6 years of age. Although the current FDA approval is for patients $\geq$6 years of age, medical professionals do elect to use it off label in children $<$6 years of age for specific conditions in which the potential benefit may outweigh risk (eg, active bleeding, acute respiratory distress from nasal obstruction, acute complicated sinusitis, improved surgical visualization, nasal decongestion for scope examination, other conditions, etc). Providers should be aware of potential adverse cardiovascular effects of an unmonitored volume of administration, which may be most relevant in infants or young children and those with comorbid cardiac conditions.
2. Because of the variable dosing risk, be aware that use of oxymetazoline in the supine position with the spray bottle inverted can result in a significantly higher dose (approximately 1 ± 0.5 mL administered per spray), as compared with the spray bottle in an upright position, which results in 30 μL (0.03 mL) per spray. When possible, to avoid excessive nasal dose administration, use the spray bottle in an upright position with child also upright.

Surgeon, Anesthesiologist, and Operating Room Personnel: Surgical Considerations

1. Avoid administration of an unmonitored medication volume. During a surgical procedure, implement a reliable process to keep track of the total volume of medication that is administered.
2. Effective communication between the surgeon and anesthesiologist should occur with intraoperative use of these medications. Routine monitoring of heart rate, BP, and respiration through the intraoperative and postoperative period is essential. If a second medication bottle needs to be opened for use during a case, ensure that the anesthesiologist is aware.
3. Remove excess medication from pharynx. Both during and at the end of the procedure, suction excess medication that has pooled in the nasopharynx and oropharynx to avoid additional potential mucosal absorption.

Future Perspectives

Encourage the initiation of additional pharmacokinetic trials of topical nasal oxymetazoline in the pediatric patient population, including for both surgical and nonsurgical use. In young children, consider evaluation of the hemostatic efficacy of a half-strength concentration of the agent compared with the full-strength concentration.

Lead Authors

Richard Cartabuke, MD, FAAP
Joseph D. Tobias, MD, FAAP
Kris R. Jatana, MD, FAAP

Section on Anesthesiology and Pain Medicine Executive Committee, 2020–2021

Anita Honkanen, MD, FAAP, Chairperson
Mary Landrigan-Ossar, MD, PhD, FAAP, Chairperson-Elect
Debnath Chatterjee, MD, FAAP
Christina Diaz, MD, FAAP
Stephen Hays, MD, FAAP
Lisa Wise-Faberowski, MD, FAAP
Raeford Brown, MD, FAAP, Immediate Past Chairperson

Liaisons

Nina Deutsch, MD – *Society for Pediatric Anesthesia*
Adam C. Adler, MD, MS, FAAP – *American Academy of Pediatrics Committee on Drugs*
Sulpicio G. Soriano, MD, FAAP – *American Society of Anesthesiologists Committee on Pediatric Anesthesia*
Rita Agarwal, MD, FAAP – *Society for Pediatric Pain Medicine*

Staff

Jennifer G. Riefe, MEd

Section on Otolaryngology–Head and Neck Surgery Executive Committee, 2020–2021

Steven Sobol, MD, FAAP, Chair
Kristina Rosbe, MD, FAAP, Immediate Past Chair
Cristina Baldassari, MD, FAAP
G. Paul Digoy, MD, FAAP
Kris R. Jatana, MD, FAAP
Peggy Elaine Kelley, MD, FAAP
Anna Meyer, MD, FAAP
Eileen Margolies Raynor, MD, FAAP
Brian Reilly, MD, FAAP
Jeffrey Simons, MD, FAAP

Staff

Vivian B. Thorne

ABBREVIATIONS

BP: blood pressure
ENT: ear, nose, and throat
FDA: US Food and Drug Administration
MRD: maximum recommended dose
OTC: over-the-counter
PACU: postanesthesia care unit

FINANCIAL DISCLOSURE: The authors have indicated they have no financial relationships relevant to this article to disclose.

FUNDING: No external funding.

POTENTIAL CONFLICT OF INTEREST: Dr Jatana is a stockholder for Tivic Health Systems; Drs Cartabuke and Tobias have indicated they have no potential conflicts of interest to disclose.

REFERENCES

1. Haenisch B, Walstab J, Herberhold S, et al. Alpha-adrenoceptor agonistic activity of oxymetazoline and xylometazoline. *Fundam Clin Pharmacol.* 2010;24(6):729–739
2. Katz RI, Hovagim AR, Finkelstein HS, Grinberg Y, Boccio RV, Poppers PJ. A comparison of cocaine, lidocaine with epinephrine, and oxymetazoline for prevention of epistaxis on nasotracheal intubation. *J Clin Anesth.* 1990;2(1):16–20
3. Riegle EV, Gunter JB, Lusk RP, Muntz HR, Weiss KL. Comparison of vasoconstrictors for functional endoscopic sinus surgery in children. *Laryngoscope.* 1992;102(7):820–823
4. Higgins TS, Hwang PH, Kingdom TT, Orlandi RR, Stammberger H, Han JK. Systematic review of topical vasoconstrictors in endoscopic sinus surgery. *Laryngoscope.* 2011;121(2):422–432
5. Maze M, Smith CM. Identification of receptor mechanism mediating epinephrine-induced arrhythmias during halothane anesthesia in the dog. *Anesthesiology.* 1983;59(4):322–326
6. Latham GJ, Jardine DS. Oxymetazoline and hypertensive crisis in a child: can we prevent it? *Paediatr Anaesth.* 2013;23(10):952–956
7. Ramesh AS, Cartabuke R, Essig C, Tobias JD. Oxymetazoline-induced postoperative hypertension. *Pediatric Anesthesia and Critical Care Journal.* 2013;1(2):72–77
8. Fabi M, Formigari R, Picchio FM. Are nasal decongestants safer than rhinitis? A case of oxymetazoline-induced syncope. *Cardiol Young.* 2009;19(6):633–634
9. Higgins GL III, Campbell B, Wallace K, Talbot S. Pediatric poisoning from over-the-counter imidazoline-containing products. *Ann Emerg Med.* 1991;20(6):655–658
10. Mahieu LM, Rooman RP, Goossens E. Imidazoline intoxication in children. *Eur J Pediatr.* 1993;152(11):944–946
11. Jensen P, Edgren B, Hall L, Ring JC. Hemodynamic effects following ingestion of an imidazoline-containing product. *Pediatr Emerg Care.* 1989;5(2):110–112
12. US Food and Drug Administration. FDA drug safety communication: serious adverse events from accidental ingestion by children of over-the-counter eye

drops and nasal sprays. 2012. Available at: https://www.fda.gov/drugs/drug-safety-and-availability/fda-drug-safety-communication-serious-adverse-events-accidental-ingestion-children-over-counter-eye. Accessed July 7, 2019

13. Bucaretchi F, Dragosavac S, Vieira RJ. Acute exposure to imidazoline derivatives in children [in Portuguese]. *J Pediatr (Rio J)*. 2003;79(6):519–524
14. Giannakopoulos H, Levin LM, Chou JC, et al. The cardiovascular effects and pharmacokinetics of intranasal tetracaine plus oxymetazoline: preliminary findings. *J Am Dent Assoc*. 2012;143(8):872–880
15. Cartabuke RS, Anderson BJ, Elmaraghy C, Rice J, Tumin D, Tobias JD. Hemodynamic and pharmacokinetic analysis of oxymetazoline use during nasal surgery in children. *Laryngoscope*. 2019;129(12):2775–2781
16. Hakim M, Walia H, Rafiq M, Grannell T, Cartabuke RS, Tobias JD. Oxymetazoline metered dose spray: factors affecting delivery volume. *J Pediatr Pharmacol Ther*. 2016;21(3):247–251
17. Nordt SP, Vivero LE, Cantrell FL. Not just a drop in the bucket-inversion of oxymetazoline nasal decongestant container increases potential for severe pediatric poisoning. *J Pediatr*. 2016;168:240–241
18. Dokuyucu R, Gokce H, Sahan M, et al. Systemic side effects of locally used oxymetazoline. *Int J Clin Exp Med*. 2015;8(2):2674–2678
19. Eddy O, Howell JM. Are one or two dangerous? Clonidine and topical imidazolines exposure in toddlers. *J Emerg Med*. 2003;25(3):297–302
20. Liebelt EL, Shannon MW. Small doses, big problems: a selected review of highly toxic common medications. *Pediatr Emerg Care*. 1993;9(5):292–297
21. Thrush DN. Cardiac arrest after oxymetazoline nasal spray. *J Clin Anesth*. 1995;7(6):512–514
22. Glazener F, Blake K, Gradman M. Bradycardia, hypotension, and near-syncope associated with Afrin (oxymetazoline) nasal spray. *N Engl J Med*. 1983;309(12):731
23. "Medication Management," "Record of Care, Treatment and Services," "National Patient Safety Goals" chapters. Joint Commission Comprehensive Accreditation Manual. E-dition, Joint Commission Resources. Effective July 1, 2021. Available at: https://store.jcrinc.com/e-dition-/. Accessed September 28, 2021

Transition to a Safe Home Sleep Environment for the NICU Patient

- *Clinical Report*

CLINICAL REPORT Guidance for the Clinician in Rendering Pediatric Care

American Academy of Pediatrics

DEDICATED TO THE HEALTH OF ALL CHILDREN™

Transition to a Safe Home Sleep Environment for the NICU Patient

Michael H. Goodstein, MD, FAAP,[a,b] Dan L. Stewart, MD, FAAP,[c] Erin L. Keels, DNP, APRN-CNP, NNP-BC,[d,e]

Rachel Y. Moon, MD, FAAP,[f] COMMITTEE ON FETUS AND NEWBORN, TASK FORCE ON SUDDEN INFANT DEATH SYNDROME

Of the nearly 3.8 million infants born in the United States in 2018, 8.3% had low birth weight (ie, weight <2500 g) and 10% were born preterm (ie, gestational age of <37 weeks). Ten to fifteen percent of infants (approximately 500 000 annually), including low birth weight and preterm infants and others with congenital anomalies, perinatally acquired infections, and other diseases, require admission to a NICU. Every year, approximately 3600 infants in the United States die of sudden unexpected infant death (SUID), including sudden infant death syndrome (SIDS), unknown and undetermined causes, and accidental suffocation and strangulation in an unsafe sleep environment. Preterm and low birth weight infants are 2 to 3 times more likely than healthy term infants to die suddenly and unexpectedly. Thus, it is important that health care professionals prepare families to maintain their infant in a safe home sleep environment as per recommendations of the American Academy of Pediatrics. Medical needs of the NICU infant often require practices such as nonsupine positioning, which should be transitioned as soon as medically possible and well before hospital discharge to sleep practices that are safe and appropriate for the home environment. This clinical report outlines the establishment of appropriate NICU protocols for the timely transition of these infants to a safe home sleep environment. The rationale for these recommendations is discussed in the accompanying technical report "Transition to a Safe Home Sleep Environment for the NICU Patient," included in this issue of *Pediatrics*.

abstract

[a]Division of Newborn Services, WellSpan Health, York, Pennsylvania; [b]Department of Pediatrics, College of Medicine, The Pennsylvania State University, Hershey, Pennsylvania; [c]Department of Pediatrics, Norton Children's and School of Medicine, University of Louisville, Louisville, Kentucky; [d]National Association of Neonatal Nurse Practitioners, National Association of Neonatal Nurses, Chicago, Illinois; [e]Neonatal Advanced Practice, Nationwide Children's Hospital, Columbus, Ohio; and [f]Division of General Pediatrics, School of Medicine, University of Virginia, Charlottesville, Virginia

Drs Goodstein and Stewart conceptualized, conducted the literature search, wrote and revised the manuscript, and considered input from all reviewers and the board of directors; Dr Keels conducted the literature search, wrote and revised the manuscript, and considered input from all reviewers and the board of directors; Dr Moon conceptualized and revised the manuscript and considered input from all reviewers and the board of directors; and all authors approved the final manuscript as submitted and take responsibility for the final publication.

To cite: Goodstein MH, Stewart DL, Keels EL, et al; AAP COMMITTEE ON FETUS AND NEWBORN, TASK FORCE ON SUDDEN INFANT DEATH SYNDROME. Transition to a Safe Home Sleep Environment for the NICU Patient. *Pediatrics*. 2021;148(1):e2021052045

INTRODUCTION

Sudden unexpected infant death (SUID), including sudden infant death syndrome (SIDS), is the leading cause of postneonatal mortality in the United States. In up to 95% of these cases, there are one or more environmental risk factors identified.[1] Preterm and low birth weight infants are 2 to 3 times more likely than healthy term infants to die

suddenly and unexpectedly,[2,3] so it is particularly important to model a safe home sleep environment in the NICU before a neonate is discharged from the hospital. The American Academy of Pediatrics (AAP), through the Committee on Fetus and Newborn, has recommended since 2008 that preterm infants be transitioned to a predominantly supine position by a postmenstrual age of 32 weeks to promote safe sleep, a recommendation supported by the AAP Task Force on Sudden Infant Death Syndrome (henceforth, "task force").[2,4,5] Because the recommendations for infant sleep safety at home also include other postnatal environmental factors (eg, use of a firm, flat sleep surface, avoidance of loose bedding or soft objects, a neutral thermal environment, room sharing without bed sharing, smoke-free environment), safe sleep recommendations for NICU patients should also address these factors. Recognizing that not all infants are ready for such a sleep environment by 32 weeks' postmenstrual age, the task force recommends transitioning the infant to the safe home sleep practices as soon as he or she is medically stable and significantly before the anticipated discharge from the hospital.[4]

Studies have shown that NICU providers do not consistently support infant sleep safety recommendations.[5–7] Researchers in a 2016 study of 96 NICU nurses found that only 53% strongly agreed that safe sleep recommendations make a difference in preventing SIDS, and only 20% strongly agreed that parents would model nurses' behaviors at home.[7] However, research from the well-baby nursery, community settings, and the NICU demonstrate that safe sleep education and modeling in these sites translate into increased knowledge and improved safe sleep practices among new parents.[8–11]

This clinical report reviews the evidence for common NICU sleep practices and provides guidance for transitioning the infant to a sleep environment that is safe and appropriate for the home environment.

SLEEP POSITION

Since 1992, back sleeping has been recommended for the reduction of sleep-related deaths. This recommendation, in conjunction with the Back to Sleep campaign in 1994, resulted in SIDS rates in the United States decreasing by 53% by 1999.[12] Prone and side sleep positions are associated with an increased risk of SIDS, and neither are recommended.[4] The risk of SIDS for preterm and low birth weight infants in the prone position is potentially greater than that of healthy term infants.[4,13] However, there are a number of scenarios in the NICU in which nonsupine positioning is applied for potential therapeutic benefit. Nonsupine positioning in the NICU in all cases can be used as a teachable moment with the family regarding eventual readiness for safe infant sleep positioning and environment.

Respiratory Distress and Chronic Lung Disease

Prone positioning is commonly used in infants with both acute and chronic respiratory distress. Preterm infants in the prone position have improved oxygenation and pulmonary function, including dynamic lung compliance and tidal volume, as well as less intrapulmonary shunting and improved thoraco-abdominal synchrony.[14–16] In the supine position, some lung tissue is dependent to the heart and mediastinal structures, increasing potential for atelectasis. In addition, in the supine position, abdominal contents may limit ventilation through opposition to the excursion of the diaphragm.[14,17] A Cochrane review of positioning for acute respiratory distress in infants and children found small but statistically significant improvements in oxygenation and tachypnea with prone positioning.[18] The benefit of prone positioning during the acute phase of respiratory disease (when infants are closely monitored) may outweigh the importance of modeling safe sleep positioning in the extremely preterm infant.

Data are more limited regarding potential benefits of prone positioning in the preterm infant with evolving chronic lung disease. The studies are small and have shown conflicting results.[19–23] One study found higher oxygen saturations and functional residual capacity in the prone position but no difference in compliance or resistance in oxygen-dependent infants.[19] Another study found prone positioning increased tidal volumes and minute ventilation but also increased work of breathing.[22] Although undefined, at some point the diminishing benefits of prone positioning are outweighed by the concern of reinforcing a sleep position that increases the risk of SUID.

Airway Abnormalities

Although uncommon, there are congenital airway abnormalities that result in respiratory compromise, and some infants with these conditions may benefit from prone positioning. The benefit of prone positioning is particularly relevant in Pierre Robin sequence, in which there is gravity-dependent tongue-based obstruction.[24] Although infants with mild cases of Pierre Robin sequence will be stable sleeping supine and infants with severe cases will have early surgical

intervention, intermediate cases may be more challenging and achieve relief with prone positioning until they outgrow their airway obstruction.

Apnea of Prematurity

Some studies have suggested that the frequency and severity of apnea of prematurity may be decreased through prone positioning, but these studies showed mild benefit and were limited by small sample size.[25,26] More recent studies have disputed this conclusion.[27,28] A 2017 Cochrane review found no statistical differences in apnea, bradycardia, or oxygen saturations and concluded that body position was not relevant to controlling apnea frequency.[29] Nonsupine positioning should not be used as a strategy to decrease apnea of prematurity.

Gastroesophageal Reflux

Positioning has often been touted as a treatment of gastroesophageal reflux disease (GERD), but the risk of sudden unexpected death has decreased enthusiasm for this strategy. The AAP agrees with the recommendation of both the North American Society for Pediatric Gastroenterology, Hepatology and Nutrition and the European Society for Pediatric Gastroenterology, Hepatology and Nutrition "not to use positional therapy (ie, head elevation, elevation of the head of the crib, lateral and prone positioning) to treat symptoms of GERD in sleeping infants."[30] Studies have suggested less reflux when the infant is in the prone position versus the supine position, so it is acceptable to place an awake infant prone after feeding if the infant is continuously monitored.[31,32] Although gastric emptying may be improved by placing the infant in the right lateral position, some studies have demonstrated that when preterm infants are placed in the left lateral position after feeding, there is a decrease in the number of transient relaxations of the lower esophageal sphincter.[32–35] However, infants should not be placed in an inclined or nonsupine position for sleep as treatment of GERD.

Hyperbilirubinemia

Prone positioning is sometimes used in alternation with supine positioning while infants are being treated with phototherapy for hyperbilirubinemia. However, a systematic review found supine positioning was equally effective to periodically turning infants.[36] The National Institute for Health and Clinical Excellence (NICE) in the United Kingdom stated that positioning has no significant influence on the mean change in serum bilirubin concentration or the duration of phototherapy for infants born at term.[37] As such, the NICE recommends infants be placed in the supine position while being treated with phototherapy to ensure consistent advice about SIDS risk.[37] Since the NICE recommendation, a study of infants born at ≥33 weeks' gestation compared supine with alternating positioning and found identical rates of decrease in total serum bilirubin concentration at 12 and 24 hours after initiation of phototherapy.[38] The consistency of the results in both term and preterm infants confirm that barring another medical condition requiring prone position, hyperbilirubinemia should be treated routinely in the supine position.

Neonatal Opioid Withdrawal Syndrome

The infant with neonatal opioid withdrawal syndrome (NOWS) is generally treated with supportive, nonpharmacologic care designed to minimize stimulation and to support the infant's self-regulation.[39,40] In one study, prone positioning was associated with decreased severity of NOWS scores and reduced caloric intake.[41] Although prone positioning may be useful for monitored inpatients during the acute withdrawal phase of NOWS, it should be discontinued when possible and before hospital discharge to decrease SUID risk.

BEDDING AND POSITIONERS

Per AAP recommendations, infants at home should be placed on a flat, firm sleep surface (ie, crib, bassinet, portable crib, or play yard that conforms to the safety standards of the Consumer Product Safety Commission)[2,42,43] covered by a fitted sheet with no other bedding. Because soft bedding and loose objects in the sleep environment can obstruct the infant's airway, increasing the risk of rebreathing, SIDS, and suffocation,[44–52] these items should not be in the sleep environment. Although bedding and positioners are often used for developmentally sensitive care and for treatment of plagiocephaly, these items should be removed from the sleep environment.

Developmentally Sensitive Care

Developmentally sensitive care is an important therapeutic intervention for preterm and other ill infants. However, because such care often may be inconsistent with provisions for a safe infant home sleep environment, staff should use demonstration of these techniques as a teachable moment with the family regarding eventual readiness for safe infant sleep positioning and environment.

Developmentally sensitive care refers to a broad category of

interventions designed to minimize the stress of the extrauterine environment and optimize the physical and neurodevelopmental outcomes for preterm and ill neonates.[53,54] These may include therapeutic positioning, swaddling, or other strategies. Although there is controversy regarding the effectiveness of formalized programs for developmentally sensitive care, components of these approaches may improve short-term outcomes. Integration of developmentally sensitive care has been endorsed by professional organizations, such as the National Association of Neonatal Nurses, with development of guidelines and quality metrics.[54–64]

Therapeutic positioning keeps the infant contained and maintains the fetal midline position of flexion to support comfort and self-regulation.[55–59] This positioning may involve the time-limited use of positioning devices, including blanket rolls and commercially available products. Without support from these devices, the preterm infant will lie flat and asymmetric with hips and joints abducted with abnormal rotation. Over time, this may lead to musculoskeletal and neurodevelopmental abnormalities, including upper extremity hyperabduction and flexion and generalized muscular rigidity.[55] Positioning devices are incompatible with a safe home sleep environment and, although the AAP encourages transitioning to a safe sleep environment at 32 weeks' postmenstrual age, not all infants will have achieved positional stability by this age, resulting in wide interpretation at the bedside.[7,65–67] Through quality improvement research, some centers have developed programs for consistent timing and increased compliance with safe sleep recommendations[8,11,68–73] (see section on A Rational Approach to Transition of the NICU Patient to a Home Sleep Environment).

Positional or Deformational Plagiocephaly

Positional or deformational plagiocephaly (DP) (most commonly unilateral flattening of the parieto-occipital region, with compensatory anterior shift of the ipsilateral ear and anterior displacement of the ipsilateral forehead) results from unevenly distributed external pressure resulting in abnormal head shape.[74] DP is common in the NICU and may occur secondary to limitations on positioning, muscle tone, nursing care practices, and other medical conditions.[75,76] Preterm infants are more susceptible to developing plagiocephaly attributable to decreased mineralization of the skull bones, increased prone positioning, placing the infant repeatedly on the same side and slower motor development. Although pediatric occupational and physical therapists frequently use a variety of positioning devices and supports to correct DP (and the often accompanying torticollis),[77–80] these products should be removed before hospital discharge, because they are contrary to home safe sleep recommendations. Thus, home therapy should be limited to creating a nonrestrictive environment that promotes spontaneous physical movement and symmetrical motor development.[81,82]

As infants who require developmentally sensitive care or treatment of DP mature and approach discharge readiness, an interdisciplinary, collaborative, and thoughtful approach is required to determine how and when positioning devices should be discontinued and removed to achieve a safe home sleep environment. In addition, communication with and education of the infant's family are crucial to promote understanding of safe sleep practices and decrease the inappropriate use of the devices after hospital discharge.

SKIN-TO-SKIN CARE AND THE USE OF A SEPARATE SLEEP SURFACE

The benefits of skin-to-skin care (SSC) are numerous and include improved initiation and maintenance of breastfeeding, thermoregulation and glucose homeostasis, decreased crying, and cardiorespiratory stability.[83–87] In preterm infants, SSC improves autonomic and neurobehavioral maturation and results in better sleep patterns and growth.[58,88] However, there are potential complications, including infant falls and sudden unexpected postnatal collapse, when SSC is not appropriately monitored. When SSC is performed in the NICU, close monitoring is important, and the parent should be educated about the dangers of sharing a sleep surface, whether in the hospital or home. Although parents may unintentionally fall asleep with their infant at home, this is especially dangerous with the preterm or low birth weight infant.[3,13,89] Thus, it is important to reinforce safe sleep education when mothers are rooming-in with their infants and are not under the constant observation of NICU staff. The risk of falls and sudden unexpected postnatal collapse should be mitigated by conducting frequent assessments and monitoring of the mother-infant dyad for maternal fatigue. If the caregiver is becoming drowsy while caring for the infant, then the infant should

be moved to a separate sleep surface.[87]

THERMOREGULATION

In the NICU, thermoregulation issues tend to focus on the prevention of hypothermia, because it is well established that achieving normothermia optimizes outcomes, including reductions in mortality. Preterm infants have more difficulty with thermoregulation than term infants; however, this improves with maturation.[90] Although weight-based criteria for weaning from the incubator to open bassinet varies among NICUs, a Cochrane review found that transfer out of thermoregulatory support at a weight of 1600 g did not adversely affect temperature stability or weight gain.[91–94]

As preterm infants stabilize in an open environment, attention should be redirected from hypothermia to modeling safe sleep with the prevention of overheating and overbundling. Families should be educated on evaluating the infant for signs of overheating, such as sweating or the torso feeling hot to the touch.[2] Parents should also be warned about the potential for head covering, including hats, to contribute to overheating and thermal stress. A recent article found that in a large cohort of preterm infants, the failure rate attributable to hypothermia for transitioning out of supplemental heat without a hat was 2.7%.[95] Given the questionable benefit of hat use and the potential for overheating with head coverings, clinicians should carefully weigh the risks and benefits regarding the discharge of an infant from the NICU with a hat. If the infant is discharged wearing a hat during sleep, the clinician should provide education to the family regarding discontinuation once the infant achieves stable temperatures in the home environment. This should include education about how to determine that the infant's temperature is stable.

SWADDLING

In the NICU, swaddling, or the snug wrapping of an infant in a light blanket, is an important part of developmentally sensitive care. When swaddled, preterm infants should be placed in the supine position, have their hands brought to midline under the chin, and hips and knees should be in the flexed position and able to move freely.[96] Swaddling may be useful in helping preterm infants maintain a normal temperature.

Swaddling is also commonly used in the care of infants with NOWS. Although no studies specifically address swaddling in this population, it has been suggested that it is beneficial in decreasing excessive crying and promotion of sleep.[39,40] This may be related to inhibition of the Moro reflex when swaddling with the arms tucked in the swaddle.

When infants are swaddled, wearable blankets (which often have a swaddle wrap component) are preferred to conventional blankets for providing warmth while preventing head covering. Proper swaddling technique should allow the hips to be flexed and abducted to reduce the risk of exacerbating developmental dysplasia of the hip.[97]

Because there is a much greater risk of sudden unexpected death if infants are swaddled and then placed in a nonsupine position,[97–100] care must be taken to always place swaddled infants supine. In addition, when the infant begins to attempt to roll over, swaddling should be discontinued.

HUMAN MILK AND BREASTFEEDING

There are numerous benefits to breastfeeding, including decreased risk of infection and decreased risk of allergies, asthma, eczema, obesity, inflammatory bowel disease, high cholesterol, type 1 diabetes mellitus, SIDS, and possibly some childhood cancers.[101–104] In the preterm infant, human milk has also been shown to improve feeding tolerance and reduce the risk of necrotizing enterocolitis.[105–108]

Given both the early and long-term benefits for the preterm infant, clinicians should provide family education on the importance of human milk on admission to the NICU or earlier if possible.[109] Multidisciplinary teams should be available to support breastfeeding and expression and provision of mother's milk, not just during the hospitalization but also after discharge for the transition to direct breastfeeding at home.[110,111]

A RATIONAL APPROACH TO TRANSITION OF THE NICU PATIENT TO A HOME SLEEP ENVIRONMENT

Programs to model and teach safe infant sleep in both the newborn nursery and the NICU have been developed.[8,11,68–73,112,113] These programs typically include standardized policies for infant sleep safety consistent with AAP recommendations, education for both staff and families, visible educational prompts, modeling of safe sleep, and audits for quality improvement. One NICU study demonstrated maintenance of improvement at 6-month audits after intervention, with 98% of infants lying supine in open cribs, 93% in a wearable blanket, and 88% of bassinets with a visible safe sleep card.[71] Furthermore, standardized programs have been associated with higher rates of supine sleep and other safe sleep behaviors in the home.[11,72,73]

One of the challenges in transitioning the NICU patient to a safe home

sleep environment relates to resolving therapeutic positioning practices for the infant that are inconsistent with sleep safety at home. Although the AAP through its Committee on Fetus and Newborn recommends that "hospitalized preterm infants should be kept predominantly in the supine position, at least from the postmenstrual age of 32 weeks onward, so that they become acclimated to supine sleeping before discharge,"[5] not all infants will be clinically ready to be maintained in such a sleep environment at that age. To manage clinical variability, algorithms have been developed on the basis of literature review, expert opinion, and unit consensus.[11,114] Quality improvement programs using these algorithms have demonstrated more consistent modeling in the NICU and improved parental adherence with safe sleep practices after hospital discharge.[11,114] In one study, 2 Massachusetts community NICUs improved overall adherence with practices consistent with sleep safety at home from 25.9% to 79.7% ($P < .001$),[114] and this standardized approach to integrating these safe sleep practices into routine NICU care was adopted by all NICUs statewide.[115] In another study, a decision-guiding algorithm led to significant improvement in both NICU staff and parental compliance, with safe sleep practices in the home increasing from 23% to 82% ($P < .001$).[11]

Creating a culture of infant sleep safety in the NICU setting can be challenging. Resistance to change is common, so consensus-building is essential to success. An algorithm such as that published by Gelfer et al[11] can be used as a starting point for the input of a multidisciplinary team including all of those involved with the care of the infant, including but not limited to physicians, advanced practice providers, nursing staff, lactation consultants, respiratory therapists, and developmental therapists (physical therapy, occupational therapy, speech therapy).

Clinicians must address the acute physiologic needs of the NICU infant; incremental transition to a safe home sleep environment can begin as these needs resolve. Because preterm infants are at increased risk of SUID, clinicians should provide regular, repetitive, and consistent safe sleep education with families throughout the hospitalization. Through messaging with not only words but also modeling behaviors, clinicians will enable NICU families to be better prepared for the transition to a safe home sleep environment.

RECOMMENDATIONS

Overall recommendations for transition to safe home sleep for the NICU patient are provided below. Table 1 summarizes transition issues as pertaining to infant sleep safety.

1. The intensive care nursery should develop a safe sleep policy incorporating the points below, with the goal of transitioning the infant to a safe home sleep environment consistent with the recommendations of the AAP Task Force on SIDS.[8,69,72,112,113,116–120]
2. The NICU should use an algorithm for routine and repeated evaluation of each NICU infant for safe home sleep readiness.[11,114,115]
3. Incremental implementation of components of a safe sleep environment can be implemented for NICU infants not ready to completely transition to a safe home sleep environment (eg, the infant may be ready for supine positioning but may still need positioners for plagiocephaly).[11,114,115]
4. All staff involved in the care of NICU infants should receive education on and maintain expertise in infant sleep safety, including the AAP recommendations, hospital policy, and transitional algorithm.*
5. Family education regarding infant sleep safety should be provided early and often throughout the hospital course.† Multiple communication strategies (bedside cards, whiteboards) should be used to increase parental awareness and provide anticipatory guidance for NICU infants who are not clinically ready to transition to a safe home sleep environment. One example is a bedside card denoting that the infant is receiving therapeutic positioning because of prematurity or illness.[11,114,115,121]
6. When the infant is deemed ready for transition to a safe home sleep environment, the therapeutic positioning card should be replaced with messaging that the infant is now being maintained in a safe sleep environment.[11,114,115,121]
7. When the infant transitions to the safe home sleep environment, consideration should be given to using this opportunity to provide formal safe sleep education for the family and celebrate the event on par with a developmental milestone.[11,114,115,121]
8. If an infant has a clinical deterioration after going into a safe home sleep environment, then therapeutic positioning may need to be reinstituted. As soon as the infant is clinically stable again, he or she should be

*Refs 8, 11, 69, 72, 73, 112–115, 118, and 120–123.
†Refs 8, 11, 68–70, 72, 112, 113, 118–120, and 122–125.

TABLE 1 NICU Transition to a Safe Home Sleep Environment

Respiratory distress[11,14,16,17,24,66,112,114]
- a. For the infant with acute respiratory distress, regardless of gestational age, nonsupine positioning may be used as clinically indicated to stabilize/improve respiratory function.
- b. If nonsupine positioning is used, especially as the infant matures, parents should be educated about infant home sleep safety and the reasons for using therapeutic positioning.
- c. Once the acute respiratory distress is resolving, the infant should be placed supine for modeling infant home sleep safety, and the parents should receive additional education before hospital discharge.
- d. For infants who have developed chronic lung disease, periodic assessments should be performed to monitor the infant's progress. Once the infant has weaned to a standardized minimal supplemental respiratory support (determined by the individual institution), then supine positioning can be maintained, and parents should receive additional education before hospital discharge.
- e. The management of the infant with upper airway obstruction needs to be individualized on the basis of the severity of the obstruction. Nonsupine positioning may be necessary to prevent excessive hypercarbia or hypoxemia and consideration should be given to home monitoring of the marginal airway.

Apnea of prematurity[27–29,134]
- a. There is inadequate evidence to justify the use of prone positioning for the treatment of apnea of prematurity.
- b. For more information on apnea of prematurity, please refer to the clinical report on apnea of prematurity from the AAP.[134]

Gastroesophageal reflux and GERD[4,30,33]
- a. Gastroesophageal reflux is extremely common in infants in the NICU.
- b. Because of the increased risk of SUID, infants with gastroesophageal reflux or GERD should not have the head of the bed elevated, nor should they be laid down on their side or prone.
- c. For more information refer to the clinical report on gastroesophageal reflux in the preterm infant by the AAP.

Hyperbilirubinemia and phototherapy[36,38,135,136]
- a. There is no benefit to changing infant position while undergoing phototherapy.
- b. Unless there are other competing medical issues, infants should be kept supine while receiving phototherapy to model and promote infant home sleep safety.

NOWS[2,39–41]
- a. There are some commonly used therapeutic interventions in the treatment of NOWS (ie, prone positioning) that are not consistent with infant home sleep safety.
- b. Early and frequent education is critical to prevent families from thinking that the proper use of therapeutic interventions in the hospital can be replicated in the home environment.
- c. The use of therapeutic interventions that are not consistent with infant home sleep safety should be minimized. When interventions are necessary, it is important to review their use and attempt to transition to a safe home sleep environment as soon as clinically stable.
- d. Clear, consistent, safe home sleep messaging should be emphasized repeatedly with families of infants with NOWS throughout the hospitalization.

Developmentally sensitive care[11,71,112,114,119]
- a. Developmentally sensitive care is an important component to the health and well-being of the preterm infant.
- b. Although many of the tools and therapies used to promote developmentally sensitive care are not consistent with a safe home sleep environment for infants, parental observation of these techniques can serve as a teachable moment for eventual safe sleep readiness.
- c. It is important to transition infants to a safe home sleep environment as early as possible before NICU discharge.
- d. Good communication with the use of a multidisciplinary team is key for consistent transitioning of NICU patients to a safe infant home sleep environment (see A Rational Approach to Transition of the NICU Patient to a Home Sleep Environment for details).

DP and torticollis[2,77–82]
- a. Positioning devices recommended by qualified personnel, such as but not limited to occupational and physical therapists, can be used to prevent, control, and correct DP and torticollis while infants are under continuous monitoring in the NICU.
- b. Parents need to be educated regarding the use of sleep positioning devices: that their use is limited to the inpatient setting under strict monitoring, and that they are not part of a safe home sleep environment.
- c. Education regarding tummy time should emphasize that it be performed during awake, supervised periods only and never when the infant is asleep, even with "close" supervision.

Thermoregulation[2,90,94,99,100,137–140]
- a. Preterm and low birth weight infants are prone to temperature instability and may require additional bundling to avoid hypothermia.
- b. Excessive bundling needs to be avoided because overheating and head covering have been associated with an increased risk of SUID.
- c. If an infant is discharged wearing a hat, families should be counseled to discontinue its use once the infant demonstrates temperature stability in the home environment.
- d. If swaddling is performed, it is important that it is done properly, the infant is always placed supine, and it is discontinued before the infant is able to roll over.

DDH[97–100]
- a. Infants are frequently swaddled in the NICU when approaching hospital discharge; however, improper swaddling can lead to or exacerbate DDH. Proper swaddling technique should allow the hips to be flexed and abducted.
- b. Parents should be well-educated about all safety issues regarding swaddling, in particular the increased risk of SUID with nonsupine positioning.
- c. For more information refer to the clinical report on DDH by the AAP.

Human milk and breastfeeding[2,87,89,101–104,110,111]
- a. The use of human milk is recommended for its numerous health benefits, including a reduced risk for SIDS.
- b. Special care should be taken when mothers are rooming-in and breastfeeding to minimize the risk of falling asleep with the infant in the adult bed.
- c. Provide mothers with appropriate outpatient support to optimize breastfeeding success after hospital discharge.

DDH, developmental dysplasia of the hip.

returned to a safe home sleep environment.[11,114,115,121]

9. Before hospital discharge, all NICU families should receive standardized safe infant sleep education and be queried about a safe home sleep environment followed by applicable counseling.‡
10. If the family does not have the means for a safe home sleep environment, then a referral should be made to social work for assistance and/or referral to resources that can provide cribs or portable play yards at low or no cost.[126–129]
11. Crib audits should be an integral component of a NICU safe sleep program to monitor success or identify areas for improvement. Consider the use of run charts to allow staff to see real-time feedback on whether an intervention is working. This is integral for determining the need for and implementation of plan-do-study-act cycles.§
12. Consideration should be given to incorporating safe sleep education into the electronic medical record. Examples include assessments for a safe sleeping home environment and alerts to perform the assessment and complete the education.[130–133]
13. Include primary and ancillary care providers and neurodevelopmental teams in preparation for a smooth transition to home that includes maintenance and reinforcement of a safe home sleep environment.

LEAD AUTHORS

Michael H. Goodstein, MD, FAAP
Dan L. Stewart, MD, FAAP
Erin L. Keels, DNP, APRN, NNP-BC
Rachel Y. Moon, MD, FAAP

COMMITTEE ON FETUS AND NEWBORN, 2019–2020

James Cummings, MD, FAAP, Chairperson
Ivan Hand, MD, FAAP
Ira Adams-Chapman, MD, MD, FAAP
Susan W. Aucott, MD, FAAP
Karen M. Puopolo, MD, FAAP
Jay P. Goldsmith, MD, FAAP
David Kaufman, MD, FAAP
Camilia Martin, MD, FAAP
Meredith Mowitz, MD, FAAP

LIAISONS

Timothy Jancelewicz, MD, FAAP – *American Academy of Pediatrics Section on Surgery*
Michael Narvey, MD – *Canadian Paediatric Society*
Russell Miller, MD – *American College of Obstetricians and Gynecologists*
RADM Wanda Barfield, MD, MPH, FAAP – *Centers for Disease Control and Prevention*
Lisa Grisham, APRN, NNP-BC – *National Association of Neonatal Nurses*

STAFF

Jim Couto, MA

TASK FORCE ON SUDDEN INFANT DEATH SYNDROME

Rachel Y. Moon, MD, FAAP, Chairperson
Elie Abu Jawdeh, MD, PhD, FAAP
Rebecca Carlin, MD, FAAP
Jeffrey Colvin, MD, JD, FAAP
Michael H. Goodstein, MD, FAAP
Fern R. Hauck, MD, MS

CONSULTANTS

Elizabeth Bundock, MD, PhD – *National Association of Medical Examiners*
Lorena Kaplan, MPH – *Eunice Kennedy Shriver National Institute for Child Health and Human Development*
Sharyn Parks Brown, PhD, MPH – *Centers for Disease Control and Prevention*
Marion Koso-Thomas, MD, MPH – *Eunice Kennedy Shriver National Institute for Child Health and Human Development*
Carrie K. Shapiro-Mendoza, PhD, MPH – *Centers for Disease Control and Prevention*

STAFF

James Couto, MA

ABBREVIATIONS

AAP: American Academy of Pediatrics
DP: deformational plagiocephaly
GERD: gastroesophageal reflux disease
NICE: National Institute for Health and Clinical Excellence
NOWS: neonatal opioid withdrawal syndrome
SIDS: sudden infant death syndrome
SSC: skin-to-skin care
SUID: sudden unexpected infant death

DOI: https://doi.org/10.1542/peds.2021-052045

Address correspondence to Michael Goodstein, MD. Email: mgoodstein@wellspan.org

PEDIATRICS (ISSN Numbers: Print 0031-4005; Online, 1098-4275).

FINANCIAL DISCLOSURE: The authors have indicated they have no financial relationships relevant to this article to disclose.

FUNDING: No external funding.

POTENTIAL CONFLICT OF INTEREST: The authors have indicated they have no potential conflicts of interest to disclose.

‡Refs 8, 69, 72, 112, 113, 119, 120, and 122–125.
§Refs 11, 69, 73, 112–115, 118, 119, 121, 122, and 125.

REFERENCES

1. Ostfeld BM, Esposito L, Perl H, Hegyi T. Concurrent risks in sudden infant death syndrome. *Pediatrics*. 2010;125(3):447–453
2. Moon RY; Task Force on Sudden Infant Death Syndrome. SIDS and other sleep-related infant deaths: evidence base for 2016 updated recommendations for a safe infant sleeping environment. *Pediatrics*. 2016;138(5):e20162940
3. Malloy MH. Prematurity and sudden infant death syndrome: United States 2005-2007. *J Perinatol*. 2013;33(6):470–475
4. Moon RY; Task Force on Sudden Infant Death Syndrome. SIDS and other sleep-related infant deaths: updated 2016 recommendations for a safe infant sleeping environment. *Pediatrics*. 2016;138(5):e20162938
5. American Academy of Pediatrics Committee on Fetus and Newborn. Hospital discharge of the high-risk neonate. *Pediatrics*. 2008;122(5):1119–1126
6. Aris C, Stevens TP, Lemura C, et al. NICU nurses' knowledge and discharge teaching related to infant sleep position and risk of SIDS. *Adv Neonatal Care*. 2006;6(5):281–294
7. Barsman SG, Dowling DA, Damato EG, Czeck P. Neonatal nurses' beliefs, knowledge, and practices in relation to sudden infant death syndrome risk-reduction recommendations. *Adv Neonatal Care*. 2015;15(3):209–219
8. Srivatsa B, Eden AN, Mir MA. Infant sleep position and SIDS: a hospital-based interventional study. *J Urban Health*. 1999;76(3):314–321
9. Moon RY, Oden RP, Grady KC. Back to Sleep: an educational intervention with women, infants, and children program clients. *Pediatrics*. 2004;113(3, pt 1):542–547
10. Rasinski KA, Kuby A, Bzdusek SA, Silvestri JM, Weese-Mayer DE. Effect of a sudden infant death syndrome risk reduction education program on risk factor compliance and information sources in primarily black urban communities. *Pediatrics*. 2003;111(4, pt 1). Available at: www.pediatrics.org/cgi/content/full/111/4/e347
11. Gelfer P, Cameron R, Masters K, Kennedy KA. Integrating "Back to Sleep" recommendations into neonatal ICU practice. *Pediatrics*. 2013;131(4). Available at: www.pediatrics.org/cgi/content/full/131/4/e1264
12. Centers of Disease Control and Prevention. Linked birth/infant death records on CDC WONDER online database. Available at: https://wonder.cdc.gov/controller/datarequest/D23. Accessed July 2, 2020
13. Oyen N, Markestad T, Skaerven R, et al. Combined effects of sleeping position and prenatal risk factors in sudden infant death syndrome: the Nordic Epidemiological SIDS Study. *Pediatrics*. 1997;100(4):613–621
14. Wagaman MJ, Shutack JG, Moomjian AS, Schwartz JG, Shaffer TH, Fox WW. Improved oxygenation and lung compliance with prone positioning of neonates. *J Pediatr*. 1979;94(5):787–791
15. Kassim Z, Donaldson N, Khetriwal B, et al. Sleeping position, oxygen saturation and lung volume in convalescent, prematurely born infants. *Arch Dis Child Fetal Neonatal Ed*. 2007;92(5):F347–F350
16. Wolfson MR, Greenspan JS, Deoras KS, Allen JL, Shaffer TH. Effect of position on the mechanical interaction between the rib cage and abdomen in preterm infants. *J Appl Physiol (1985)*. 1992;72(3):1032–1038
17. Albert RK, Hubmayr RD. The prone position eliminates compression of the lungs by the heart. *Am J Respir Crit Care Med*. 2000;161(5):1660–1665
18. Gillies D, Wells D, Bhandari AP. Positioning for acute respiratory distress in hospitalised infants and children. *Cochrane Database Syst Rev*. 2012;(7):CD003645
19. Bhat RY, Leipälä JA, Singh NR, Rafferty GF, Hannam S, Greenough A. Effect of posture on oxygenation, lung volume, and respiratory mechanics in premature infants studied before discharge. *Pediatrics*. 2003;112(1, pt 1):29–32
20. Elder DE, Campbell AJ, Galletly D. Effect of position on oxygen saturation and requirement in convalescent preterm infants. *Acta Paediatr*. 2011;100(5):661–665
21. Levy J, Habib RH, Liptsen E, et al. Prone versus supine positioning in the well preterm infant: effects on work of breathing and breathing patterns. *Pediatr Pulmonol*. 2006;41(8):754–758
22. Hutchison AA, Ross KR, Russell G. The effect of posture on ventilation and lung mechanics in preterm and light-for-date infants. *Pediatrics*. 1979;64(4):429–432
23. Leipälä JA, Bhat RY, Rafferty GF, Hannam S, Greenough A. Effect of posture on respiratory function and drive in preterm infants prior to discharge. *Pediatr Pulmonol*. 2003;36(4):295–300
24. Insalaco LF, Scott AR. Peripartum management of neonatal Pierre Robin sequence. *Clin Perinatol*. 2018;45(4):717–735
25. Kurlak LO, Ruggins NR, Stephenson TJ. Effect of nursing position on incidence, type, and duration of clinically significant apnoea in preterm infants. *Arch Dis Child Fetal Neonatal Ed*. 1994;71(1):F16–F19
26. Heimler R, Langlois J, Hodel DJ, Nelin LD, Sasidharan P. Effect of positioning on the breathing pattern of preterm infants. *Arch Dis Child*. 1992;67(3):312–314
27. Bhat RY, Hannam S, Pressler R, Rafferty GF, Peacock JL, Greenough A. Effect of prone and supine position on sleep, apneas, and arousal in preterm infants. *Pediatrics*. 2006;118(1):101–107
28. Keene DJ, Wimmer JEJ Jr, Mathew OP. Does supine positioning increase apnea, bradycardia, and desaturation in preterm infants? *J Perinatol*. 2000;20(1):17–20
29. Ballout RA, Foster JP, Kahale LA, Badr L. Body positioning for spontaneously breathing preterm infants with apnoea. *Cochrane Database Syst Rev*. 2017;(1):CD004951
30. Rosen R, Vandenplas Y, Singendonk M, et al. Pediatric gastroesophageal reflux clinical practice guidelines: joint recommendations of the North American Society for Pediatric Gastroenterology, Hepatology, and Nutrition and the European Society for Pediatric Gastroenterology, Hepatology, and Nutrition. *J Pediatr Gastroenterol Nutr*. 2018;66(3):516–554
31. Bhat RY, Rafferty GF, Hannam S, Greenough A. Acid gastroesophageal reflux in convalescent preterm infants: effect

of posture and relationship to apnea. *Pediatr Res*. 2007;62(5):620–623

32. Corvaglia L, Rotatori R, Ferlini M, Aceti A, Ancora G, Faldella G. The effect of body positioning on gastroesophageal reflux in premature infants: evaluation by combined impedance and pH monitoring. *J Pediatr*. 2007;151(6):591–596, 596.e1
33. Eichenwald EC; Committee on Fetus And Newborn. Diagnosis and management of gastroesophageal reflux in preterm infants. *Pediatrics*. 2018;142(1):e20181061
34. Omari TI, Rommel N, Staunton E, et al. Paradoxical impact of body positioning on gastroesophageal reflux and gastric emptying in the premature neonate. *J Pediatr*. 2004;145(2):194–200
35. van Wijk MP, Benninga MA, Dent J, et al. Effect of body position changes on postprandial gastroesophageal reflux and gastric emptying in the healthy premature neonate. *J Pediatr*. 2007;151(6):585–590, 590.e1–2
36. Lee Wan Fei S, Abdullah KL. Effect of turning vs. supine position under phototherapy on neonates with hyperbilirubinemia: a systematic review. *J Clin Nurs*. 2015;24(5–6):672–682
37. National Institute for Health and Care Excellence. *Clinical Guideline 98: Jaundice in Newborn Babies Under 28 Days*. London, United Kingdom: National Institute for Health and Care Excellence; 2016
38. Donneborg ML, Knudsen KB, Ebbesen F. Effect of infants' position on serum bilirubin level during conventional phototherapy. *Acta Paediatr*. 2010;99(8):1131–1134
39. Edwards L, Brown LF. Nonpharmacologic management of neonatal abstinence syndrome: an integrative review. *Neonatal Netw*. 2016;35(5):305–313
40. Ryan G, Dooley J, Gerber Finn L, Kelly L. Nonpharmacological management of neonatal abstinence syndrome: a review of the literature. *J Matern Fetal Neonatal Med*. 2018;32(10):1735–1740
41. Maichuk GT, Zahorodny W, Marshall R. Use of positioning to reduce the severity of neonatal narcotic withdrawal syndrome. *J Perinatol*. 1999;19(7):510–513
42. US Consumer Product Safety Commission. *CPSC Document #5030, Crib Safety Tips: Use Your Crib Safely*. Washington, DC: US Consumer Product Safety Commission. Available at: https://www.cpsc.gov/safety-education/safety-guides/cribs/crib-safety-tips
43. Moon RY; Task Force on Sudden Infant Death Syndrome. SIDS and other sleep-related infant deaths: expansion of recommendations for a safe infant sleeping environment. *Pediatrics*. 2011;128(5). Available at: www.pediatrics.org/cgi/content/full/128/5/e1341
44. Kemp JS, Nelson VE, Thach BT. Physical properties of bedding that may increase risk of sudden infant death syndrome in prone-sleeping infants. *Pediatr Res*. 1994;36(1, pt 1):7–11
45. Hauck FR, Herman SM, Donovan M, et al. Sleep environment and the risk of sudden infant death syndrome in an urban population: the Chicago Infant Mortality Study. *Pediatrics*. 2003;111(5, pt 2):1207–1214
46. Scheers NJ, Dayton CM, Kemp JS. Sudden infant death with external airways covered: case-comparison study of 206 deaths in the United States. *Arch Pediatr Adolesc Med*. 1998;152(6):540–547
47. Chiodini BA, Thach BT. Impaired ventilation in infants sleeping facedown: potential significance for sudden infant death syndrome. *J Pediatr*. 1993;123(5):686–692
48. Sakai J, Kanetake J, Takahashi S, Kanawaku Y, Funayama M. Gas dispersal potential of bedding as a cause for sudden infant death. *Forensic Sci Int*. 2008;180(2-3):93–97
49. Shapiro-Mendoza CK, Camperlengo L, Ludvigsen R, et al. Classification system for the sudden unexpected infant death case registry and its application. *Pediatrics*. 2014;134(1). Available at: www.pediatrics.org/cgi/content/full/134/1/e210
50. Kanetake J, Aoki Y, Funayama M. Evaluation of rebreathing potential on bedding for infant use. *Pediatr Int*. 2003;45(3):284–289
51. Kemp JS, Thach BT. Quantifying the potential of infant bedding to limit CO2 dispersal and factors affecting rebreathing in bedding. *J Appl Physiol (1985)*. 1995;78(2):740–745
52. Patel AL, Harris K, Thach BT. Inspired CO(2) and O(2) in sleeping infants rebreathing from bedding: relevance for sudden infant death syndrome. *J Appl Physiol (1985)*. 2001;91(6):2537–2545
53. Coughlin M, Gibbins S, Hoath S. Core measures for developmentally supportive care in neonatal intensive care units: theory, precedence and practice. *J Adv Nurs*. 2009;65(10):2239–2248
54. Symington A, Pinelli J. Developmental care for promoting development and preventing morbidity in preterm infants. *Cochrane Database Syst Rev*. 2006;(2):CD001814
55. Encyclopedia on Early Childhood Development. Individualized developmental care for preterm infants. 2017. Available at: www.child-encyclopedia.com/sites/default/files/textes-experts/en/809/individualized-developmental-care-for-preterm-infants.pdf. Accessed July 27, 2020
56. Johnston C, Campbell-Yeo M, Disher T, et al. Skin-to-skin care for procedural pain in neonates. *Cochrane Database Syst Rev*. 2017;(2):CD008435
57. Conde-Agudelo A, Belizán JM, Diaz-Rossello J. Kangaroo mother care to reduce morbidity and mortality in low birthweight infants. *Cochrane Database Syst Rev*. 2011;(3):CD002771
58. Baley J; Committee on Fetus And Newborn. Skin-to-skin care for term and preterm infants in the neonatal ICU. *Pediatrics*. 2015;136(3):596–599
59. Shah PS, Herbozo C, Aliwalas LL, Shah VS. Breastfeeding or breast milk for procedural pain in neonates. *Cochrane Database Syst Rev*. 2012;(12):CD004950
60. Laffin M. *Position Paper: NICU Developmental Care*. Lonedell, MO: National Perinatal Association; 2008
61. Kenner C, McGrath J, eds. *Developmental Care of Newborns and Infants*. 2nd ed. Chicago, IL: National Association of Neonatal Nurses; 2015
62. Altimier L, Kenner C, Damus K. The Wee Care Neuroprotective NICU Program (Wee Care): the effect of a comprehensive developmental care training program on seven neuroprotective core measures for family-centered developmental care of

premature neonates. *Newborn Infant Nurs Rev.* 2015;15(1):6–16

63. Milette I, Martel MJ, Ribeiro da Silva M, Coughlin McNeil M. Guidelines for the institutional implementation of developmental neuroprotective care in the neonatal intensive care unit. Part A: background and rationale. A joint position statement from the CANN, CAPWHN, NANN, and COINN. *Can J Nurs Res.* 2017;49(2):46–62
64. National Association of Neonatal Nurses. *Age-Appropriate Care of the Premature and Critically Ill Hospitalized Infant: Guideline for Practice.* Glenview, IL: National Association of Neonatal Nurses; 2011
65. Patton C, Stiltner D, Wright KB, Kautz DD. Do nurses provide a safe sleep environment for infants in the hospital setting? An integrative review. *Adv Neonatal Care.* 2015;15(1):8–22
66. McMullen SL. Transitioning premature infants supine: state of the science. *MCN Am J Matern Child Nurs.* 2013;38(1):8–12; quiz 13–14
67. Grazel R, Phalen AG, Polomano RC. Implementation of the American Academy of Pediatrics recommendations to reduce sudden infant death syndrome risk in neonatal intensive care units: An evaluation of nursing knowledge and practice. *Adv Neonatal Care.* 2010;10(6):332–342
68. Stastny PF, Ichinose TY, Thayer SD, Olson RJ, Keens TG. Infant sleep positioning by nursery staff and mothers in newborn hospital nurseries. *Nurs Res.* 2004;53(2):122–129
69. Mason B, Ahlers-Schmidt CR, Schunn C. Improving safe sleep environments for well newborns in the hospital setting. *Clin Pediatr (Phila).* 2013;52(10):969–975
70. Colson ER, Bergman DM, Shapiro E, Leventhal JH. Position for newborn sleep: associations with parents' perceptions of their nursery experience. *Birth.* 2001;28(4):249–253
71. McMullen SL, Lipke B, LeMura C. Sudden infant death syndrome prevention: a model program for NICUs. *Neonatal Netw.* 2009;28(1):7–12
72. Goodstein MH, Bell T, Krugman SD. Improving infant sleep safety through a comprehensive hospital-based program. *Clin Pediatr (Phila).* 2015;54(3):212–221
73. Kellams A, Parker MG, Geller NL, et al. TodaysBaby quality improvement: safe sleep teaching and role modeling in 8 US maternity units. *Pediatrics.* 2017;140(5):e20171816
74. Rogers GF. Deformational plagiocephaly, brachycephaly, and scaphocephaly. Part I: terminology, diagnosis, and etiopathogenesis. *J Craniofac Surg.* 2011;22(1):9–16
75. Graham JM Jr, Kreutzman J, Earl D, Halberg A, Samayoa C, Guo X. Deformational brachycephaly in supine-sleeping infants. *J Pediatr.* 2005;146(2):253–257
76. Hummel P, Fortado D. Impacting infant head shapes. *Adv Neonatal Care.* 2005;5(6):329–340
77. Madlinger-Lewis L, Reynolds L, Zarem C, Crapnell T, Inder T, Pineda R. The effects of alternative positioning on preterm infants in the neonatal intensive care unit: a randomized clinical trial. *Res Dev Disabil.* 2014;35(2):490–497
78. Drake E. *Positioning the Neonate for Best Outcomes Monograph.* Glenview, IL: National Association of Neonatal Nurses; 2017
79. Lockridge T, Podruchny A, Thorngate I. *Developmental Care CNE Learning Module Series: Infant Sleep Protocols.* Glenview, IL: National Association of Neonatal Nurses; 2018
80. Hunter J. *Developmental Care CNE Learning Module Series: Therapeutic Positioning: Neuromotor, Physiologic, and Sleep Implications.* Glenview, IL: National Association of Neonatal Nurses; 2018
81. Aarnivala H, Vuollo V, Harila V, Heikkinen T, Pirttiniemi P, Valkama AM. Preventing deformational plagiocephaly through parent guidance: a randomized, controlled trial. *Eur J Pediatr.* 2015;174(9):1197–1208
82. Klimo P Jr, Lingo PR, Baird LC, et al. Congress of Neurological Surgeons systematic review and evidence-based guideline on the management of patients with positional plagiocephaly: the role of repositioning. *Neurosurgery.* 2016;79(5):E627–E629
83. Moore ER, Anderson GC, Bergman N, Dowswell T. Early skin-to-skin contact for mothers and their healthy newborn infants. *Cochrane Database Syst Rev.* 2012;(5):CD003519
84. Feldman R, Weller A, Sirota L, Eidelman AI. Skin-to-skin contact (Kangaroo care) promotes self-regulation in premature infants: sleep-wake cyclicity, arousal modulation, and sustained exploration. *Dev Psychol.* 2002;38(2):194–207
85. Feldman R, Eidelman AI. Skin-to-skin contact (Kangaroo Care) accelerates autonomic and neurobehavioural maturation in preterm infants. *Dev Med Child Neurol.* 2003;45(4):274–281
86. Chwo MJ, Anderson GC, Good M, Dowling DA, Shiau SH, Chu DM. A randomized controlled trial of early kangaroo care for preterm infants: effects on temperature, weight, behavior, and acuity. *J Nurs Res.* 2002;10(2):129–142
87. Feldman-Winter L, Goldsmith JP; Committee On Fetus and Newborn; Task Force On Sudden Infant Death Syndrome. Safe sleep and skin-to-skin care in the neonatal period for healthy term newborns. *Pediatrics.* 2016;138(3):e20161889
88. Cleveland L, Hill CM, Pulse WS, DiCioccio HC, Field T, White-Traut R. Systematic review of skin-to-skin care for full-term, healthy newborns. *J Obstet Gynecol Neonatal Nurs.* 2017;46(6):857–869
89. Blair PS, Platt MW, Smith IJ, Fleming PJ; CESDI SUDI Research Group. Sudden infant death syndrome and sleeping position in pre-term and low birth weight infants: an opportunity for targeted intervention. *Arch Dis Child.* 2006;91(2):101–106
90. Jefferies AL; Canadian Paediatric Society, Fetus and Newborn Committee. Going home: Facilitating discharge of the preterm infant. *Paediatr Child Health.* 2014;19(1):31–42
91. Schneiderman R, Kirkby S, Turenne W, Greenspan J. Incubator weaning in preterm infants and associated practice variation. *J Perinatol.* 2009;29(8):570–574
92. Shankaran S, Bell EF, Laptook AR, et al; Eunice Kennedy Shriver National Institute of Child Health, and Human Development Neonatal Research Network. Weaning of moderately preterm infants

from the incubator to the crib: a randomized clinical trial. *J Pediatr*. 2019;204:96–102.e4

93. New K, Flenady V, Davies MW. Transfer of preterm infants from incubator to open cot at lower versus higher body weight. *Cochrane Database Syst Rev*. 2011;(9):CD004214
94. Fulmer M, Zachritz W, Posencheg MA. Intensive care neonates and evidence to support the elimination of hats for safe sleep. *Adv Neonatal Care*. 2020;20(3):229–232
95. Barone G, Corsello M, Papacci P, Priolo F, Romagnoli C, Zecca E. Feasibility of transferring intensive cared preterm infants from incubator to open crib at 1600 grams. *Ital J Pediatr*. 2014;40:41
96. van Sleuwen BE, L'hoir MP, Engelberts AC, et al. Comparison of behavior modification with and without swaddling as interventions for excessive crying. *J Pediatr*. 2006;149(4):512–517
97. van Sleuwen BE, Engelberts AC, Boere-Boonekamp MM, Kuis W, Schulpen TW, L'Hoir MP. Swaddling: a systematic review. *Pediatrics*. 2007;120(4). Available at: www.pediatrics.org/cgi/content/full/120/4/e1097
98. Ponsonby AL, Dwyer T, Gibbons LE, Cochrane JA, Wang YG. Factors potentiating the risk of sudden infant death syndrome associated with the prone position. *N Engl J Med*. 1993;329(6):377–382
99. Pease AS, Fleming PJ, Hauck FR, et al. Swaddling and the risk of sudden infant death syndrome: a meta-analysis. *Pediatrics*. 2016;137(6):e20153275
100. McDonnell E, Moon RY. Infant deaths and injuries associated with wearable blankets, swaddle wraps, and swaddling. *J Pediatr*. 2014;164(5):1152–1156
101. Section on Breastfeeding. Breastfeeding and the use of human milk. *Pediatrics*. 2012;129(3). Available at: www.pediatrics.org/cgi/content/full/129/3/e827
102. Ip S, Chung M, Raman G, Trikalinos TA, Lau J. A summary of the Agency for Healthcare Research and Quality's evidence report on breastfeeding in developed countries. *Breastfeed Med*. 2009;4(suppl 1):S17–S30
103. Hauck FR, Thompson JM, Tanabe KO, Moon RY, Vennemann MM. Breastfeeding and reduced risk of sudden infant death syndrome: a meta-analysis. *Pediatrics*. 2011;128(1):103–110
104. Vennemann MM, Bajanowski T, Brinkmann B, et al; GeSID Study Group. Does breastfeeding reduce the risk of sudden infant death syndrome? *Pediatrics*. 2009;123(3). Available at: www.pediatrics.org/cgi/content/full/123/3/e406
105. Herrmann K, Carroll K. An exclusively human milk diet reduces necrotizing enterocolitis. *Breastfeed Med*. 2014;9(4):184–190
106. Assad M, Elliott MJ, Abraham JH. Decreased cost and improved feeding tolerance in VLBW infants fed an exclusive human milk diet. *J Perinatol*. 2016;36(3):216–220
107. Maffei D, Schanler RJ. Human milk is the feeding strategy to prevent necrotizing enterocolitis! *Semin Perinatol*. 2017;41(1):36–40
108. Boyd CA, Quigley MA, Brocklehurst P. Donor breast milk versus infant formula for preterm infants: systematic review and meta-analysis. *Arch Dis Child Fetal Neonatal Ed*. 2007;92(3):F169–F175
109. Briere CE, Lucas R, McGrath JM, Lussier M, Brownell E. Establishing breastfeeding with the late preterm infant in the NICU. *J Obstet Gynecol Neonatal Nurs*. 2015;44(1):102–113
110. Hallowell SG, Spatz DL, Hanlon AL, Rogowski JA, Lake ET. Characteristics of the NICU work environment associated with breastfeeding support. *Adv Neonatal Care*. 2014;14(4):290–300
111. Noble LM, Okogbule-Wonodi AC, Young MA. ABM clinical protocol #12: transitioning the breastfeeding preterm infant from the neonatal intensive care unit to home, revised 2018. *Breastfeed Med*. 2018;13(4):230–236
112. Voos KC, Terreros A, Larimore P, Leick-Rude MK, Park N. Implementing safe sleep practices in a neonatal intensive care unit. *J Matern Fetal Neonatal Med*. 2014;28(14):1637–1640
113. Kuhlmann S, Ahlers-Schmidt CR, Lukasiewicz G, Truong TM. Interventions to improve safe sleep among hospitalized infants at eight children's hospitals. *Hosp Pediatr*. 2016;6(2):88–94
114. Hwang SS, O'Sullivan A, Fitzgerald E, Melvin P, Gorman T, Fiascone JM. Implementation of safe sleep practices in the neonatal intensive care unit. *J Perinatol*. 2015;35(10):862–866
115. Hwang SS, Melvin P, Diop H, Settle M, Mourad J, Gupta M. Implementation of safe sleep practices in Massachusetts NICUs: a state-wide QI collaborative. *J Perinatol*. 2018;38(5):593–599
116. McMullen SL, Carey MG. Predicting transition to the supine sleep position in preterm infants. *ANS Adv Nurs Sci*. 2014;37(4):350–356
117. McMullen SL, Wu YW, Austin-Ketch T, Carey MG. Transitioning the premature infant from nonsupine to supine position prior to hospital discharge. *Neonatal Netw*. 2014;33(4):194–198
118. Shaefer SJ, Herman SE, Frank SJ, Adkins M, Terhaar M. Translating infant safe sleep evidence into nursing practice. *J Obstet Gynecol Neonatal Nurs*. 2010;39(6):618–626
119. Zachritz W, Fulmer M, Chaney N. An evidence-based infant safe sleep program to reduce sudden unexplained infant deaths. *Am J Nurs*. 2016;116(11):48–55
120. Naugler MR, DiCarlo K. Barriers to and interventions that increase nurses' and parents' compliance with safe sleep recommendations for preterm infants. *Nurs Womens Health*. 2018;22(1):24–39
121. Carrier CT. Back to Sleep: a culture change to improve practice. *Newborn Infant Nurs Rev*. 2009;9(3):163–168
122. McMullen SL, Fioravanti ID, Brown K, Carey MG. Safe sleep for hospitalized infants. *MCN Am J Matern Child Nurs*. 2016;41(1):43–50
123. Colson ER, Joslin SC. Changing nursery practice gets inner-city infants in the supine position for sleep. *Arch Pediatr Adolesc Med*. 2002;156(7):717–720
124. Dowling DA, Barsman SG, Forsythe P, Damato EG. Caring about Preemies' Safe Sleep (CaPSS): an educational program to improve adherence to safe sleep recommendations by

mothers of preterm infants. *J Perinat Neonatal Nurs*. 2018;32(4):366–372

125. Lipke B, Gilbert G, Shimer H, et al. Newborn safety bundle to prevent falls and promote safe sleep. *MCN Am J Matern Child Nurs*. 2018;43(1):32–37
126. Carlins EM, Collins KS. Cribs for Kids: risk and reduction of sudden infant death syndrome and accidental suffocation. *Health Soc Work*. 2007;32(3):225–229
127. Hauck FR, Tanabe KO, McMurry T, Moon RY. Evaluation of bedtime basics for babies: a national crib distribution program to reduce the risk of sleep-related sudden infant deaths. *J Community Health*. 2015;40(3):457–463
128. Engel M, Ahlers-Schmidt CR, Suter B. Safe sleep knowledge and use of provided cribs in a crib delivery program. *Kans J Med*. 2017;10(3):1–8
129. Salm Ward TC, McClellan MM, Miller TJ, Brown S. Evaluation of a crib distribution and safe sleep educational program to reduce risk of sleep-related infant death. *J Community Health*. 2018;43(5):848–855
130. Adams WG, Mann AM, Bauchner H. Use of an electronic medical record improves the quality of urban pediatric primary care. *Pediatrics*. 2003;111(3):626–632
131. Gioia PC. Quality improvement in pediatric well care with an electronic record. *Proc AMIA Symp*. 2001:209–213
132. Miller AR, Tucker CE. Can health care information technology save babies? *J Polit Econ*. 2011;119(2):289–324
133. Biddle TL, Rust CL. A comprehensive safe-sleep initiative to save babies in Kentucky. *J Obstet Gynecol Neonatal Nurs*. 2018;47(3, suppl): S34–S35
134. Eichenwald EC; Committee on Fetus and Newborn, American Academy of Pediatrics. Apnea of prematurity. *Pediatrics*. 2016;137(1):e20153757
135. Bhethanabhotla S, Thukral A, Sankar MJ, Agarwal R, Paul VK, Deorari AK. Effect of position of infant during phototherapy in management of hyperbilirubinemia in late preterm and term neonates: a randomized controlled trial. *J Perinatol*. 2013;33(10):795–799
136. National Institute for Health and Care Excellence. *Clinical Guideline 98: Jaundice in Newborn Babies Under 28 Days*. London, United Kingdom: National Institute for Health and Care Excellence; 2016
137. Ponsonby AL, Dwyer T, Gibbons LE, Cochrane JA, Jones ME, McCall MJ. Thermal environment and sudden infant death syndrome: case-control study. *BMJ*. 1992;304(6822):277–282
138. Iyasu S, Randall LL, Welty TK, et al. Risk factors for sudden infant death syndrome among northern plains Indians. *JAMA*. 2002; 288(21):2717–2723
139. Blair PS, Mitchell EA, Heckstall-Smith EM, Fleming PJ. Head covering - a major modifiable risk factor for sudden infant death syndrome: a systematic review. *Arch Dis Child*. 2008;93(9):778–783
140. Wilson CA, Taylor BJ, Laing RM, Williams SM, Mitchell EA. Clothing and bedding and its relevance to sudden infant death syndrome: further results from the New Zealand Cot Death Study. *J Paediatr Child Health*. 1994;30(6):506–512

Transition to a Safe Home Sleep Environment for the NICU Patient

- *Technical Report*

TECHNICAL REPORT

American Academy of Pediatrics
DEDICATED TO THE HEALTH OF ALL CHILDREN™

Transition to a Safe Home Sleep Environment for the NICU Patient

Michael H. Goodstein, MD, FAAP,[a,b] Dan L. Stewart, MD, FAAP,[c] Erin L. Keels, DNP, APRN-CNP, NNP-BC,[d,e] Rachel Y. Moon, MD, FAAP,[f] COMMITTEE ON FETUS AND NEWBORN, TASK FORCE ON SUDDEN INFANT DEATH SYNDROME

Of the nearly 3.8 million infants born in the United States in 2018, 8.3% had low birth weight (<2500 g [5.5 lb]) and 10% were born preterm (gestational age of <37 completed weeks). Many of these infants and others with congenital anomalies, perinatally acquired infections, and other disease require admission to a NICU. In the past decade, admission rates to NICUs have been increasing; it is estimated that between 10% and 15% of infants will spend time in a NICU, representing approximately 500 000 neonates annually. Approximately 3600 infants die annually in the United States from sleep-related deaths, including sudden infant death syndrome *International Classification of Diseases, 10th Revision* (R95), ill-defined deaths (R99), and accidental suffocation and strangulation in bed (W75). Preterm and low birth weight infants are particularly vulnerable, with an incidence of death 2 to 3 times greater than healthy term infants. Thus, it is important for health care professionals to prepare families to maintain their infant in a safe sleep environment, as per the recommendations of the American Academy of Pediatrics. However, infants in the NICU setting commonly require care that is inconsistent with infant sleep safety recommendations. The conflicting needs of the NICU infant with the necessity to provide a safe sleep environment before hospital discharge can create confusion for providers and distress for families. This technical report is intended to assist in the establishment of appropriate NICU protocols to achieve a consistent approach to transitioning NICU infants to a safe sleep environment as soon as medically possible, well before hospital discharge.

INTRODUCTION

According to the 2016 policy statement from the American Academy of Pediatrics (AAP) Task Force on Sudden Infant Death Syndrome, all infants, including preterm and low birth weight infants, in the NICU should be placed in the supine position for sleep as soon as they are

abstract

[a]*Division of Newborn Services, WellSpan Health, York, Pennsylvania;* [b]*Department of Pediatrics, College of Medicine, The Pennsylvania State University, Hershey, Pennsylvania;* [c]*Department of Pediatrics, Norton Children's and School of Medicine, University of Louisville, Louisville, Kentucky;* [d]*National Association of Neonatal Nurse Practitioners, National Association of Neonatal Nurses, Chicago, Illinois;* [e]*Neonatal Advanced Practice, Nationwide Children's Hospital, Columbus, Ohio; and* [f]*Division of General Pediatrics, School of Medicine, University of Virginia, Charlottesville, Virginia*

Drs Goodstein and Stewart and Ms Keels conceptualized and conducted the literature search, wrote and revised the manuscript, and considered input from all reviewers and the board of directors; Dr Moon conceptualized and revised the manuscript and considered input from all reviewers and the board of directors; and all authors approved the final manuscript as submitted.

To cite: Goodstein M H, Stewart D L, Keels E L, et al. AAP COMMITTEE ON FETUS AND NEWBORN, TASK FORCE ON SUDDEN INFANT DEATH SYNDROME. Transition to a Safe Home Sleep Environment for the NICU Patient. *Pediatrics.* 2021;148(1):e2021052046

medically stable and significantly before their anticipated discharge from the hospital. In particular, very preterm infants should be kept predominantly in the supine position by 32 weeks' postmenstrual age (PMA) so that they become acclimated to supine sleeping before discharge from the hospital.[1–3] There are many other factors that define a safe sleep environment to minimize the risk of sudden infant death syndrome (SIDS), accidental suffocation and strangulation, and undetermined sleep deaths (collectively known as sudden unexpected infant death [SUID]), as outlined in the same 2016 policy statement.

During NICU hospitalization, infants are routinely kept in an environment that is not consistent with these recommendations for numerous reasons, on the basis of both treatment of underlying pathophysiology as well as the normal physiology of the preterm infant. Pathologic conditions resulting in short-term respiratory distress (respiratory distress syndrome and transient tachypnea of the newborn) or long-term respiratory compromise (bronchopulmonary dysplasia and pulmonary hypoplasia) result in use of positioning inconsistent with safe sleep messaging. Other conditions that may be pathologic, such as gastroesophageal reflux (GER), lead to the use of therapeutic interventions such as side-lying position and elevation of the head of the bed, maneuvers the literature suggests may be of questionable value.[4] To reduce the need for narcotic and anxiolytic medications, which have been reported to have adverse effects on neurodevelopment,[5–7] infants with neonatal opioid withdrawal syndrome (NOWS) may be positioned prone or swaddled firmly. Developmental care for the optimal growth and maturation of the preterm infant can include the use of nonsupine positioning, soft mattresses, and positioners. Although developmental care has been shown to be beneficial to the long-term neurodevelopmental outcomes of preterm infants, many of the tools involved in the constantly monitored NICU environment are contraindicated after hospital discharge. Transition to a safe sleep environment as soon as medically possible, well before discharge from the hospital, is extremely important because in preterm infants the adjusted odds ratio (aOR) for SIDS is 1.85 to 2.72 and for suffocation is 1.86 to 2.59 compared with term infants, and the sleep environment greatly affects the risk of these sleep-related deaths.[1,8]

Although the AAP through its Committee on Fetus and Newborn recommended the transition to the use of the supine position by 32 weeks' PMA[3] in 2008, and this recommendation was supported by the AAP Task Force on Sudden Infant Death Syndrome in 2011,[1,2] there is long-term and ongoing nonadherence to this recommendation from NICU providers.[3,9,10] Research on resistance to this recommendation has thus far been focused on only NICU nurses. In a 2006 survey of 252 NICU nurses, 65% identified prone positioning as the best general sleep position for preterm infants, followed by 12% who believed either prone or side-lying position was the best sleep position.[9] In addition, the nurses surveyed were inconsistent regarding how they determined when a preterm infant is ready to sleep supine. Answers included close to discharge (13%), when maintaining their body temperature in an open crib (25%), PMA of 34 to 36 weeks (15%), PMA ≥37 weeks (13%), and when the infant's respiratory status was stable (6%). Nursing beliefs and knowledge continue to be a barrier to a culture of consistent safe sleep messaging. A 2016 survey of 96 NICU nurses found that 53% strongly agreed that recommendations make a difference in preventing SIDS, and only 20% strongly agreed that parents would model nurses' behaviors at home.[10]

Various reasons are given to explain why nonsupine positioning and other common practices contrary to a safe sleep environment persist even when infants are approaching discharge from the NICU. However, studies find that when expectant or new parents receive education on infant sleep safety on a consistent basis, their knowledge increases and their safe sleep behaviors improve, regardless of the setting (eg, well-infant nursery, NICU, Special Supplemental Nutrition Program for Women, Infants, and Children office, community health center).[11–14] The purpose of this report is to address the many issues that result in conflict with safe sleep guidelines, looking at the validity of practices based on review of the evidence regarding pathophysiology and normal physiology of the vulnerable infant. The goal of this technical report is not to provide an all-encompassing review of the literature for each issue but rather a summary of data for each issue and provide suggestions to resolve conflicting practices. By creating a consistent approach to transitioning the infant in the NICU to a safe sleep environment as soon as medically possible, well before hospital discharge, families can be exposed to modeling of safe sleep behaviors that could decrease the risk of SUID in this vulnerable population. Areas of concern include developmental care and/or neurodevelopmental issues, positional plagiocephaly and/or torticollis, orthopedic issues

(developmental hip dysplasia), respiratory distress, GER and/or aspiration, thermoregulation, jaundice, and neonatal drug withdrawal. Some of this content and the advice provided may also be applicable to infants in the well newborn and pediatric inpatient units.

DEVELOPMENTALLY SENSITIVE CARE

Infants born preterm have increased risks of poor neurodevelopmental outcomes, with risks increasing as the gestational age decreases.[15,16] Developmentally sensitive care is a broad term given to a number of interventions aimed at modifying the imperfect extrauterine environment to optimize physical and neurodevelopmental outcomes for preterm and ill neonates.[17] This is achieved through a patient-centered approach that protects sleep, manages pain and stress, supports essential activities of daily living (ie, positioning, feeding, and skin care), integrates family and/or caregivers into the plans of care, and modifies the physical environment.[17] Conflicting information exists about the effectiveness of formalized and programmatic approaches to developmentally sensitive care.[18,19] However, there is evidence that components of these approaches, particularly skin-to-skin care (SSC)[20–22] and breastfeeding,[23] promote improved short-term outcomes in response to the suboptimal environment of the NICU. Despite the disagreements in the literature about the effects of programs or packages of developmental care, integration of developmentally sensitive care in the NICU has been endorsed by professional organizations,[24,25] and formal programs, recommendations, guidelines, and quality metrics exist.[26–28] Commonly used techniques of developmental care that may affect the appropriate transition to safe sleep include positioning, use of positioning aids, swaddling, and SSC.

Positioning and Use of Positioning Aids

As the fetus rapidly grows in size during the third trimester of pregnancy, the intrauterine environment becomes more restrictive, and the fetus moves into a midline position of flexion.[29] This position of the head, shoulder, hip, and knee flexion; scapular protraction; and posterior pelvic tilt help the fetus develop appropriate skeletal shapes, flexor muscle tone, stretch reflexes, and self-regulating behaviors.[29] With preterm birth comes, among other things, loss of the physiologic flexion positioning of the intrauterine environment.[29] If not supported, the preterm infant lies flat and asymmetric, with hip and joints abducted with abnormal rotation, unable to bring himself or herself to a flexed and midline position for comfort and self-regulation. Over time, this may lead to musculoskeletal and neurodevelopmental abnormalities, such as upper extremity hyperabduction and flexion and generalized muscular rigidity. To help prevent these morbidities and provide comfort and decrease measures of stress, neonatal nurses, families, and other caregivers therapeutically position the preterm infant in a flexed, midline, and contained position, with the head and neck in a neutral posture, shoulders rounded with hands brought to the midline, trunk in "C" curve, pelvis in posterior tilt, hips and legs in symmetrical and neutral flexion and rotation, and feet supported.[29–31] Therapeutic positioning is achieved through the use of various positioning devices and supports, such as diapers or blanket rolls as well as commercially available products.[30–33] Currently, there is no standardized protocol or device to direct and provide therapeutic positioning, leaving the choice in many cases to the individual nurse or caregiver.[34] The Infant Positioning Assessment Tool was developed to help provide caregiver education, standardization, and evaluation of therapeutic positioning.[35,36] The Infant Positioning Assessment Tool has demonstrated initial validity and reliability but has not been widely implemented.[35,37,38] As the infant matures and approaches readiness for discharge from the hospital, an interdisciplinary, collaborative, and thoughtful approach is required to determine how and when the use of positioning devices is discontinued and removed from the infant's bedding to achieve a safe sleep environment. Additionally, communication and education of the infant's caregivers and family are crucial elements to avoid confusion, conflicting information, and inappropriate use of the devices after discharge from the hospital.[39]

Many developmental care guidelines include the AAP Safe Sleep recommendations and encourage the transition into a safe sleep environment for medically stable infants after the age of 32 weeks' gestation and before discharge from hospital to home.[26–28] However, no specific time frame has been established to meet this goal, leading to wide interpretation at the bedside.[10,40–42] Some centers have developed quality and process improvement programs to establish more concrete timing and increased compliance with the Safe Sleep recommendations.[43,44]

Impact of Light and Noise Reduction on the Safe Sleep Environment

NICUs and special care nurseries can be overstimulating to preterm and sick newborn infants. Lighting, noise, and temperature can be sources of noxious stimuli.[45–47] In an effort to

modify the external environment to decrease stressful stimulation, many nurses and caregivers will place a blanket or other covering over the infant's head of the bed.[48] If not well secured, these coverings could become loose and cover the infant, increasing the risks of smothering. The removal of loose blankets in the crib is an important strategy toward implementing a safe sleep environment.[1,2]

Swaddling

The practice of swaddling infants has been described in many cultures throughout history.[49] Infant swaddling, in which a cloth or device is wrapped around the infant to contain the infant's body and extremities, has been shown to promote sleep[49]; improve self-regulation, particularly in preterm infants[49]; and decrease crying time.[50] Swaddling also has been shown to promote supine sleep position.[51] However, inappropriate use of and/or tight swaddling can increase the risks of developmental hip dysplasia, cause overheating, and restrict breathing. It has been associated with vitamin D deficiency, acute respiratory tract infections, and delayed regain of birth weight and may interfere with early establishment of breastfeeding.[49,52,53] There is a much greater risk of SUID when a swaddled infant is placed in or rolls to the prone position.[54–56] When swaddled, preterm infants should be placed in the supine position, have their hands brought to midline under the chin, and hips and knees should be in the flexed position and able to move freely.[50] Term infants, especially those with NOWS, may benefit from swaddling with arms tucked in the swaddle to reduce startle response and prevent the hazard of loose blankets in escaping from the swaddle. Because of the risk of SUID when swaddled infants are in the side or prone position, swaddling should be discontinued when the infant begins to attempt to roll over.[50,55,56] For a more extensive discussion about the potential risks and benefits of swaddling, refer to the technical report, "SIDS and Other Sleep-Related Infant Deaths: Evidence Base for 2016 Updated Recommendations for a Safe Infant Sleeping Environment" (currently undergoing revision).[1]

Skin-to-Skin Care

SSC, or kangaroo mother care, is the practice of placing the infant's unclothed chest against the mother's unclothed chest for immediate, continuous, and sustained contact and exclusive breastfeeding.[57] SSC was initially adopted as an alternative to incubators in countries with limited resources in the late 1970s and subsequently demonstrated improved survival for preterm and low birth weight infants.[58] Now widely adopted in countries with both limited and abundant resources, the practice of SSC has been shown to promote temperature and blood sugar stability, lower respiratory rate, increase oxygen saturation, decrease symptoms associated with mild to moderate pain, and promote maternal bonding and attachment and breastfeeding. These advantages may all contribute to overall physiologic and neurobehavioral development.[22,59–61] However, safety concerns have arisen with the increased practice of SSC. Dislodgement of life support equipment and dropping small and immature infants, falling out of bed, and airway obstruction have all been reported. When occurring in healthy term or late preterm infants, these events are referred to as sudden unexpected postnatal collapse, which frequently results in death or severe neurologic impairment.[62] These unfortunate but real events remind caregivers and parents to be mindful and vigilant of the position of the infant's airway and the safety of caregiver holding to prevent falls when providing SSC.[22,62] If this is undertaken in the NICU, the infant should be monitored and secured, preferably with a conforming wrap carrier. The parent should be positioned in a recliner or approved kangaroo care chair or hospital bed and the kangaroo care provider should be educated by staff about how this situation differs from the home environment. Because of the concerns noted above and the known dangers of sharing sleep surfaces, such as bed-sharing in the home environment, adults should be thoroughly educated about the dangers of sleeping during SSC.

Conclusions Regarding Developmentally Sensitive Care

1. Developmentally sensitive care is an important component to the health and well-being of the preterm infant.
2. Many of the tools and therapies used to promote developmentally sensitive care are not consistent with a home safe sleep environment.
3. It is important to transition infants to a home safe sleep environment well before discharge from the NICU.
4. Good communication with the use of a multidisciplinary team is key for consistent transitioning of NICU patients to a home safe sleep environment (see A Rational Approach to Transition of the NICU Patient to a Home Sleep Environment for details).

DEFORMATIONAL PLAGIOCEPHALY AND TORTICOLLIS

Variations in head shape are often observed in term and preterm infants in the NICU. These head shape abnormalities can be secondary to nursing care practices, limitations on positioning, muscle

tone, or other medical conditions that can lead to positional or deformational plagiocephaly (DP).[63,64]

Preterm infants are more susceptible to developing plagiocephaly because of decreased mineralization of the skull bones. In addition, they are more likely to have been positioned prone, which may be indicated when the infant is medically unstable to decrease stress, promote sleep, improve feeding tolerance, and enhance oxygenation and ventilation. Although therapeutic positioning to promote medical stability takes precedence during the acute phase of illness, whenever possible, nurses should make efforts to choose positions that promote symmetrical cranial shape.[65–67]

Since the early 1990s, DP has been increasing in prevalence and is being more frequently diagnosed. Most parents and health care professionals attribute this increase to the supine sleep position recommended for infant safety,[68] although this has been challenged in recent studies.[69–72] It was estimated that 46.6% of 7- to 12-week-old infants had nonsynostotic plagiocephaly (NSP) in a Canadian cohort study,[72] and in a Swedish study in 2009, 42% of 2-month-old infants had some degree of NSP.[73] In a prospective New Zealand study, there were significant multivariate risk factors for NSP at 6 weeks, including newborn passive head rotation (aOR: 9.51; 95% confidence interval [CI]: 2.59–34.94), 6-week sleep position (aOR: 5.27; 95% CI: 1.81–15.39), and upright time (aOR: 3.99; 95% CI: 1.42–11.23). At 4 months, risk factors were limited passive head rotation at birth (aOR: 6.51; 95% CI: 1.85–22.98), limited active head rotation at 4 months (aOR: 3.11; 95% CI: 1.21–8.05), tried but unable to vary head position at 6 weeks (aOR: 4.28; 95% CI: 1.58–11.59), low activity level at 4 months (aOR: 3.28; 95% CI: 1.16–9.29), and average to difficult rating on the Pictorial Assessment of Temperament test (aOR: 3.30; 95% CI: 1.17–9.29).[70]

Whether congenital muscular torticollis is the main predisposing factor for DP remains controversial. Although one study found asymmetries of the head and neck to be common in normal newborn infants, and 16 (16%) of 102 were found to have torticollis at birth,[74] other recent studies suggest that cranial shape is more often determined by postnatal factors than prenatal and perinatal factors and that most concomitant cervical imbalance (positional torticollis) develops postnatally along with DP.[75]

DP results from unevenly distributed external pressure, resulting in abnormal head shapes. Most cases involve unilateral occipital flattening, ipsilateral frontal bossing, and anterior shifting of the ipsilateral ear and cheek.[76] A rapidly growing head is malleable and most susceptible to deformation between 2 and 4 months and declines thereafter.[70,72,77] Placing the infant repeatedly on the same side according to infant preferences, as well as slower motor development, are risk factors for the development of DP. In the NICU, occupational and physical therapists often make use of various positioning devices and supports, such as blanket rolls and commercially available products, to prevent progression and to correct DP and torticollis.[30–33] However, these therapies are contraindicated when the infant is getting closer to discharge from the hospital, as they are generally not consistent with home infant sleep safety recommendations.

Many infants with DP undergo additional treatment at home. Such treatments, including physical therapy, need to be in line with safe sleep recommendations. Devices that promote a nonsupine sleep position or have the potential to compromise the airway are not appropriate. The "Congress of Neurological Surgeons Systematic Review and Evidence-Based Guideline on the Management of Patients With Positional Plagiocephaly: The Role of Repositioning" stated that it cannot at this time endorse any sleep positioning device because it would be contrary to the repeated recommendations set forth by the AAP Task Force on Sudden Infant Death Syndrome to avoid placing any soft surface bedding in the infant's crib.[78] Although orthotic helmet therapy can be difficult for the parents and can cause side effects, including sweating, irritation, and pain for the infant, they can provide significant and faster improvement of cranial asymmetry in infants with positional plagiocephaly compared with conservative therapy. The Congress of Neurologic Surgeons recommends a helmet for infants with persistent moderate to severe plagiocephaly after a course of conservative treatment or if the infant presents at an advanced age.[79]

A recent randomized controlled trial in Finland evaluated the causal relationship between DP and cervical imbalance (positional torticollis). The intervention group was given instructions to create a nonrestrictive environment that promotes spontaneous physical movement and symmetrical motor development.[77] The instructions focused on 3 areas: alternating head position laterally (left and right) during feeding and sleep, avoiding excessive awake time in supine position (including prolonged placement in car seats and other devices) in addition to using tummy time daily, and preventing

restriction of movement. Infant neck stretching exercises were performed by the parents if an infant showed signs of muscular imbalance of the neck.[77] Infants in the intervention group were less likely to have DP at follow-up, and if present, the asymmetry was milder. In addition, infants who had DP were more likely to have torticollis. This study concluded that early intervention reduces the prevalence and severity of DP at 3 months.[77]

The Finnish randomized controlled trial was similar to a prevention project among Swedish child health nurses that incorporated a short cranial asymmetry prevention program.[80] In this study, researchers concluded that education of child health nurses, who in turn educate parents about NSP prevention, is successful in increasing parents' awareness of safe interventions to prevent acquired cranial asymmetry.[80]

These studies provide an evidence-based approach that the parents can use to maintain the supine position for infant safety while decreasing the risk of NSP and/or DP and cervical imbalance (positional torticollis). For more information on congenital muscular torticollis, see the 2019 AAP State of the Art report: Congenital Muscular Torticollis: Bridging the Gap Between Research and Clinical Practice.[81] For more information on DP, see the Congress of Neurologic Surgeons Systematic Review and Evidence-Based Guidelines for the Patients With Positional Plagiocephaly.[78,79,82–84]

Conclusions Regarding DP and Torticollis

1. DP and torticollis occur commonly in the NICU environment.
2. The preterm infant is especially at risk for DP because of decreased mineralization of the skull bones, as well as more prone and side positioning.
3. Positioning devices recommended by qualified personnel, such as but not limited to occupational and physical therapists, can be used to prevent, control, and correct DP and torticollis while infants are under continuous monitoring in the NICU.
4. Parents need to be educated regarding the use of sleep positioning devices: that their use is limited to the inpatient setting under strict monitoring and that they are not part of a safe sleep environment.
5. Orthotic helmets may be appropriate for infants with persistent moderate to severe plagiocephaly after a course of conservative treatment or if the infant presents at an advanced age.[79]
6. Parents should be educated to avoid excessive use of car seats and infant positioning devices that can promote DP.
7. Education regarding tummy time should emphasize that it be performed during awake, supervised periods only and never when the infant is asleep, even with close supervision.
8. It is important to transition infants to a safe sleep environment well before discharge from the NICU.

DEVELOPMENTAL DYSPLASIA OF THE HIPS

Clinical hip instability occurs in 1% to 2% of term infants, yet up to 15% of term infants have hip instability or immaturity detectable by imaging studies.[85] Developmental dysplasia of the hip (DDH), which was previously called congenital hip dislocation, is the most common neonatal hip disorder and is no longer considered congenital but developmental in origin. The incidence of DDH is approximately 1 to 2/1000 live births, but this estimate does not encompass the entire spectrum. At birth, an involved hip is rarely dislocated but is dislocatable. The clinical significance depends on whether the hip stabilizes, subluxates, or dislocates and is dependent on many factors, including breech position, female sex, incorrect lower extremity swaddling, and positive family history. Breech presentation may be the single most important risk factor; DDH is reported to occur in 2% to 27% of boys and girls presenting in breech position.[86–88] Other nonsyndromic findings associated with DDH include being the first born, presence of torticollis, foot abnormalities, and oligohydramnios.[89,90]

Many mild forms of DDH resolve without treatment. The clinical hip examination plus or minus abnormalities on ultrasonography will determine the need for an abduction brace (frequently referred to as a Pavlik harness). Potential risks associated with the use of the Pavlik harness include aseptic necrosis of the femoral head, temporary femoral nerve palsy, and obturator (inferior) hip dislocation.[88,91,92] Stopping treatment after 3 weeks if the hip does not reduce and proper strap placement with weekly monitoring are important to minimize the risks associated with brace treatment.[93,94] Some clinicians use double or even triple diapering to manage DDH; although innocuous, it is probably ineffective.[95]

Transitioning the NICU patient to a safe home sleep environment often involves swaddling, which reduces crying and facilitates better sleep. In utero, the infants' legs are in the fetal position with the knees bent up and across each other. Sudden straightening can loosen the joints and damage the soft cartilage of the socket. Improper swaddling may lead to hip dysplasia and should be avoided in infants with this diagnosis. Infants should never be placed in prone or side positions while swaddled. Proper hip swaddling techniques can be found

at https://hipdysplasia.org/wp-content/uploads/2020/05/HipHealthySwaddlingBrochure.pdf.

A leading proponent of swaddling states that contemporary swaddling techniques permit infants to be snugly wrapped with their hips being safely flexed and abducted.[96] This position should be encouraged. An alternative method is to swaddle only the upper extremities and allow the lower limbs to move freely.[97] For a more extensive discussion of the diagnosis and management of DDH, refer to the AAP clinical report "Evaluation and Referral for Developmental Dysplasia of the Hip in Infants."[85]

Conclusions Regarding DDH

1. Infants are frequently swaddled in the NICU when approaching hospital discharge.
2. Improper swaddling can lead to or exacerbate DDH.
3. Proper swaddling technique should allow the hips to be flexed and abducted.
4. Parents should be well-educated about all safety issues regarding swaddling, in particular the increased risk of SUID with nonsupine positioning.
5. For more information, refer to the AAP clinical report on DDH.[85]

RESPIRATORY DISTRESS (ACUTE AND CHRONIC)

One of the most common reasons for admission to the NICU is respiratory distress. Some infants will have acute respiratory distress with rapid resolution, such as transient tachypnea of the newborn, and others will develop chronic respiratory conditions, such as bronchopulmonary dysplasia. Some infants will have respiratory distress from airway compromise or other systemic problems affecting respiration.

It may seem counterintuitive to place infants with respiratory distress in the prone position, because it has been shown to increase the risk of rebreathing exhaled gases, which can result in hypoxia or hypercarbia.[98–101] The prone position decreases the rate of heat loss and increases body temperature, putting the infant at risk for overheating.[102,103] Prone positioning has been shown to alter autonomic regulation of the cardiovascular system, especially in preterm infants, potentially decreasing cerebral oxygenation.[104–106] Prone positioning also encourages longer and deeper sleep periods with fewer awakenings and behaviors associated with stress.[107,108] The SIDS triple risk hypothesis suggests that some infants who die because of SIDS had an intrinsic abnormality in the brainstem that prevented appropriate arousal to an environmental threat. All of these elements (rebreathing, overheating, and impaired sleep arousal) have been implicated in increased SIDS risk. However, there is some evidence of potential respiratory benefit with prone positioning.

Acute Respiratory Distress

Once umbilical catheters are removed, one of the commonly used interventions to decrease respiratory symptoms in the newborn infant is prone positioning. Numerous studies have been performed to understand what components of ventilation and oxygenation are affected by prone positioning, as well as the effects of PMA and degree of illness (acute versus chronic lung disease). Wagaman et al[109] found that prone positioning of preterm infants with acute respiratory disease resulted in significantly improved arterial oxygen tension, dynamic lung compliance, and tidal volume. Improved diaphragmatic excursion may contribute to increased tidal volume seen with prone positioning. In the supine position, the abdominal contents can oppose excursion of the diaphragm, limiting ventilation. Improvement in oxygenation may be related to improved ventilation-perfusion matching. In the supine position, some lung tissue is dependent to the heart and mediastinal structures, increasing the risk of atelectasis in the unstable newborn lung.[109,110] In addition to improved lung volume, there is evidence of less intrapulmonary shunting and improved thoracoabdominal synchrony in the prone position.[111,112]

In a Cochrane review[113] from 2012, researchers evaluated positioning for acute respiratory distress in hospitalized infants and children using data from 24 studies with a total of 581 participants. Although the data combined studies of infants and children, 60% were preterm infants. Seventy percent of the study participants were evaluated while on mechanical ventilation. Results were limited because of lack of data for many parameters, small participant numbers, and short study times. There was a small but statistically significant improvement in oxygenation (2% higher oxygen saturations) when positioned prone. Prone positioning also provided a small improvement in tachypnea, with a decrease of 4 breaths per minute.

Although these results are statistically significant, they may be of marginal clinical relevance. However, because the extremely preterm infant will have a prolonged hospital course in the NICU, the benefit of prone positioning during the acute phase of respiratory illness may outweigh the importance of modeling safe sleep positioning at that time. Nonsupine positioning can still be viewed as a teachable

moment between clinician and family. Early safe sleep education can be incorporated into explanations as to why the infant is positioned nonsupine during acute respiratory distress.

Chronic Respiratory Distress

Fewer data are available for determining any benefits of prone positioning in the convalescent preterm infant with resolving pulmonary disease. A small study of 20 preterm infants (median gestational age of 30 weeks; range, 27–32 weeks) recovering from respiratory distress syndrome evaluated pulmonary mechanics at a median postconceptional age of 35 weeks.[114] In oxygen-dependent infants, oxygen saturations and functional residual capacity were higher in the prone position, but there were no differences in compliance or resistance of the respiratory system. In addition, there were no differences in any of the measurements for non–oxygen-dependent infants.

In another study of healthy preterm infants approaching discharge with no history of respiratory distress, there was no effect of prone versus supine positioning regarding respiratory rate; tidal volume; minute ventilation; lung compliance; pleural pressure; or inspiratory, elastic, and resistive work of breathing.[115] Other studies have shown conflicting results; Hutchinson et al found increased tidal and minute volumes but also increased work of breathing in late preterm infants in the prone position.[116] Elder et al found no impact of position on oxygen saturations in preterm infants approaching hospital discharge.[117] Leipala et al[118] found an increase in tidal volume but lower respiratory muscle strength in the prone compared with the supine position in preterm infants studied immediately before discharge from the hospital.

The contradiction of improved respiratory function for some preterm infants with the decreased risk of SIDS or sleep-related deaths must be resolved or, as Poets and von Bodman[119] noted, we are left with a "cognitive dissonance otherwise resulting from parents seeing their infant being nursed in the prone position for several weeks while being told that they must place their infant supine once at home."[119] At some point, the diminishing benefits of prone positioning are outweighed by the risk of SUID, a leading cause of postneonatal mortality. Clearly, this needs to be addressed well before discharge from the NICU.

Upper Airway Obstruction

Numerous congenital abnormalities of the airway can result in respiratory compromise. Pierre Robin sequence can be particularly challenging in regard to infant sleep safety because of the gravity-dependent tongue-based obstruction.[120] For infants on the mildest end of the spectrum who do not experience significant airway obstruction while in the supine position and have normal arterial saturations and adequate gas exchange, there is no need to deviate from standard safe sleep recommendations. In the 40% of cases that are severe,[120] infants will require an inpatient surgical intervention, such as mandibular distraction osteogenesis, tongue-lip adhesion, or tracheostomy, resulting in a stable airway in supine position at discharge. However, the intermediate cases are more problematic because they are not severe enough for early surgical intervention but require the side or prone position for a stable airway. In these cases, it may be appropriate for an infant to sleep on the side or in prone position with consideration of using a home monitor with or without pulse oximetry. Although home monitoring does not prevent or reduce the risk of SUID and is not recommended for that purpose, in this situation monitoring including consideration of pulse oximetry is appropriate for limiting airway obstruction, which could lead to hypoxic injury or death. Regardless, these infants should be managed by a specialized team proficient in the care of such disorders.

Conclusions Regarding Respiratory Distress

1. For the infant with acute respiratory distress, regardless of gestational age, nonsupine positioning may be used as clinically indicated to stabilize and/or improve respiratory function.
2. If nonsupine positioning is used, especially as the infant matures, parents should be educated about infant sleep safety and the reasons for deviating from home safe sleep recommendations.
3. Once the acute respiratory distress is resolving, the infant should be placed supine for modeling home safe sleep, and the parents should receive additional education before hospital discharge.
4. For infants who have developed chronic lung disease, periodic assessments can be performed to monitor the infant's progress. Once the infant has weaned to a standardized minimal supplemental respiratory support (determined by the individual institution), then supine positioning can be maintained, and parents should receive additional education before hospital discharge.
5. Management of the infant with upper airway obstruction needs to be individualized on the basis of the severity of the obstruction. Nonsupine positioning may be necessary to prevent excessive hypercarbia or hypoxemia.

Consideration should be given to home monitoring of the marginal airway.

APNEA OF PREMATURITY

Infant apnea is defined by the AAP as "an unexplained episode of cessation of breathing for 20 seconds or longer, or a shorter respiratory pause associated with bradycardia, cyanosis, pallor, and/or marked hypotonia."[121] Apnea can be classified as central, obstructive, or mixed, on the basis of airflow and respiratory effort. The incidence of apnea is inversely proportional to gestational age. Although all infants born at less than 28 weeks' gestation will have recurrent apnea, the incidence decreases to 20% by 34 weeks' gestation, and these events resolve in 98% of infants by 40 weeks' PMA.[122] It is unclear as to what degree of apnea is considered acceptable, and there is concern about the long-term neurodevelopmental effects of recurrent apnea and periodic breathing on the preterm infant. Measurements of cerebral oxygenation using near-infrared spectrophotometry have demonstrated decreases in tissue oxygenation during apneic events in preterm infants both late in hospitalization and up to 6 months' postterm corrected age.[105] It has been suggested that intermittent hypoxia resulting from continuing apnea and periodic breathing can cause hypoxic cerebral injury[123] and worsening of neurodevelopmental outcomes.[124,125]

Some research has suggested that use of the prone position may reduce apnea frequency and/or severity. In a small study of 35 preterm infants that used a crossover design placing each infant supine and prone, there were significantly more central and mixed apneas in the supine position.[126] In addition, during mixed apneas, there were greater decreases in heart rate ($P = .02$), longer duration of bradycardia ($P = .0003$), and longer accompanying desaturations ($P = .03$) when infants were in the supine position. In another small crossover design study of 14 stable preterm infants, there was no positional difference in the incidence of bradycardia, but there was an increase in apnea density, defined as the number of episodes lasting >6 seconds during quiet sleep (4.5 vs 2.5; $P = .01$), and periodic breathing (percentage of quiet sleep, 13.6% vs 7.7%; $P = .015$) when infants were in the supine position.[127]

In more recent studies, researchers have found either no positional differences in the incidence of apnea or bradycardia or a reduction in alarms with supine positioning.[128,129] Bhat et al found preterm infants in prone position to have more central apneas (median: 5.6 vs 2.2; $P = .04$) but fewer obstructive apneas (0.5 vs 0.9; $P = .007$). While supine, the infants had more awakenings (9.7 vs 3.5; $P = .003$) and arousals per hour (13.6 vs 9.0; $P = .001$).[129] These studies were also limited by small sample size. A 2017 Cochrane review identified 5 eligible trials totaling 114 infants in which no statistical differences were identified between supine and prone positioning with regard to the frequency of apnea, bradycardia, or oxygen desaturations.[130] The overall quality of evidence was low, and the reviewers concluded that they "cannot recommend use of one body position over another for spontaneously breathing preterm infants with apnea." For additional information on apnea of prematurity, refer to the AAP clinical report: Apnea of Prematurity.[131]

Home Monitors

Home monitors are frequently used in the NICU setting to allow for earlier discharge of infants with mild, persistent apnea of prematurity. However, they have not been found to be protective against SUID and are not recommended for this purpose. In addition, the use of non–medical-grade monitors has increased in popularity. As per task force recommendations,[1] parents should be educated that no monitor takes the place of following the safe sleep recommendations.

Conclusions Regarding Apnea and Prone Positioning

1. There is inadequate evidence to justify the use of prone positioning for the treatment of apnea of prematurity.
2. For more information on apnea of prematurity, refer to the AAP clinical report on apnea of prematurity.[131]

GASTROESOPHAGEAL REFLUX DISEASE

GER is a normal developmental process that involves the involuntary passage of gastric contents into the esophagus. GER episodes are usually brief, with little or no symptoms. Many healthy, term infants have 30 or more episodes per day of GER and are known as "happy spitters." Generally, these episodes dissipate over the first year of life as the smooth muscle of the lower end of the esophagus increases in tone with maturation. These episodes of GER are classified as transient lower esophageal sphincter relaxations,[132,133] whereas pathologic GER, or gastroesophageal reflux disease (GERD), involves signs and symptoms of esophagitis with reflux into the esophagus, oral cavity, and/or airways. Putative morbidities of GERD in preterm infants include frequent vomiting, aspiration pneumonia, irritability, failure to thrive, and exacerbations of respiratory symptoms.[134] GER and GERD probably represent 2 ends of a spectrum of the same

condition, varying with the severity of the gastric reflux.[134,135]

As feeding volume increases and/or abdominal straining occurs, the likelihood of acid reflux episodes increases.[132] The presence of a nasogastric or orogastric tube may also contribute to GER because its presence impairs the ability of the lower esophageal sphincter to completely close, especially in the first postprandial hour.[136,137] Esophageal motility, transit time, and gastric emptying are known to be slower in the preterm infant. Full maturation of the intestinal motor function does not occur for several months. Contractions of the gastrointestinal tract with feedings are neurally regulated but modulated by gastrointestinal tract hormones.[138]

Small enteral feedings (20–24 mL/kg per feeding) produce a more mature motor pattern validated by improved feeding tolerance and faster gastric emptying and intestinal transit time.[139] Approximately 80% of infants with uncomplicated GER will improve with conservative measures alone, including small frequent feeds and holding the infant upright for 20 to 30 minutes after feeding. If present, removal of a nasogastric or orogastric tube may also improve symptoms of GER.[137,140]

In term infants, GER symptoms can be abated by avoidance of overfeeding and exposure to tobacco smoke, change of formula, and the use of thickened feeds.[141] Thickening of human milk with starch is problematic because the viscosity decreases over time because of amylase in the milk, which degrades the starch in the thickener.[142] Care should be taken with thickening feeds for preterm infants because a xanthan gum product has been linked to late-onset necrotizing enterocolitis.[143] In addition, commercially available formulas that thicken on acidification in the stomach are not nutritionally optimal for the preterm infant. Although there is no reason to suspect that thickening of feeds would work differently in preterm as compared with term infants, there are few data showing the efficacy of thickened feeds in this population.[4]

According to Salvatore and Vandenplas in 2002, as many as 15% to 40% of infants with GER or GERD have a cow milk protein intolerance or dietary protein–induced gastroenteropathy. After the neonatal period, a trial of an elemental formula may be indicated in infants younger than 1 year if a cow milk protein intolerance is suspected.[144] For infants receiving human milk, similar improvement can be obtained by restricting all dairy, including casein and whey, in the mother's diet.[141] Cow milk protein intolerance is most often diagnosed in infants on the basis of their symptoms and how they respond to dietary changes. There is evidence to support a trial of an extensively hydrolyzed protein formula for 2 to 4 weeks in term infants, but if no improvement occurs with this dietary change, the infant's normal diet can be resumed.

In the preterm infant, the persistence of symptoms, despite holding the infant upright for 20 to 30 minutes, small frequent feeds, and removal of the nasogastric or orogastric tube if feasible, often leads to the use of therapeutic interventions, such as side-lying and elevation of the head of the bed. There is no benefit to elevating the head of the bed, and it should be avoided, especially after discharge, because it may actually increase the risks of SUID.[145] Often, a combination of pH and electrical impedance monitoring is used to evaluate the effect of body positioning on GER and GERD.[145–148] Placing the preterm infant in the left lateral position after feeding versus right lateral position and placing the infant prone versus supine may decrease GER episodes.[147,149,150] Although placement of the infant in the right lateral position may increase GER episodes, it may promote gastric emptying.[150] Prone and lateral positioning of infants from birth to 12 months is associated with an increased risk of SUID and should be avoided. The risks associated with prone and/or lateral positioning outweigh any benefit gained. Multiple studies in different countries have not shown an increase in the incidence of aspiration since the change to supine sleeping.[151–153]

Despite the evidence against aspiration in the supine position, many parents and caregivers remain unconvinced.[154–162] Coughing or gagging is misconstrued as aspiration, although it represents the normal protective gag reflex. The AAP concurs with the North American Society for Pediatric Gastroenterology, Hepatology and Nutrition that the risk of SUID outweighs the benefit of prone or lateral sleep position on GER. Therefore, most infants from birth to 12 months of age should be positioned supine during sleep. Elevating the head of the infant's crib while the infant is supine is not effective in reducing GER.[163,164] If the head of the bed is elevated, the infant may slide into positions that may compromise the airway and result in the death of the infant.

In the 1980s, the US Food and Drug Administration had approved several devices to reduce GER or positional plagiocephaly. However, after reports to the Consumer Product Safety Commission (CPSC) of a number of deaths, the Food and

Drug Administration required manufacturers to demonstrate that the product benefit outweighed the risk of suffocation.[165] Many manufacturers dropped their claims of medical benefit, but devices continued to be sold by retailers directly to the public as non–medical-grade devices.

In 2019, inclined sleepers (which are frequently advertised as being beneficial for infants with GER) came under additional scrutiny after a series of deaths were reported to the CPSC and additional deaths were uncovered in a *Consumer Reports* article.[166] Major manufacturers voluntarily recalled their products. The CPSC issued a statement for a supplemental proposed rule (Supplemental NPR), proposing to adopt the current ASTM International standard for inclined sleep products, with modifications that would make the mandatory standard more stringent than the voluntary standard. The proposed changes include limiting the seat back angle for sleep to 10 degrees or less.[167]

Often, health care providers are pressured to elevate the head of the bed and/or provide pharmacologic interventions despite the lack of evidence supporting these practices. A recent study demonstrated that infants could more easily roll from supine to prone in an inclined sleeper, and once in the prone position, they would fatigue faster than they would on a stable, flat surface because of the high musculoskeletal demands necessary to maintain safe posture to prevent suffocation.[168] The study also found that prone positioning on an inclined sleep surface places the infant at higher risk of airway obstruction or suffocation, as evidenced by oxygen saturation results. These results may provide a mechanism to some of the suffocation deaths related to car seats and other sitting and carrying devices.[169]

Safe sleep is paramount during maturation of the lower esophageal sphincter, which will abate the symptoms of GER with time. Therefore, supine positioning is the preferred safe sleep position for infants with GER or GERD. For a more extensive discussion of GER and GERD in the preterm and young infant, see the AAP clinical report "Diagnosis and Management of Gastroesophageal Reflux in Preterm Infants"[4] or the "Pediatric Gastroesophageal Reflux Clinical Practice Guidelines: Joint Recommendations of the North American Society for Pediatric Gastroenterology, Hepatology, and Nutrition and the European Society for Pediatric Gastroenterology, Hepatology, and Nutrition."[141]

CONCLUSIONS REGARDING GER AND GERD

1. GER is extremely common in infants in the NICU.
2. Because of the increased risk of SUID, infants should not have the head of the bed elevated, nor should they be laid down on their side or prone.
3. Term infants can be treated with small, frequent feeds; holding the infant upright after feeding; thickened feeds; elemental formula; and removal of the nasogastric or orogastric tube, when appropriate. If the mother is providing human milk, elimination of all cow milk protein from her diet may be beneficial.
4. Preterm infants can be treated as above, but care should be taken to avoid commercial thickeners because of the association with necrotizing enterocolitis.
5. For more information, refer to the AAP clinical report on GER in the preterm infant ("Diagnosis and Management of Gastroesophageal Reflux in Preterm Infants"[4]).

THERMOREGULATION

Temperature regulation in the newborn infant is frequently referred to as being immature at birth secondary to the lack of completely developed thermoregulatory mechanisms, including large surface area-to-volume ratios and the relatively small insulating body shell.[170] As a result of this immaturity, neonates do show greater fluctuations of body temperature and difficulty in achieving acceptable thermoregulation.

It is well-established that prevention of hypothermia and achieving normothermia in newborn infants decreases mortality and optimizes outcomes. Achieving a neutral thermal environment is the goal for every patient in the NICU. Achieving a neutral thermal environment requires that thermoregulatory control be a balance between heat production and heat loss. Measures to achieve this goal include drying the infant at birth; providing warmth and insulated surfaces, as needed; providing radiant heat; and avoiding cool air currents. In addition, humidity is routinely used in incubators in the NICU. Certain clinical scenarios require chemical mattresses and polyethylene wraps or bags to prevent heat loss.[171,172] Hats are also routinely used in the delivery room to reduce heat loss. Estimates of heat loss from the head and face of the newborn infant vary but have been reported at up to 85%.[173] Some estimates, based on study of clothed adults, may be significantly inflated. An infant simulation study using a heated mannequin model found wearing a hat decreased the local heat loss by an average of 18.9% in all clothed and thermal conditions.[174] The type of hat used to reduce heat loss is

important. A simple stocking net hat has been shown to provide minimal improvement in temperature.[175] Although data are inconsistent, a polyethylene hat has been shown to be more effective in preventing heat loss in the delivery room for preterm infants.[176] In a small study, researchers found a cotton-wool (Gamgee) material reduced heat loss in term infants.[177]

Although preterm infants cannot regulate their body temperature as well as term infants, their thermoregulatory ability improves with maturation.[178] Weight-based criteria for weaning out of the incubator to a cot or bassinet varies from center to center.[179–181] A Cochrane review in 2011 concluded that transfer to a cot when the infant attained a weight of 1600 g did not have adverse effects on temperature stability or weight gain, and earlier weaning from the incubator did not necessarily lead to earlier discharge.[182]

Discharge readiness is usually determined by demonstration of functional maturation, including the physiologic competencies of thermoregulation.[178] Often, the ability to increase metabolism and generate heat reaches that of the term infant before 40 weeks' PMA, which is reassuring at the time of discharge planning from the NICU. Prone sleeping infants have a reduced ability to lose heat, which can lead to overheating.[102] Evidence points toward probable differences in autonomic control of metabolism and cardiorespiratory function in the prone versus supine position.[170] Nonetheless, overheating, as well as prone positioning, is an independent risk factor for SUID and must be avoided.[1] Although studies have shown an increased risk of SUID with overheating, the definition of overheating has varied, making it difficult to recommend a specific room temperature guideline to avoid overheating.[183,184]

Infants should be dressed appropriately for the environment.[175–177] In term infants, this is usually 1 layer more than an adult. However, there is significant variation in how preterm infants are transitioned from the incubator to the open crib, including weight criteria, PMA, number of layers of clothing provided, and use of wearable blankets and hats.[179,180] In one study, infants were placed in the bassinet with 2 layers of blankets or a sleep sack and a hat.[180] Although the focus during transition to the open bassinet is on prevention of hypothermia, once the infant demonstrates temperature stability, providers should turn their attention to modeling safe sleep and the dangers of overheating and overbundling. Infants are safest when they do not sleep with blankets.[173,185] If there is concern that the infant will become cold, an infant sleeping bag, sleeping sack, or wearable blanket is recommended as an alternative to blankets. When using a sleeping bag, special care should be taken with the preterm infant to ensure they cannot slip inside and that the head cannot become covered.[186] Some wearable blankets come with a swaddle feature. There is no evidence to recommend swaddling (wrapping the infant in a light blanket or wearable blanket with a wrap) as a strategy to reduce the risk of SUID.[1] Refer to the section on developmentally sensitive care for a discussion of the risks and benefits of swaddling.

Parents and/or caregivers should be educated on evaluating the infant for signs of overheating, including sweating or the chest feeling hot to the touch.[1] Overbundling and covering of the face and head should be avoided.[173] Head covering is associated with an increased risk of SUID. This increased risk with head coverings generally refers to covering with bedding or bed clothes. Only one study refers specifically to hats, finding that although the majority did not wear hats, there were significantly more hat-wearing infants among the SIDS infants compared with the control infants.[187] A systematic review of 10 population-based, age-matched controlled studies found the pooled prevalence of head covering in SIDS victims was 24.6% compared with 3.2% of controls. The causal mechanism of this increased risk remains unclear, but hypoxia, rebreathing, and thermal stress have been hypothesized as mechanisms.[173] Although it may be unlikely that dislodgement of a hat could lead to obstruction of an infant's airway, there may be legitimate concern regarding their contribution to overheating and/or thermal stress. A recent article questioned the necessity of hats for preterm infants after initial stabilization.[188] A chart review of 729 infants transitioned out of supplemental heat without the use of hats found a failure rate attributable to hypothermia of 2.7%. Given the questionable benefit of hat use and the potential for harm, clinicians should weigh the risk/benefit ratio in regard to discharging an infant from the NICU with a hat. If the infant is discharged wearing a hat, the clinician should provide instruction for families to discontinue use once the infant demonstrates stable temperatures in the home environment. This should include education about how to determine that the infant's temperature is stable.

CONCLUSIONS REGARDING THERMOREGULATION

1. Preterm and low birth weight infants are prone to temperature instability and may require

additional bundling to avoid hypothermia.
2. Excessive bundling should be avoided because overheating and head covering have been associated with an increased risk of SUID.
3. If an infant is discharged wearing a hat, families should be counseled to discontinue its use once the infant demonstrates temperature stability in the home environment.
4. If swaddling is performed, it is important that it is done properly, the infant is always placed supine, and it is discontinued when the infant begins to attempt to roll.

HYPERBILIRUBINEMIA AND PHOTOTHERAPY

Hyperbilirubinemia is an extremely common problem in both the term and preterm infant. During the first week of life, up to 60% of term newborn infants and 80% of preterm infants will develop jaundice because of the immaturity of the liver, leading to elevated concentrations of circulating unconjugated bilirubin.[189] Beyond the common physiologic jaundice of the newborn infant, there are many hemolytic conditions and other abnormalities that can lead to excessive jaundice. Nomograms are available to help the clinician detect which term and late preterm infants are at higher risk of going on to develop excessive jaundice that untreated could lead to kernicterus and permanent bilirubin encephalopathy.[190]

The mainstay of therapy for neonatal unconjugated hyperbilirubinemia is phototherapy. The factors that affect the dose of phototherapy are the irradiance of the light used, the distance from the light source, and the amount of skin exposed.[189] The infant should be naked except for diaper and eye protection. The phototherapy dose increases as the distance from the light to the infant decreases. Spectral power increases as the amount of skin exposed to phototherapy increases and can be maximized by using a phototherapy blanket under the infant while using phototherapy lamps over the infant.

When using standard phototherapy units, many providers choose to rotate the infant between supine and prone positioning. Several small studies have been undertaken to evaluate the utility of changing the position of the neonate during phototherapy, and no benefit in relation to decrease in bilirubin concentrations was found.[191–193] All recent studies have been evaluated in a systematic review that also concluded that supine positioning is as effective as turning infants periodically.[192] Two more recent and larger trials provide additional evidence suggesting that positional change is unnecessary for successful use of phototherapy. Donneborg included infants as young as 33 weeks' gestation and used higher light irradiance compared with older studies.[193] The study demonstrated identical rates of decrease in total serum bilirubin at 12 and 24 hours after initiation of phototherapy, regardless of supine or alternating positioning. Most recently, Bhethanabhotla et al[194] studied 100 infants of greater than 34 weeks' gestational age and found no difference with or without positioning in the duration of phototherapy or the rate of decrease in total serum bilirubin concentration.

Although the AAP guideline "Management of Hyperbilirubinemia in the Newborn Infant 35 or More Weeks of Gestation" did not comment on positioning of the infant during phototherapy, there is an analysis and statement from the United Kingdom's National Institute for Health and Clinical Excellence (NICE) on this issue.[195] The NICE Guideline Development Group accepted that, in term infants, the position of the infant during phototherapy has no significant influence on duration of phototherapy or mean change in serum bilirubin concentration. It concluded that to ensure consistent advice regarding the risk of SIDS, infants should be placed in a supine position.[195]

The NICE recommendation did not include preterm infants, because it was released before the most recent studies that included infants as early as 33 weeks' gestation. However, the consistency of the results in both term and middle-to-late preterm infants should provide clinicians with confidence in maintaining these infants in a strictly supine position if there is no other contraindicating medical condition. Modeling the supine position is a powerful tool in the education of families regarding infant sleep safety and SUID risk reduction. These more mature preterm and term infants are likely to have short stays in the NICU, so early modeling of safe sleep is more pressing, and the use of phototherapy should not interfere with supine sleep positioning.[196]

CONCLUSIONS REGARDING PHOTOTHERAPY

1. Hyperbilirubinemia and the use of phototherapy is common in term and preterm infants in the NICU.
2. There is no benefit to changing an infant's position while under phototherapy. However, the provider may choose to place the infant on a bilirubin blanket, in addition to an overhead phototherapy unit, if the absolute total serum bilirubin concentration is increasing rapidly, in effect,

performing double-sided phototherapy.
3. Unless there are other competing medical issues, infants should be kept supine while receiving phototherapy to model and promote infant sleep safety.

NEONATAL OPIOID WITHDRAWAL SYNDROME

NOWS is a clinical condition observed in neonates experiencing withdrawal from in utero opiate exposure.[197] Symptoms caused by central nervous system irritability, autonomic nervous system dysfunction, and gastrointestinal and respiratory tract distress typically appear 2 to 3 days after birth and can last for weeks or months.[197] Although opiate replacement therapy may be indicated on the basis of the severity of clinical presentation, the foundation of treatment and support of the infant with NOWS is directed at supportive, nonpharmacologic care aimed at minimizing the stimulation that is being experienced and/or supporting the infant to self-regulate.[198,199] These measures include promoting SSC,[200] rooming-in and breastfeeding,[201–203] decreasing light and noise,[200] swaddling and positioning,[200] use of pacifiers and/or rockers,[200] and massage.[200] Many of these interventions, commonly associated with developmentally sensitive care, previously described in this report, have variably been shown to help support preterm infants' neuroregulation, decrease length of medical treatment, and decrease hospital length of stay.[198,200,203] Despite a paucity of evidence, these interventions are being used to help support infants struggling with NOWS.[198,200,203]

SSC has been recommended as a strategy to help support infants with NOWS for many of the same reasons as previously mentioned in this article, such as improved neurologic regulation, establishment of breastfeeding, and maternal bonding.[200] One of the benefits of SSC is to enhance breastfeeding,[204] which in turn has been shown to decrease the severity of NOWS symptoms, days of pharmacologic treatment, and hospital stay.[198,205] Current recommendations support breastfeeding when the mother is compliant with maintenance therapy.[197]

The importance of not falling asleep with the infant during SSC, especially after hospital discharge, should be stressed with opioid-dependent parents. The opioid-dependent parent falling asleep with the infant would be analogous to bed-sharing with someone who is impaired in his or her alertness or ability to arouse because of sedating medications, which greatly increases the risk of SIDS.[1] Falling asleep with the infant during SSC is of particular concern for the mother of an infant with NOWS, because during pregnancy, women often require increases in methadone dosing because of factors such as increased intravascular volume and increased tissue reservoir and hepatic metabolism of the drug.[206] The optimal approach to methadone dose management in the postpartum period, however, is not well defined, and there is the theoretical concern that methadone concentrations may increase as plasma volume and hepatic clearance return to the prepregnant state. Yet in a study of 101 methadone-maintained pregnant women, researchers found no significant increase in oversedation events: after adjusting for benzodiazepine prescriptions, the incident relative rate of an event among postpartum women compared with pregnant women was 1.74 (95% CI: 0.56–5.30).[206] Nevertheless, opioid exposure is still of concern because a retrospective study has implicated opiates in sudden infant death, with maternal methadone use identified in 31% of 32 neonatal deaths evaluated by autopsy.[207] It is unclear whether the deaths were directly related to the methadone or other environmental factors. In addition, the frequent occurrence of polysubstance use (eg, tobacco and alcohol) among those who use opioids further increases the risk of sudden infant death, particularly associated with bed-sharing.[208–210] Thus, presence of maternal substance use disorder warrants extensive safe sleep education before discharge from the hospital.

Swaddling is frequently used in the care of infants with NOWS and seems to be an effective therapeutic intervention for this population. Although no studies specifically address swaddling and infants with NOWS, it is believed the intervention may be useful to decrease excessive crying and promote sleep.[198,199,211] Refer to the section on developmentally sensitive care for additional information on benefits and risks of swaddling.

Swings and motion devices are commonly used in NICUs, well newborn units, and pediatric inpatient units to calm fussy infants, particularly those suffering from NOWS. Rocking devices have been used through the ages for their calming effect on crying infants. Although not extensively studied, there are reports demonstrating the consoling effect of rocking.[212,213] The data are inconsistent regarding direction of the movement, and one study showed more benefit by rocking at 60 cycles per minute versus 45 cycles per minute.[213] A recent study showed benefit of rocking by either a parent or mechanical device, although rocking by the parent appeared to be more effective.[214] It is important that staff use motion devices appropriately,

while infants are awake and properly monitored. In addition, infants should be moved to a safe sleep environment if they fall asleep in a swing or motion device, because these are not considered safe sleep surfaces. Although infants are under constant monitoring in the NICU environment, leaving a sleeping infant in a swing or motion device is poor modeling for families and undermines safe sleep messaging.

There is some evidence that placing infants who are experiencing narcotic withdrawal in the prone position decreases the severity of NOWS scores as well as caloric intake.[215] As described previously in this article, prone positioning may increase the risks of musculoskeletal abnormalities[108] as well as SUID, is not consistent with AAP safe sleep recommendations, and is not recommended as a strategy to console infants with NOWS outside of a monitored unit. Prone positioning may be useful for monitored inpatients during the acute withdrawal phase of NOWS but should be discontinued, and the patient should be placed in supine position as soon as possible and before discharge from the hospital.

The time that the infant may need these interventions focused on neurodevelopmentally sensitive care will depend on the length and severity of NOWS symptoms. Particularly in infants whose NOWS symptoms seem to worsen without these interventions, transition to safe sleep practices before discharge from the hospital often presents challenges to NICU clinicians and families. Each center caring for infants with NOWS should develop and implement a standardized process to identify when the infant has reached medical stability and transition to safe sleep recommendations before discharge from the hospital.

CONCLUSIONS REGARDING NOWS

1. There are some commonly used interventions in the treatment of NOWS (ie, prone positioning) that are not consistent with home infant sleep safety.
2. Early and frequent education is critical to prevent families from thinking that therapeutic interventions in the hospital that are not consistent with home infant safe sleep guidelines can be replicated in the home environment.
3. The use of therapeutic interventions that are not consistent with home infant sleep safety should be minimized. When they are necessary, it is important to review their use and transition to a safe sleep environment as early as possible.
4. Clear, consistent, safe sleep messaging should be emphasized with families of infants with NOWS well in advance of discharge from the hospital.

HUMAN MILK AND BREASTFEEDING

Although not directly related to the transition to safe sleep, a discussion about infant sleep safety is not complete without mentioning breastfeeding and human milk feeding. The benefits of breastfeeding are numerous, including decreased risk of infection; decreased risk of allergies, asthma, and eczema; decreased risk of obesity, inflammatory bowel disease, high cholesterol, and type I diabetes mellitus; and possibly decreased risk of some childhood cancers.[216] In addition, in preterm infants, human milk has been shown to improve feeding tolerance and reduce the risk of necrotizing enterocolitis.[217–220] Multiple studies have shown that breastfeeding is associated with a decreased risk of SUID.[221–223] A recent meta-analysis found that providing term infants with any human milk for at least the first 2 months of life decreased the risk of SUID by 40% (relative risk 0.60 [0.44–0.82]).[224]

The reduction in risk of SUID from human milk may be multifactorial. Human milk has biologically active components that are immunoprotective through their antimicrobial and immunomodulatory activity. Among the many components are white blood cells, stem cells, immunoglobulins (especially secretory immunoglobulin A), lactoferrin, lysozyme, and human milk oligosaccharides.[225,226] The decrease in viral infections (which have been associated with an increased risk of SUID[1]) may partially explain this protective effect of human milk. In addition, polyunsaturated fatty acids in human milk, in particular docosahexaenoic acid, are important in the overall maturation of the central nervous system, especially the cardiorespiratory center, and myelination of the brain.[227–230] In one study, infants who died of SIDS had delayed myelination of the brain compared with control infants.[231]

Given the increased risk of SUID in the preterm infant, breastfeeding and the use of human milk after discharge may be even more important in this population. However, successful maternal milk production is dependent on early initiation, and in the case of the preterm or term infant with respiratory distress, it requires the mother to provide expressed milk through pumping or hand expression. As a result, clinicians need to provide education regarding the benefits of breastfeeding on admission to the NICU, or earlier if possible,[232] and work in multidisciplinary teams to enhance support for breastfeeding, milk expression, and provision of mother's milk throughout the NICU stay.[233] Furthermore, preterm infants and their mothers require

significant support when they are discharged from the hospital and transition to direct breastfeeding in the home setting.[234]

Finally, as noted in the previous discussion on SSC, it is critical that parents be aware of the dangers of falling asleep with their infant. This is especially important when mothers are rooming-in with their infant and not under constant observation by NICU staff. Although it is often stated that breastfeeding naturally results in maternal drowsiness from the release of prolactin and oxytocin, there are few data to support this concept.[235,236] Breastfeeding mothers are often exhausted in the early days and weeks from sleep deprivation and disruptions in their normal circadian rhythms. In a 2019 study, researchers found that after delivery, new mothers averaged 3.7 hours of sleep, and the longest interval of sleep observed was between 2 and 3 hours throughout the postpartum hospital course.[237] Of the 101 participants, 50 required at least 1 intervention or corrective action to address unsafe sleep.[237]

Mothers may also be emotionally or physically exhausted from the stress and other demands of a NICU hospitalization.[238] The risks for infant falls or smothering are analogous to those seen with rooming-in on the well newborn unit with healthy mother-infant dyads. Studies have observed associations between postpartum sleepiness and fatigue and decline in cognitive neurobehavioral functioning.[239,240] Education of staff and families is crucial, and staff should also take care to evaluate the mother's level of sleepiness.[238,241] The risk of falls and sudden unexpected postnatal collapse should be minimized by conducting frequent assessments and monitoring of the mother-infant dyad and evaluating the level of maternal fatigue. If the mother or caregiver is tired or sleepy while holding the infant, the infant should be moved to a separate sleep surface.[62]

This can be an opportunity for open, nonjudgmental discussion regarding the family's infant sleep safety plan for home. The AAP 2016 policy statement on SIDS recommends room-sharing with the infant on a separate sleep surface.[2] The policy also states numerous conditions under which bed-sharing is particularly dangerous. And even in situations in which there are no other risk factors, there is some evidence of increased risk with bed-sharing, especially in the youngest age groups and among those who were born preterm or with low birth weight. Sample size limitations prevent a determination of how large that risk is, but clearly the data do not support a definitive conclusion that bed-sharing in the youngest group is safe, even under less hazardous circumstances. For additional information, refer to both the AAP clinical report "Safe Sleep and Skin-to-Skin Care in the Neonatal Period for Healthy Term Newborns"[62] and AAP technical report "SIDS and Other Sleep-Related Infant Deaths: Evidence Base for 2016 Updated Recommendations for a Safe Infant Sleeping Environment."[1]

CONCLUSIONS REGARDING HUMAN MILK AND BREASTFEEDING

1. The use of human milk is recommended for its numerous health benefits, including reducing the risk of SUID.
2. Special care should be taken when mothers are rooming-in and breastfeeding to minimize the risk of falling asleep with the infant in the adult bed.
3. Provide mothers with appropriate outpatient support to optimize breastfeeding success after discharge from the hospital.

A RATIONAL APPROACH TO TRANSITION OF THE NICU PATIENT TO A HOME SLEEP ENVIRONMENT

Consistent messaging and modeling in the newborn nursery have been shown to improve parental intent to keep infants supine and not share sleep surfaces.[11,242–244] In the NICU environment, McMullin et al found that a bundled intervention for nursing can lead to consistent modeling of safe sleep before hospital discharge. The intervention included nursing education, crib cards, written instructions reviewed with parents, and sleep sacks for modeling to parents. Audits 6 months after the intervention found 98% of infants supine in open cribs, 93% of infants in sleep sacks, and 88% of bassinets with safe sleep crib cards visible.[245]

Standardized programs have also demonstrated higher rates of supine sleep and other safe sleep behaviors in the home.[246,247] Given that 20% of SUID cases involve preterm infants and preterm infants are at a twofold to threefold increased risk of SUID,[248–250] it is critical that families of infants in the NICU be exposed to safe sleep environmental modeling and education for a successful transition to a safe sleep environment in the home. The AAP through its Committee on Fetus and Newborn recommends that "preterm infants should be placed supine for sleeping, just as term infants should, and the parents of preterm infants should be counseled about the importance of supine sleeping in preventing SUID. Hospitalized preterm infants should be kept predominantly in the supine position, at least from the postmenstrual age of 32 weeks onward, so that they become acclimated to supine sleeping before discharge."[3]

However, as outlined in this document, not all infants will be clinically ready to be maintained in a safe sleep environment by 32 weeks' PMA. Algorithms that account for some of the variables discussed in this report have been developed on the basis of literature review, expert opinions, and unit consensus.[14,251] Quality improvement programs using these algorithms can result in both more consistent modeling in the NICU and improved parental compliance with safe sleep practices. Hwang et al[251] showed a pre- to postintervention improvement with overall safe sleep environmental compliance in 2 community NICUs from 25.9% to 79.7% ($P < .001$). In another study, NICU compliance with supine positioning increased from 39% to 83% ($P < .001$), provision of a firm sleeping surface increased from 5% to 96% ($P = .001$), and the removal of soft objects from the bed improved from 45% to 75% ($P = .001$). Furthermore, parental compliance with safe sleep practices in the days after discharge from the NICU improved from 23% to 82% ($P < .001$). The largest improvements involved placing infants supine for sleep (93% vs 73%), dressing infants appropriately (93% vs 66%), and removing extra soft blankets from the crib (97% vs 61%).[14]

Although many of the studies showing improvement in modeling safe sleep have been single-center studies, a recent evaluation by Hwang et al[252] of a statewide quality improvement project, including 10 level III NICUs in Massachusetts, not only confirmed the utility of an integrated approach to safe sleep in the NICU but also demonstrated that it can be amplified across institutions at the state level via perinatal quality collaboratives. Over a 2-year period, 7261 cribs were audited for compliance with safe sleep, which was defined by 4 parameters: supine positioning; a flat crib with no incline; no positioning devices; and no toys, comforters, or fluffy blankets. Compliance increased from 48% at the start of the project to 76% at 1 year and 81% by 2 years. Three of the individual components had compliance greater than 90% at the end of the study.

Many states have been focusing efforts on hospital-based interventions to promote safe sleep behaviors, anticipating that the downstream effect will be a decrease in SUID and infant sleep-related deaths. Some studies and epidemiological data support this tactic. In Tennessee, Heitmann et al analyzed a Department of Health program to implement a safe sleep policy at all 71 birthing hospitals in the state. Audits revealed a 45.6% decrease in infants found with any risk factors for unsafe sleep. There were significant decreases in infants found asleep nonsupine, with a toy or object in the crib, and not sleeping in a crib.[253]

Creating a culture of infant sleep safety in the NICU setting can be challenging. At the institutional level, diffusion of innovation theory can help guide culture change. Successful quality improvement efforts require a team of key players, including (1) opinion leaders, the respected leaders who have influence over others; (2) change agents, the key people who support change, stabilize adoption, and solve problems; and (3) change aides, trustworthy people on the front lines who help maintain change.

In addition, people respond differently to change, so it is important to seek out the innovators or risk takers who like new things and the early adopters who accept change readily. It is equally important that change agents and aides work closely with the late majority or skeptics and the traditionalists who prefer the status quo. Resistance to change is common, so consensus building is essential to success. Ideally, the components of change should be developed by a multidisciplinary team to reflect input from physicians, nursing, lactation consultants, respiratory therapists, and development therapists (physical therapists, occupational therapists, and speech therapists). Having access to local, state, and national statistics regarding SUID can facilitate breakdown of barriers to promoting consistent safe sleep education and modeling. Statistics can be obtained through multiple sources, including state departments of health; the Centers for Disease Control and Prevention, through CDC Wonder linked birth and infant death records (https://wonder.cdc.gov/lbd.html); and yearly state child death review reports. In addition, hospitals can work together with local coroners, medical examiners, and child death review teams to provide feedback on the effectiveness of safety efforts. One study demonstrated the efficacy of a sustained quality improvement effort that linked outcome data from local child fatality review teams. The average death rate decreased from 1.08 infants per 1000 births preintervention to 0.48 infants per 1000 births after complete intervention with feedback from child fatality review teams and performance improvement methodology.[254] The authors concluded that repeated messaging and education by the entire nursery staff has the potential to play a role in reducing sleep-related deaths in infants born at a hospital.

CONCLUSIONS

As clinicians, we must find equipoise between the acute physiologic needs of the infant and the inevitable necessity to provide a home safe sleep environment before discharge from the hospital. There are many

competing and conflicting needs for the NICU patient and family. Preterm infants are at increased risk of SUID, so as providers, we should focus on sharing regular, repetitive, and consistent education with families throughout the hospitalization. Through our messaging with not only our words but also our modeling behaviors, we will enable NICU families to be properly prepared for the transition home to a safe sleep environment.

LEAD AUTHORS

Michael H. Goodstein, MD, FAAP
Dan L. Stewart, MD, FAAP
Erin L. Keels, DNP, APRN-CNP, NNP-BC
Rachel Y. Moon, MD, FAAP

COMMITTEE ON FETUS AND NEWBORN, 2019–2020

James Cummings, MD, FAAP, Chairperson
Ivan Hand, MD, FAAP
Ira Adams-Chapman, MD, MD, FAA
PSusan W. Aucott, MD, FAAP
Karen M. Puopolo, MD, FAAP
Jay P. Goldsmith, MD, FAAP
David Kaufman, MD, FAAP
Camilia Martin, MD, FAAP
Meredith Mowitz, MD, FAAP

LIAISONS

Timothy Jancelewicz, MD, FAAP – *American Academy of Pediatrics Section on Surgery*
Michael Narvey, MD – *Canadian Paediatric Society*
Russell Miller, MD – *American College of Obstetricians and Gynecologists*
RADM Wanda Barfield, MD, MPH, FAAP – *Centers for Disease Control and Prevention*
Lisa Grisham, APRN, NNP-BC – *National Association of Neonatal Nurses*

STAFF

Jim Couto, MA

TASK FORCE ON SUDDEN INFANT DEATH SYNDROME

Rachel Y. Moon, MD, FAAP, Chairperson
Elie Abu Jawdeh, MD, PhD, FAAP
Rebecca Carlin, MD, FAAP
Jeffrey Colvin, MD, JD, FAAP
Michael H. Goodstein, MD, FAAP
Fern R. Hauck, MD, MS

CONSULTANTS

Elizabeth Bundock, MD, PhD – *National Association of Medical Examiners*

Lorena Kaplan, MPH – *Eunice Kennedy Shriver National Institute for Child Health and Human Development*

Sharyn Parks Brown, PhD, MPH – *Centers for Disease Control and Prevention*

Marion Koso-Thomas, MD, MPH – *Eunice Kennedy Shriver National Institute for Child Health and Human Development*

Carrie K. Shapiro-Mendoza, PhD, MPH – *Centers for Disease Control and Prevention*

STAFF

James Couto, MA

ABBREVIATIONS

AAP: American Academy of Pediatrics
aOR: adjusted odds ratio
CI: confidence interval
CPSC: Consumer Product Safety Commission
DDH: developmental dysplasia of the hip
DP: deformational plagiocephaly
GER: gastroesophageal reflux
GERD: gastroesophageal reflux disease
NICE: National Institute for Health and Clinical Excellence
NOWS: neonatal opioid withdrawal syndrome
NSP: nonsynostotic plagiocephaly
PMA: postmenstrual age
SIDS: sudden infant death syndrome
SSC: skin-to-skin care
SUID: sudden unexpected infant death

FINANCIAL DISCLOSURE: The authors have indicated they have no financial relationships relevant to this article to disclose.

DOI: https://doi.org/10.1542/peds.2021-052046

Address correspondence to Michael Goodstein, MD, FAAP. E-mail: mgoodstein@wellspan.org

PEDIATRICS (ISSN Numbers: Print, 0031-4005; Online, 1098-4275).

FINANCIAL DISCLOSURE: The authors have indicated they have no financial relationships relevant to this article to disclose.

FUNDING: No external funding.

POTENTIAL CONFLICT OF INTEREST: The authors have indicated they have no potential conflicts of interest to disclose.

REFERENCES

1. Moon RY; Task Force on Sudden Infant Death Syndrome. SIDS and other sleep-related infant deaths: evidence base for 2016 updated recommendations for a safe infant sleeping environment. *Pediatrics*. 2016;138(5):e20162940
2. Moon RY; Task Force on Sudden Infant Death Syndrome. SIDS and other sleep-related infant deaths: updated 2016 recommendations for a safe infant sleeping environment. *Pediatrics*. 2016;138(5):e20162938
3. American Academy of Pediatrics Committee on Fetus and Newborn. Hospital discharge of the high-risk neonate. *Pediatrics*. 2008;122(5):1119–1126

4. Eichenwald EC; Committee on Fetus and Newborn. Diagnosis and management of gastroesophageal reflux in preterm infants. *Pediatrics.* 2018;142(1):e20181061
5. Attarian S, Tran LC, Moore A, Stanton G, Meyer E, Moore RP. The neurodevelopmental impact of neonatal morphine administration. *Brain Sci.* 2014;4(2):321–334
6. Kocek M, Wilcox R, Crank C, Patra K. Evaluation of the relationship between opioid exposure in extremely low birth weight infants in the neonatal intensive care unit and neurodevelopmental outcome at 2 years. *Early Hum Dev.* 2016;92:29–32
7. Steinhorn R, McPherson C, Anderson PJ, Neil J, Doyle LW, Inder T. Neonatal morphine exposure in very preterm infants-cerebral development and outcomes. *J Pediatr.* 2015;166(5):1200–1207.e4
8. Malloy MH, Hoffman HJ. Prematurity, sudden infant death syndrome, and age of death. *Pediatrics.* 1995;96(3 Pt 1):464–471
9. Aris C, Stevens TP, Lemura C, et al. NICU nurses' knowledge and discharge teaching related to infant sleep position and risk of SIDS. *Adv Neonatal Care.* 2006;6(5):281–294
10. Barsman SG, Dowling DA, Damato EG, Czeck P. Neonatal nurses' beliefs, knowledge, and practices in relation to sudden infant death syndrome risk-reduction recommendations. *Adv Neonatal Care.* 2015;15(3):209–219
11. Srivatsa B, Eden AN, Mir MA. Infant sleep position and SIDS: a hospital-based interventional study. *J Urban Health.* 1999;76(3):314–321
12. Moon RY, Oden RP, Grady KC. Back to Sleep: an educational intervention with women, infants, and children program clients. *Pediatrics.* 2004;113(3 pt 1):542–547
13. Rasinski KA, Kuby A, Bzdusek SA, Silvestri JM, Weese-Mayer DE. Effect of a sudden infant death syndrome risk reduction education program on risk factor compliance and information sources in primarily black urban communities. *Pediatrics.* 2003;111(4 pt 1). Available at: www.pediatrics.org/cgi/content/full/111/4/e347
14. Gelfer P, Cameron R, Masters K, Kennedy KA. Integrating "Back to Sleep" recommendations into neonatal ICU practice. *Pediatrics.* 2013;131(4). Available at: www.pediatrics.org/cgi/content/full/131/4/e1264
15. Brydges CR, Landes JK, Reid CL, Campbell C, French N, Anderson M. Cognitive outcomes in children and adolescents born very preterm: a meta-analysis. *Dev Med Child Neurol.* 2018;60(5):452–468
16. Vohr BR. Neurodevelopmental outcomes of extremely preterm infants. *Clin Perinatol.* 2014;41(1):241–255
17. Coughlin M, Gibbins S, Hoath S. Core measures for developmentally supportive care in neonatal intensive care units: theory, precedence and practice. *J Adv Nurs.* 2009;65(10):2239–2248
18. Symington A, Pinelli J. Developmental care for promoting development and preventing morbidity in preterm infants. *Cochrane Database Syst Rev.* 2006;(2):CD001814
19. Als H. Individualized developmental care for preterm infants. 2017. Available at: www.child-encyclopedia.com/sites/default/files/textes-experts/en/809/individualized-developmental-care-for-preterm-infants.pdf. Accessed December 10, 2018
20. Johnston C, Campbell-Yeo M, Disher T, et al. Skin-to-skin care for procedural pain in neonates. *Cochrane Database Syst Rev.* 2017;(2):CD008435
21. Conde-Agudelo A, Belizán JM, Diaz-Rossello J. Kangaroo mother care to reduce morbidity and mortality in low birthweight infants. *Cochrane Database Syst Rev.* 2011;(3):CD002771
22. Baley J; Committee on Fetus and Newborn. Skin-to-skin care for term and preterm infants in the neonatal ICU. *Pediatrics.* 2015;136(3):596–599
23. Shah PS, Herbozo C, Aliwalas LL, Shah VS. Breastfeeding or breast milk for procedural pain in neonates. *Cochrane Database Syst Rev.* 2012;(12):CD004950
24. Laffin M. *Position Paper: NICU Developmental Care.* Lonedell, MO: National Perinatal Association; 2008
25. Kenner C, McGrath J, eds. *Developmental Care of Newborns and Infants.* 2nd ed. Chicago, IL: National Association of Neonatal Nurses; 2015
26. Altimier L, Kenner C, Damus K. The Wee Care Neuroprotective NICU Program (Wee Care): the effect of a comprehensive developmental care training program on seven neuroprotective core measures for family-centered developmental care of premature neonates. *Newborn Infant Nurs Rev.* 2015;15:6–16
27. Milette I, Martel MJ, Ribeiro da Silva M, Coughlin McNeil M. Guidelines for the institutional implementation of developmental neuroprotective care in the neonatal intensive care unit. Part A: background and rationale. A joint position statement from the CANN, CAPWHN, NANN, and COINN. *Can J Nurs Res.* 2017;49(2):46–62
28. National Association of Neonatal Nurses. *Age-Appropriate Care of the Premature and Critically Ill Hospitalized Infant: Guideline for Practice.* Glenview, IL: National Association of Neonatal Nurses; 2011
29. Waitzman K. The importance of positioning the near-term infant for sleep, play, and development. *Newborn Infant Nurs Rev.* 2007;7(2):76–81
30. Madlinger-Lewis L, Reynolds L, Zarem C, Crapnell T, Inder T, Pineda R. The effects of alternative positioning on preterm infants in the neonatal intensive care unit: a randomized clinical trial. *Res Dev Disabil.* 2014;35(2):490–497
31. Drake E. *Positioning the Neonate for Best Outcomes Monograph.* Glenview, IL: National Association of Neonatal Nurses; 2017
32. Lockridge T, Podruchny A, Thorngate I. *Developmental Care CNE Learning Module Series: Infant Sleep Protocols.* Glenview, IL: National Association of Neonatal Nurses; 2018
33. Hunter J. *Developmental Care CNE Learning Module Series: Therapeutic Positioning: Neuromotor, Physiologic, and Sleep Implications.* Glenview, IL: National Association of Neonatal Nurses; 2018
34. Zarem C, Crapnell T, Tiltges L, et al. Neonatal nurses' and therapists' perceptions of positioning for preterm infants in the neonatal intensive care

unit. *Neonatal Netw.* 2013;32(2):110–116

35. Coughlin M, Lohman MB, Gibbins S. Reliability and effectiveness of an infant positioning assessment tool to standardize developmentally supportive positioning practices in the neonatal intensive care unit. *Newborn Infant Nurs Rev.* 2010;10(2):104–106
36. Koninklijke Philips N.V. *Therapeutic Positioning in the NICU.* Amsterdam, Netherlands: Koninklijke Philips N.V.; 2014
37. Spilker A, Hill C, Rosenblum R. The effectiveness of a standardised positioning tool and bedside education on the developmental positioning proficiency of NICU nurses. *Intensive Crit Care Nurs.* 2016;35:10–15
38. Jeanson E. One-on-one bedside nurse education as a means to improve positioning consistency. *Newborn Infant Nurs Rev.* 2013;13(1):27–30
39. Naugler MR, DiCarlo K. Barriers to and interventions that increase nurses' and parents' compliance with safe sleep recommendations for preterm infants. *Nurs Womens Health.* 2018;22(1):24–39
40. Patton C, Stiltner D, Wright KB, Kautz DD. Do nurses provide a safe sleep environment for infants in the hospital setting? An integrative review. *Adv Neonatal Care.* 2015; 15(1):8–22
41. McMullen SL. Transitioning premature infants supine: state of the science. *MCN Am J Matern Child Nurs.* 2013;38(1):8–12; quiz 13–14
42. Grazel R, Phalen AG, Polomano RC. Implementation of the American Academy of Pediatrics recommendations to reduce sudden infant death syndrome risk in neonatal intensive care units: An evaluation of nursing knowledge and practice. *Adv Neonatal Care.* 2010;10(6):332–342
43. Voos KC, Terreros A, Larimore P, Leick-Rude MK, Park N. Implementing safe sleep practices in a neonatal intensive care unit. *J Matern Fetal Neonatal Med.* 2015;28(14):1637–1640
44. Kuhlmann S, Ahlers-Schmidt CR, Lukasiewicz G, Truong TM. Interventions to improve safe sleep among hospitalized infants at eight children's hospitals. *Hosp Pediatr.* 2016;6(2):88–94
45. Graven SN. Early neurosensory visual development of the fetus and newborn. *Clin Perinatol.* 2004;31(2):199–216, v
46. Gray L, Philbin MK. Effects of the neonatal intensive care unit on auditory attention and distraction. *Clin Perinatol.* 2004;31(2):243–260, vi
47. Wachman EM, Lahav A. The effects of noise on preterm infants in the NICU. *Arch Dis Child Fetal Neonatal Ed.* 2011;96(4):F305–F309
48. Laudert S, Liu WF, Blackington S, et al; NIC/Q 2005 Physical Environment Exploratory Group. Implementing potentially better practices to support the neurodevelopment of infants in the NICU. *J Perinatol.* 2007;27(suppl 2):S75–S93
49. van Sleuwen BE, Engelberts AC, Boere-Boonekamp MM, Kuis W, Schulpen TW, L'Hoir MP. Swaddling: a systematic review. *Pediatrics.* 2007;120(4). Available at: www.pediatrics.org/cgi/content/full/120/4/e1097
50. van Sleuwen BE, L'hoir MP, Engelberts AC, et al. Comparison of behavior modification with and without swaddling as interventions for excessive crying. *J Pediatr.* 2006;149(4):512–517
51. Gerard CM, Harris KA, Thach BT. Spontaneous arousals in supine infants while swaddled and unswaddled during rapid eye movement and quiet sleep. *Pediatrics.* 2002;110(6). Available at: www.pediatrics.org/cgi/content/full/110/6/e70
52. Richardson HL, Walker AM, Horne RS. Minimizing the risks of sudden infant death syndrome: to swaddle or not to swaddle? *J Pediatr.* 2009;155(4):475–481
53. Nelson AM. Risks and benefits of swaddling healthy infants: an integrative review. *MCN Am J Matern Child Nurs.* 2017;42(4):216–225
54. Pease AS, Fleming PJ, Hauck FR, et al. Swaddling and the risk of sudden infant death syndrome: a meta-analysis. *Pediatrics.* 2016;137(6):e20153275
55. McDonnell E, Moon RY. Infant deaths and injuries associated with wearable blankets, swaddle wraps, and swaddling. *J Pediatr.* 2014;164(5):1152–1156
56. Ponsonby A-L, Dwyer T, Gibbons LE, Cochrane JA, Wang Y-G. Factors potentiating the risk of sudden infant death syndrome associated with the prone position. *N Engl J Med.* 1993;329(6):377–382
57. Nyqvist KH, Anderson GC, Bergman N, et al. Towards universal kangaroo mother care: recommendations and report from the first European conference and seventh international workshop on kangaroo mother care. *Acta Paediatr.* 2010;99(6):820–826
58. Rey SE, Martinez GH. *Maejo Racional del Nino Prematuro. Conference 1 Curso de Medicina Fetal y Neonatal.* Bogota, Colombia: Vundacion Vivar; 1981
59. Cleveland L, Hill CM, Pulse WS, DiCioccio HC, Field T, White-Traut R. Systematic review of skin-to-skin care for full-term, healthy newborns. *J Obstet Gynecol Neonatal Nurs.* 2017;46(6):857–869
60. Head LM. The effect of kangaroo care on neurodevelopmental outcomes in preterm infants. *J Perinat Neonatal Nurs.* 2014;28(4):290–299; quiz E3–E4
61. Bastani F, Rajai N, Farsi Z, Als H. The effects of kangaroo care on the sleep and wake states of preterm infants. *J Nurs Res.* 2017;25(3):231–239
62. Feldman-Winter L, Goldsmith JP; Committee on Fetus and Newborn; Task Force on Sudden Infant Death Syndrome. Safe sleep and skin-to-skin care in the neonatal period for healthy term newborns. *Pediatrics.* 2016;138(3):e20161889
63. Graham JM Jr, Kreutzman J, Earl D, Halberg A, Samayoa C, Guo X. Deformational brachycephaly in supine-sleeping infants. *J Pediatr.* 2005;146(2):253–257
64. Hummel P, Fortado D. Impacting infant head shapes. *Adv Neonatal Care.* 2005;5(6):329–340
65. Chang YJ, Anderson GC, Lin CH. Effects of prone and supine positions on sleep state and stress responses in mechanically ventilated preterm infants during the first postnatal week. *J Adv Nurs.* 2002;40(2):161–169
66. Chang YJ, Anderson GC, Dowling D, Lin CH. Decreased activity and oxygen desaturation in prone ventilated preterm infants during the first postnatal week. *Heart Lung.* 2002;31(1):34–42
67. Maynard V, Bignall S, Kitchen S. Effect of positioning on respiratory synchrony in non-ventilated pre-term

infants. *Physiother Res Int.* 2000;5(2):96–110

68. American Academy of Pediatrics AAP Task Force on Infant Positioning and SIDS. Positioning and SIDS [published correction appears in *Pediatrics.* 1992;90(2 pt 1):264]. *Pediatrics.* 1992;89(6 pt 1):1120–1126
69. Cavalier A, Picot MC, Artiaga C, et al. Prevention of deformational plagiocephaly in neonates. *Early Hum Dev.* 2011;87(8):537–543
70. Hutchison BL, Hutchison LA, Thompson JM, Mitchell EA. Plagiocephaly and brachycephaly in the first two years of life: a prospective cohort study. *Pediatrics.* 2004;114(4):970–980
71. Kluba S, Lypke J, Kraut W, Krimmel M, Haas-Lude K, Reinert S. Preclinical pathways to treatment in infants with positional cranial deformity. *Int J Oral Maxillofac Surg.* 2014;43(10):1171–1175
72. Mawji A, Vollman AR, Hatfield J, McNeil DA, Sauvé R. The incidence of positional plagiocephaly: a cohort study. *Pediatrics.* 2013;132(2):298–304
73. Ohman A, Nilsson S, Lagerkvist AL, Beckung E. Are infants with torticollis at risk of a delay in early motor milestones compared with a control group of healthy infants? *Dev Med Child Neurol.* 2009;51(7):545–550
74. Stellwagen L, Hubbard E, Chambers C, Jones KL. Torticollis, facial asymmetry and plagiocephaly in normal newborns. *Arch Dis Child.* 2008;93(10):827–831
75. de Chalain TM, Park S. Torticollis associated with positional plagiocephaly: a growing epidemic. *J Craniofac Surg.* 2005;16(3):411–418
76. Rogers GF. Deformational plagiocephaly, brachycephaly, and scaphocephaly. Part I: terminology, diagnosis, and etiopathogenesis. *J Craniofac Surg.* 2011;22(1):9–16
77. Aarnivala H, Vuollo V, Harila V, Heikkinen T, Pirttiniemi P, Valkama AM. Preventing deformational plagiocephaly through parent guidance: a randomized, controlled trial. *Eur J Pediatr.* 2015;174(9):1197–1208
78. Klimo P Jr, Lingo PR, Baird LC, et al. Congress of Neurological Surgeons systematic review and evidence-based guideline on the management of patients with positional plagiocephaly: the role of repositioning. *Neurosurgery.* 2016;79(5):E627–E629
79. Tamber MS, Nikas D, Beier A, et al. Congress of Neurological Surgeons systematic review and evidence-based guideline on the role of cranial molding orthosis (helmet) therapy for patients with positional plagiocephaly. *Neurosurgery.* 2016;79(5):E632–E33
80. Lennartsson F, Nordin P, Wennergren G. Teaching parents how to prevent acquired cranial asymmetry in infants. *J Pediatr Nurs.* 2016;31(4):e252–e261
81. Sargent B, Kaplan SL, Coulter C, Baker C. Congenital muscular torticollis: bridging the gap between research and clinical practice. *Pediatrics.* 2019;144(2):e20190582
82. Mazzola C, Baird LC, Bauer DF, et al. Congress of Neurological Surgeons systematic review and evidence-based guideline for the diagnosis of patients with positional plagiocephaly: the role of imaging. *Neurosurgery.* 2016;79(5):E625–E626
83. Flannery AM, Tamber MS, Mazzola C, et al. Congress of Neurological Surgeons systematic review and evidence-based guidelines for the management of patients with positional plagiocephaly: executive summary. *Neurosurgery.* 2016;79(5):623–624
84. Baird LC, Klimo P Jr, Flannery AM, et al. Congress of Neurological Surgeons systematic review and evidence-based guideline for the management of patients with positional plagiocephaly: the role of physical therapy. *Neurosurgery.* 2016;79(5):E630–E631
85. Shaw BA, Segal LS; Section on Orthopaedics. Evaluation and referral for developmental dysplasia of the hip in infants. *Pediatrics.* 2016;138(6):e20163107
86. Bache CE, Clegg J, Herron M. Risk factors for developmental dysplasia of the hip: ultrasonographic findings in the neonatal period. *J Pediatr Orthop B.* 2002;11(3):212–218
87. Imrie M, Scott V, Stearns P, Bastrom T, Mubarak SJ. Is ultrasound screening for DDH in babies born breech sufficient? *J Child Orthop.* 2010;4(1):3–8
88. Suzuki S, Yamamuro T. Avascular necrosis in patients treated with the Pavlik harness for congenital dislocation of the hip. *J Bone Joint Surg Am.* 1990;72(7):1048–1055
89. Barr LV, Rehm A. Should all twins and multiple births undergo ultrasound examination for developmental dysplasia of the hip?: A retrospective study of 990 multiple births. *Bone Joint J.* 2013;95-B(1):132–134
90. Mulpuri K, Song KM, Gross RH, et al. The American Academy of Orthopaedic Surgeons evidence-based guideline on detection and nonoperative management of pediatric developmental dysplasia of the hip in infants up to six months of age. *J Bone Joint Surg Am.* 2015;97(20):1717–1718
91. Murnaghan ML, Browne RH, Sucato DJ, Birch J. Femoral nerve palsy in Pavlik harness treatment for developmental dysplasia of the hip. *J Bone Joint Surg Am.* 2011;93(5):493–499
92. Rombouts JJ, Kaelin A. Inferior (obturator) dislocation of the hip in neonates. A complication of treatment by the Pavlik harness. *J Bone Joint Surg Br.* 1992;74(5):708–710
93. Mubarak S, Garfin S, Vance R, McKinnon B, Sutherland D. Pitfalls in the use of the Pavlik harness for treatment of congenital dysplasia, subluxation, and dislocation of the hip. *J Bone Joint Surg Am.* 1981;63(8):1239–1248
94. Kitoh H, Kawasumi M, Ishiguro N. Predictive factors for unsuccessful treatment of developmental dysplasia of the hip by the Pavlik harness. *J Pediatr Orthop.* 2009;29(6):552–557
95. Committee on Quality Improvement, Subcommittee on Developmental Dysplasia of the Hip, American Academy of Pediatrics. Clinical practice guideline: early detection of developmental dysplasia of the hip. *Pediatrics.* 2000;105(4 pt 1):896–905
96. Karp HN. Safe swaddling and healthy hips: don't toss the baby out with the bathwater. *Pediatrics.* 2008;121(5):1075–1076
97. Gerard CM, Harris KA, Thach BT. Physiologic studies on swaddling: an ancient child care practice, which may promote the supine position for infant sleep. *J Pediatr.* 2002;141(3):398–403

98. Kanetake J, Aoki Y, Funayama M. Evaluation of rebreathing potential on bedding for infant use. *Pediatr Int.* 2003;45(3):284–289

99. Kemp JS, Thach BT. Quantifying the potential of infant bedding to limit CO2 dispersal and factors affecting rebreathing in bedding. *J Appl Physiol (1985).* 1995;78(2):740–745

100. Kemp JS, Livne M, White DK, Arfken CL. Softness and potential to cause rebreathing: Differences in bedding used by infants at high and low risk for sudden infant death syndrome. *J Pediatr.* 1998;132(2):234–239

101. Patel AL, Harris K, Thach BT. Inspired CO(2) and O(2) in sleeping infants rebreathing from bedding: relevance for sudden infant death syndrome. *J Appl Physiol (1985).* 2001;91(6):2537–2545

102. Tuffnell CS, Petersen SA, Wailoo MP. Prone sleeping infants have a reduced ability to lose heat. *Early Hum Dev.* 1995;43(2):109–116

103. Ammari A, Schulze KF, Ohira-Kist K, et al. Effects of body position on thermal, cardiorespiratory and metabolic activity in low birth weight infants. *Early Hum Dev.* 2009;85(8):497–501

104. Fyfe KL, Yiallourou SR, Wong FY, Odoi A, Walker AM, Horne RS. Cerebral oxygenation in preterm infants. *Pediatrics.* 2014;134(3):435–445

105. Horne RSC, Fung ACH, NcNeil S, Fyfe KL, Odoi A, Wong FY. The longitudinal effects of persistent apnea on cerebral oxygenation in infants born preterm. *J Pediatr.* 2017;182:79–84

106. Wong FY, Witcombe NB, Yiallourou SR, et al. Cerebral oxygenation is depressed during sleep in healthy term infants when they sleep prone. *Pediatrics.* 2011;127(3). Available at: www.pediatrics.org/cgi/content/full/127/3/e558

107. Peng NH, Chen LL, Li TC, Smith M, Chang YS, Huang LC. The effect of positioning on preterm infants' sleep-wake states and stress behaviours during exposure to environmental stressors. *J Child Health Care.* 2014;18(4):314–325

108. Picheansathian W, Woragidpoonpol P, Baosoung C. Positioning of preterm infants for optimal physiological development: a systematic review. *JBI Library Syst Rev.* 2009;7(7):224–259

109. Wagaman MJ, Shutack JG, Moomjian AS, Schwartz JG, Shaffer TH, Fox WW. Improved oxygenation and lung compliance with prone positioning of neonates. *J Pediatr.* 1979;94(5):787–791

110. Albert RK, Hubmayr RD. The prone position eliminates compression of the lungs by the heart. *Am J Respir Crit Care Med.* 2000;161(5):1660–1665

111. Kassim Z, Donaldson N, Khetriwal B, et al. Sleeping position, oxygen saturation and lung volume in convalescent, prematurely born infants. *Arch Dis Child Fetal Neonatal Ed.* 2007;92(5):F347–F350

112. Wolfson MR, Greenspan JS, Deoras KS, Allen JL, Shaffer TH. Effect of position on the mechanical interaction between the rib cage and abdomen in preterm infants. *J Appl Physiol (1985).* 1992;72(3):1032–1038

113. Gillies D, Wells D, Bhandari AP. Positioning for acute respiratory distress in hospitalised infants and children. *Cochrane Database Syst Rev.* 2012;(7):CD003645

114. Bhat RY, Leipälä JA, Singh NR, Rafferty GF, Hannam S, Greenough A. Effect of posture on oxygenation, lung volume, and respiratory mechanics in premature infants studied before discharge. *Pediatrics.* 2003;112(1 pt 1):29–32

115. Levy J, Habib RH, Liptsen E, et al. Prone versus supine positioning in the well preterm infant: effects on work of breathing and breathing patterns. *Pediatr Pulmonol.* 2006;41(8):754–758

116. Hutchison AA, Ross KR, Russell G. The effect of posture on ventilation and lung mechanics in preterm and light-for-date infants. *Pediatrics.* 1979;64(4):429–432

117. Elder DE, Campbell AJ, Galletly D. Effect of position on oxygen saturation and requirement in convalescent preterm infants. *Acta Paediatr.* 2011;100(5):661–665

118. Leipälä JA, Bhat RY, Rafferty GF, Hannam S, Greenough A. Effect of posture on respiratory function and drive in preterm infants prior to discharge. *Pediatr Pulmonol.* 2003;36(4):295–300

119. Poets CF, von Bodman A. Placing preterm infants for sleep: first prone, then supine. *Arch Dis Child Fetal Neonatal Ed.* 2007;92(5):F331–F332

120. Insalaco LF, Scott AR. Peripartum Management of Neonatal Pierre Robin Sequence. *Clin Perinatol.* 2018;45(4):717–735

121. Committee on Fetus and Newborn, American Academy of Pediatrics. Apnea, sudden infant death syndrome, and home monitoring. *Pediatrics.* 2003;111(4 pt 1):914–917

122. Henderson-Smart DJ. The effect of gestational age on the incidence and duration of recurrent apnoea in newborn babies. *Aust Paediatr J.* 1981;17(4):273–276

123. Darnall RA, Chen X, Nemani KV, et al. Early postnatal exposure to intermittent hypoxia in rodents is proinflammatory, impairs white matter integrity, and alters brain metabolism. *Pediatr Res.* 2017;82(1):164–172

124. Janvier A, Khairy M, Kokkotis A, Cormier C, Messmer D, Barrington KJ. Apnea is associated with neurodevelopmental impairment in very low birth weight infants. *J Perinatol.* 2004;24(12):763–768

125. Pillekamp F, Hermann C, Keller T, von Gontard A, Kribs A, Roth B. Factors influencing apnea and bradycardia of prematurity - implications for neurodevelopment. *Neonatology.* 2007;91(3):155–161

126. Kurlak LO, Ruggins NR, Stephenson TJ. Effect of nursing position on incidence, type, and duration of clinically significant apnoea in preterm infants. *Arch Dis Child Fetal Neonatal Ed.* 1994;71(1):F16–F19

127. Heimler R, Langlois J, Hodel DJ, Nelin LD, Sasidharan P. Effect of positioning on the breathing pattern of preterm infants. *Arch Dis Child.* 1992;67(3):312–314

128. Keene DJ, Wimmer JEJ Jr, Mathew OP. Does supine positioning increase apnea, bradycardia, and desaturation in preterm infants? *J Perinatol.* 2000;20(1):17–20

129. Bhat RY, Hannam S, Pressler R, Rafferty GF, Peacock JL, Greenough A. Effect of prone and supine position on sleep, apneas, and arousal in preterm infants. *Pediatrics.* 2006;118(1):101–107

130. Ballout RA, Foster JP, Kahale LA, Badr L. Body positioning for spontaneously breathing preterm infants with apnoea. *Cochrane Database Syst Rev.* 2017;(1):CD004951

131. Eichenwald EC; Committee on Fetus and Newborn, American Academy of Pediatrics. Apnea of prematurity. *Pediatrics.* 2016;137(1):e20153757

132. Omari TI, Barnett CP, Benninga MA, et al. Mechanisms of gastro-oesophageal reflux in preterm and term infants with reflux disease. *Gut.* 2002;51(4):475–479

133. Omari TI, Barnett C, Snel A, et al. Mechanisms of gastroesophageal reflux in healthy premature infants. *J Pediatr.* 1998;133(5):650–654

134. Vandenplas Y, Rudolph CD, Di Lorenzo C, et al; North American Society for Pediatric Gastroenterology Hepatology and Nutrition; European Society for Pediatric Gastroenterology Hepatology and Nutrition. Pediatric gastroesophageal reflux clinical practice guidelines: joint recommendations of the North American Society for Pediatric Gastroenterology, Hepatology, and Nutrition (NASPGHAN) and the European Society for Pediatric Gastroenterology, Hepatology, and Nutrition (ESPGHAN). *J Pediatr Gastroenterol Nutr.* 2009;49(4):498–547

135. Vandenplas Y, Hassall E. Mechanisms of gastroesophageal reflux and gastroesophageal reflux disease. *J Pediatr Gastroenterol Nutr.* 2002;35(2):119–136

136. Peter CS, Sprodowski N, Bohnhorst B, Silny J, Poets CF. Gastroesophageal reflux and apnea of prematurity: no temporal relationship. *Pediatrics.* 2002;109(1):8–11

137. Mendes TB, Mezzacappa MA, Toro AA, Ribeiro JD. Risk factors for gastroesophageal reflux disease in very low birth weight infants with bronchopulmonary dysplasia. *J Pediatr (Rio J).* 2008;84(2):154–159

138. Schurr P, Findlater CK. Neonatal mythbusters: evaluating the evidence for and against pharmacologic and nonpharmacologic management of gastroesophageal reflux. *Neonatal Netw.* 2012;31(4):229–241

139. Berseth C. Motor function in the stomach and small intestine in the neonate. *NeoReviews.* 2006;7(1):e28–e33

140. Golski CA, Rome ES, Martin RJ, et al. Pediatric specialists' beliefs about gastroesophageal reflux disease in premature infants. *Pediatrics.* 2010;125(1):96–104

141. Rosen R, Vandenplas Y, Singendonk M, et al. Pediatric gastroesophageal reflux clinical practice guidelines: Joint recommendations of the North American Society for Pediatric Gastroenterology, Hepatology, and Nutrition and the European Society for Pediatric Gastroenterology, Hepatology, and Nutrition. *J Pediatr Gastroenterol Nutr.* 2018;66(3):516–554

142. Almeida MB, Almeida JA, Moreira ME, Novak FR. Adequacy of human milk viscosity to respond to infants with dysphagia: experimental study. *J Appl Oral Sci.* 2011;19(6):554–559

143. Beal J, Silverman B, Bellant J, Young TE, Klontz K. Late onset necrotizing enterocolitis in infants following use of a xanthan gum-containing thickening agent. *J Pediatr.* 2012;161(2):354–356

144. Salvatore S, Vandenplas Y. Gastroesophageal reflux and cow milk allergy: is there a link? *Pediatrics.* 2002;110(5):972–984

145. Martin RJ, Di Fiore JM, Hibbs AM. Gastroesophageal reflux in preterm infants: is positioning the answer? *J Pediatr.* 2007;151(6):560–561

146. Bhat RY, Rafferty GF, Hannam S, Greenough A. Acid gastroesophageal reflux in convalescent preterm infants: effect of posture and relationship to apnea. *Pediatr Res.* 2007;62(5):620–623

147. Corvaglia L, Rotatori R, Ferlini M, Aceti A, Ancora G, Faldella G. The effect of body positioning on gastroesophageal reflux in premature infants: evaluation by combined impedance and pH monitoring. *J Pediatr.* 2007;151(6):591–596.e1

148. van Wijk MP, Benninga MA, Davidson GP, Haslam R, Omari TI. Small volumes of feed can trigger transient lower esophageal sphincter relaxation and gastroesophageal reflux in the right lateral position in infants. *J Pediatr.* 2010;156(5):744–748.e1

149. Omari TI, Rommel N, Staunton E, et al. Paradoxical impact of body positioning on gastroesophageal reflux and gastric emptying in the premature neonate. *J Pediatr.* 2004;145(2):194–200

150. van Wijk MP, Benninga MA, Dent J, et al. Effect of body position changes on postprandial gastroesophageal reflux and gastric emptying in the healthy premature neonate. *J Pediatr.* 2007;151(6):585–590.e2

151. Byard RW, Beal SM. Gastric aspiration and sleeping position in infancy and early childhood. *J Paediatr Child Health.* 2000;36(4):403–405

152. Malloy MH. Trends in postneonatal aspiration deaths and reclassification of sudden infant death syndrome: impact of the "Back to Sleep" program. *Pediatrics.* 2002;109(4):661–665

153. Tablizo MA, Jacinto P, Parsley D, Chen ML, Ramanathan R, Keens TG. Supine sleeping position does not cause clinical aspiration in neonates in hospital newborn nurseries. *Arch Pediatr Adolesc Med.* 2007;161(5):507–510

154. Oden RP, Joyner BL, Ajao TI, Moon RY. Factors influencing African American mothers' decisions about sleep position: a qualitative study. *J Natl Med Assoc.* 2010;102(10):870–872, 875–880

155. Colson ER, McCabe LK, Fox K, et al. Barriers to following the back-to-sleep recommendations: insights from focus groups with inner-city caregivers. *Ambul Pediatr.* 2005;5(6):349–354

156. Mosley JM, Daily Stokes S, Ulmer A. Infant sleep position: discerning knowledge from practice. *Am J Health Behav.* 2007;31(6):573–582

157. Moon RY, Omron R. Determinants of infant sleep position in an urban population. *Clin Pediatr (Phila).* 2002;41(8):569–573

158. Moon RY, Patel KM, Shaefer SJ. Sudden infant death syndrome in child care settings. *Pediatrics.* 2000;106(2 pt 1):295–300

159. Moon RY, Weese-Mayer DE, Silvestri JM. Nighttime child care: inadequate sudden infant death syndrome risk factor knowledge, practice, and policies. *Pediatrics.* 2003;111(4 pt 1):795–799

160. Ottolini MC, Davis BE, Patel K, Sachs HC, Gershon NB, Moon RY. Prone infant sleeping despite the "Back to Sleep" campaign. *Arch Pediatr Adolesc Med.* 1999;153(5):512–517

161. Willinger M, Ko C-W, Hoffman HJ, Kessler RC, Corwin MJ. Factors associated with caregivers' choice of infant sleep position, 1994-1998: the National Infant Sleep Position Study. *JAMA.* 2000;283(16):2135–2142

162. Von Kohorn I, Corwin MJ, Rybin DV, Heeren TC, Lister G, Colson ER. Influence of prior advice and beliefs of mothers on infant sleep position. *Arch Pediatr Adolesc Med.* 2010;164(4):363–369

163. Meyers WF, Herbst JJ. Effectiveness of positioning therapy for gastroesophageal reflux. *Pediatrics.* 1982;69(6):768–772

164. Tobin JM, McCloud P, Cameron DJ. Posture and gastro-oesophageal reflux: a case for left lateral positioning. *Arch Dis Child.* 1997;76(3):254–258

165. Shuren JE. *Letter to Manufacturers Concerning Medical Claims About Infant Sleep Positioners: Devices Can Create Risk of Suffocation.* Washington, DC: US Food and Drug Administration; 2010

166. Peachman RR. Fisher-Price Rock 'n Play sleeper should be recalled, consumer reports says. 2019. Available at: https://www.consumerreports.org/recalls/fisher-price-rock-n-play-sleeper-should-be-recalled-consumer-reports-says/. Accessed April 20, 2019

167. US Consumer Product Safety Commission. Safety standard for infant sleep products. *Fed Regist.* 2019;84(218):60649–60963

168. Mannen EM, Carroll J, Bumpass DB, et al. *Biomechanical Analysis of Inclined Sleep Products.* Little Rock, AR: University of Arkansas; 2019

169. Batra EK, Midgett JD, Moon RY. Hazards associated with sitting and carrying devices for children two years and younger. *J Pediatr.* 2015;167(1):183–187

170. Sahni R. Temperature control in newborn infants. In: Polin RA, Rowitch DH, Benitz WE, Fox WW, eds. *Fetal and Neonatal Physiology.* Philadelphia, PA: Elsevier; 2017:459–489

171. Bissinger RL, Annibale DJ. Thermoregulation in very low-birth-weight infants during the golden hour: results and implications. *Adv Neonatal Care.* 2010;10(5):230–238

172. Altimier L. Thermoregulation: what's new? What's not? *Newborn Infant Nurs Rev.* 2012;12(1):51–63

173. Blair PS, Mitchell EA, Heckstall-Smith EM, Fleming PJ. Head covering - a major modifiable risk factor for sudden infant death syndrome: a systematic review. *Arch Dis Child.* 2008;93(9):778–783

174. Elabbassi EB, Chardon K, Bach V, Telliez F, Delanaud S, Libert JP. Head insulation and heat loss in naked and clothed newborns using a thermal mannequin. *Med Phys.* 2002;29(6):1090–1096

175. Roberts JR. *Use of a Stockinet Cap on Premature Infants After Delivery.* Denton, TX: Texas Women's University; 1981

176. Trevisanuto D, Doglioni N, Cavallin F, Parotto M, Micaglio M, Zanardo V. Heat loss prevention in very preterm infants in delivery rooms: a prospective, randomized, controlled trial of polyethylene caps. *J Pediatr.* 2010;156(6):914–917.e1

177. Stothers JK. Head insulation and heat loss in the newborn. *Arch Dis Child.* 1981;56(7):530–534

178. Jefferies AL; Canadian Paediatric Society, Fetus and Newborn Committee. Going home: facilitating discharge of the preterm infant. *Paediatr Child Health.* 2014;19(1):31–42

179. Schneiderman R, Kirkby S, Turenne W, Greenspan J. Incubator weaning in preterm infants and associated practice variation. *J Perinatol.* 2009;29(8):570–574

180. Shankaran S, Bell EF, Laptook AR, et al; Eunice Kennedy Shriver National Institute of Child Health and Human Development Neonatal Research Network. Weaning of moderately preterm infants from the incubator to the crib: a randomized clinical trial. *J Pediatr.* 2019;204:96–102.e4

181. Barone G, Corsello M, Papacci P, Priolo F, Romagnoli C, Zecca E. Feasibility of transferring intensive cared preterm infants from incubator to open crib at 1600 grams. *Ital J Pediatr.* 2014;40:41

182. New K, Flenady V, Davies MW. Transfer of preterm infants from incubator to open cot at lower versus higher body weight. *Cochrane Database Syst Rev.* 2011;(9):CD004214

183. Fleming PJ, Gilbert R, Azaz Y, et al. Interaction between bedding and sleeping position in the sudden infant death syndrome: a population based case-control study. *BMJ.* 1990;301(6743):85–89

184. Ponsonby A-L, Dwyer T, Gibbons LE, Cochrane JA, Jones ME, McCall MJ. Thermal environment and sudden infant death syndrome: case-control study. *BMJ.* 1992;304(6822):277–282

185. Mitchell EA, Blair PS. SIDS prevention: 3000 lives saved but we can do better. *N Z Med J.* 2012;125(1359):50–57

186. Moon RY, Hauck FR. Risk factors and theories. In: Duncan JR, Byard RW, eds. *SIDS Sudden Infant and Early Childhood Death: The Past, the Present and the Future.* Adelaide, Australia: University of Adelaide Press; 2018

187. Wilson CA, Taylor BJ, Laing RM, Williams SM, Mitchell EA. Clothing and bedding and its relevance to sudden infant death syndrome: further results from the New Zealand Cot Death Study. *J Paediatr Child Health.* 1994;30(6):506–512

188. Fulmer M, Zachritz W, Posencheg MA. Intensive care neonates and evidence to support the elimination of hats for safe sleep. *Adv Neonatal Care.* 2020;20(3):229–232

189. Maisels MJ, McDonagh AF. Phototherapy for neonatal jaundice. *N Engl J Med.* 2008;358(9):920–928

190. Bhutani VK, Johnson L, Sivieri EM. Predictive ability of a predischarge hour-specific serum bilirubin for subsequent significant hyperbilirubinemia in healthy term and near-term newborns. *Pediatrics.* 1999;103(1):6–14

191. Yamauchi Y, Kasa N, Yamanouchi I. Is it necessary to change the babies' position during phototherapy? *Early Hum Dev.* 1989;20(3–4):221–227

192. Lee Wan Fei S, Abdullah KL. Effect of turning vs. supine position under phototherapy on neonates with hyperbilirubinemia: a systematic review. *J Clin Nurs.* 2015;24(5–6):672–682

193. Donneborg ML, Knudsen KB, Ebbesen F. Effect of infants' position on serum bilirubin level during conventional phototherapy. *Acta Paediatr.* 2010;99(8):1131–1134

194. Bhethanabhotla S, Thukral A, Sankar MJ, Agarwal R, Paul VK, Deorari AK. Effect of position of infant during phototherapy in management of hyperbilirubinemia in late preterm and term neonates: a randomized controlled trial. *J Perinatol.* 2013;33(10):795–799

195. National Institute for Health and Care Excellence. Jaundice in newborn babies under 28 days. 2010. Available at: https://www.nice.org.uk/guidance/cg98. Accessed December 10, 2018

196. American Academy of Pediatrics Subcommittee on Hyperbilirubinemia. Management of hyperbilirubinemia in the newborn infant 35 or more weeks of gestation. *Pediatrics.* 2004;114(1):297–316

197. Hudak ML, Tan RC; Committee on Drugs; Committee on Fetus and Newborn; American Academy of Pediatrics. Neonatal drug withdrawal. *Pediatrics.* 2012;129(2). Available at: www.pediatrics.org/cgi/content/full/129/2/e540

198. Edwards L, Brown LF. Nonpharmacologic management of neonatal abstinence syndrome: an integrative review. *Neonatal Netw.* 2016;35(5):305–313

199. Ryan G, Dooley J, Gerber Finn L, Kelly L. Nonpharmacological management of neonatal abstinence syndrome: a review of the literature. *J Matern Fetal Neonatal Med.* 2019;32(10):1735–1740

200. Maguire D. Care of the infant with neonatal abstinence syndrome: strength of the evidence. *J Perinat Neonatal Nurs.* 2014;28(3):204–211; quiz E3–E4

201. Wachman EM, Schiff DM, Silverstein M. Neonatal abstinence syndrome: advances in diagnosis and treatment. *JAMA.* 2018;319(13):1362–1374

202. Grossman M, Seashore C, Holmes AV. Neonatal abstinence syndrome management: a review of recent evidence. *Rev Recent Clin Trials.* 2017;12(4):226–232

203. Walsh MC, Crowley M, Wexelblatt S, et al; Ohio Perinatal Quality Collaborative. Ohio Perinatal Quality Collaborative improves care of neonatal narcotic abstinence syndrome. *Pediatrics.* 2018;141(4):e20170900

204. Boundy EO, Dastjerdi R, Spiegelman D, et al. Kangaroo mother care and neonatal outcomes: a meta-analysis. *Pediatrics.* 2016;137(1):e20152238

205. Welle-Strand GK, Skurtveit S, Jansson LM, Bakstad B, Bjarkø L, Ravndal E. Breastfeeding reduces the need for withdrawal treatment in opioid-exposed infants. *Acta Paediatr.* 2013;102(11):1060–1066

206. Pace CA, Kaminetzky LB, Winter M, et al. Postpartum changes in methadone maintenance dose. *J Subst Abuse Treat.* 2014;47(3):229–232

207. Cohen MC, Morley SR, Coombs RC. Maternal use of methadone and risk of sudden neonatal death. *Acta Paediatr.* 2015;104(9):883–887

208. Blair PS, Fleming PJ, Smith IJ, et al. Babies sleeping with parents: case-control study of factors influencing the risk of the sudden infant death syndrome. CESDI SUDI research group. *BMJ.* 1999;319(7223):1457–1461

209. Blair PS, Sidebotham P, Evason-Coombe C, Edmonds M, Heckstall-Smith EM, Fleming P. Hazardous cosleeping environments and risk factors amenable to change: case-control study of SIDS in south west England. *BMJ.* 2009;339:b3666

210. Carpenter RG, Irgens LM, Blair PS, et al. Sudden unexplained infant death in 20 regions in Europe: case control study. *Lancet.* 2004;363(9404):185–191

211. Ohgi S, Akiyama T, Arisawa K, Shigemori K. Randomised controlled trial of swaddling versus massage in the management of excessive crying in infants with cerebral injuries. *Arch Dis Child.* 2004;89(3):212–216

212. Byrne M, Horowitz D. Rocking as a soothing intervention: the influence of direction and type of movement. *Infant Behav Dev.* 1981;4:207–218

213. Pederson DR. Soothing effect of rocking as determined by direction and frequency of movement. *Can J Behav Sci.* 1975;7(3):237–243

214. Möller EL, de Vente W, Rodenburg R. Infant crying and the calming response: parental versus mechanical soothing using swaddling, sound, and movement. *PLoS One.* 2019;14(4):e0214548

215. Maichuk GT, Zahorodny W, Marshall R. Use of positioning to reduce the severity of neonatal narcotic withdrawal syndrome. *J Perinatol.* 1999;19(7):510–513

216. Section on Breastfeeding. Breastfeeding and the use of human milk. *Pediatrics.* 2012;129(3). Available at: www.pediatrics.org/cgi/content/full/129/3/e827

217. Herrmann K, Carroll K. An exclusively human milk diet reduces necrotizing enterocolitis. *Breastfeed Med.* 2014;9(4):184–190

218. Assad M, Elliott MJ, Abraham JH. Decreased cost and improved feeding tolerance in VLBW infants fed an exclusive human milk diet. *J Perinatol.* 2016;36(3):216–220

219. Maffei D, Schanler RJ. Human milk is the feeding strategy to prevent necrotizing enterocolitis! *Semin Perinatol.* 2017;41(1):36–40

220. Boyd CA, Quigley MA, Brocklehurst P. Donor breast milk versus infant formula for preterm infants: systematic review and meta-analysis. *Arch Dis Child Fetal Neonatal Ed.* 2007;92(3):F169–F175

221. Ip S, Chung M, Raman G, Trikalinos TA, Lau J. A summary of the Agency for Healthcare Research and Quality's evidence report on breastfeeding in developed countries. *Breastfeed Med.* 2009;4(suppl 1):S17–S30

222. Hauck FR, Thompson JM, Tanabe KO, Moon RY, Vennemann MM. Breastfeeding and reduced risk of sudden infant death syndrome: a meta-analysis. *Pediatrics.* 2011;128(1):103–110

223. Vennemann MM, Bajanowski T, Brinkmann B, et al; GeSID Study Group. Does breastfeeding reduce the risk of sudden infant death syndrome? *Pediatrics.* 2009;123(3). Available at: www.pediatrics.org/cgi/content/full/123/3/e406

224. Thompson JMD, Tanabe K, Moon RY, et al. Duration of breastfeeding and risk of SIDS: an individual participant data meta-analysis. *Pediatrics.* 2017;140(5):e20171324

225. Andreas NJ, Kampmann B, Mehring Le-Doare K. Human breast milk: a review on its composition and bioactivity. *Early Hum Dev.* 2015;91(11):629–635

226. Ballard O, Morrow AL. Human milk composition: nutrients and bioactive factors. *Pediatr Clin North Am.* 2013;60(1):49–74

227. Fogerty AC, Ford GL, Willcox ME, Clancy SL. Liver fatty acids and the sudden infant death syndrome. *Am J Clin Nutr.* 1984;39(2):201–208

228. Xiang M, Alfvén G, Blennow M, Trygg M, Zetterström R. Long-chain polyunsaturated fatty acids in human milk and brain growth during early infancy. *Acta Paediatr.* 2000;89(2):142–147

229. Uauy R, Hoffman DR. Essential fat requirements of preterm infants. *Am J Clin Nutr.* 2000;71(1, suppl):245S–250S

230. Kum-Nji P, Mangrem CL, Wells PJ. Reducing the incidence of sudden infant death syndrome in the Delta region of Mississippi: a three-pronged approach. *South Med J.* 2001;94(7):704–710

231. Kinney HC, Brody BA, Finkelstein DM, Vawter GF, Mandell F, Gilles FH. Delayed central nervous system myelination in the sudden infant death syndrome. *J Neuropathol Exp Neurol.* 1991;50(1):29–48

232. Briere CE, Lucas R, McGrath JM, Lussier M, Brownell E. Establishing breastfeeding with the late preterm infant in the NICU. *J Obstet Gynecol Neonatal Nurs.* 2015;44(1):102–113

233. Hallowell SG, Spatz DL, Hanlon AL, Rogowski JA, Lake ET. Characteristics of the NICU work environment associated with breastfeeding support. *Adv Neonatal Care.* 2014;14(4):290–300

234. Noble LM, Okogbule-Wonodi AC, Young MA. ABM clinical protocol #12: transitioning the breastfeeding preterm infant from the neonatal intensive care unit to home, revised 2018. *Breastfeed Med.* 2018;13(4):230–236

235. World Health Organization. *Infant and Young Child Feeding: Model Chapter for Textbooks for Medical Students And Allied Health Professionals.* Geneva, Switzerland: World Health Organization; 2009

236. Heinrichs M, Baumgartner T, Kirschbaum C, Ehlert U. Social support and oxytocin interact to suppress cortisol and subjective responses to psychosocial stress. *Biol Psychiatry.* 2003;54(12):1389–1398

237. Bittle MD, Knapp H, Polomano RC, Giordano NA, Brown J, Stringer M. Maternal sleepiness and risk of infant drops in the postpartum period. *Jt Comm J Qual Patient Saf.* 2019;45(5):337–347

238. Rychnovsky J, Hunter LP. The relationship between sleep characteristics and fatigue in healthy postpartum women. *Womens Health Issues.* 2009;19(1):38–44

239. Insana SP, Montgomery-Downs HE. Sleep and sleepiness among first-time postpartum parents: a field- and laboratory-based multimethod assessment. *Dev Psychobiol.* 2013;55(4):361–372

240. Ronzio CR, Huntley E, Monaghan M. Postpartum mothers' napping and improved cognitive growth fostering of infants: results from a pilot study. *Behav Sleep Med.* 2013;11(2):120–132

241. Thach BT. Deaths and near deaths of healthy newborn infants while bed sharing on maternity wards. *J Perinatol.* 2014;34(4):275–279

242. Stastny PF, Ichinose TY, Thayer SD, Olson RJ, Keens TG. Infant sleep positioning by nursery staff and mothers in newborn hospital nurseries. *Nurs Res.* 2004;53(2):122–129

243. Mason B, Ahlers-Schmidt CR, Schunn C. Improving safe sleep environments for well newborns in the hospital setting. *Clin Pediatr (Phila).* 2013;52(10):969–975

244. Colson ER, Bergman DM, Shapiro E, Leventhal JH. Position for newborn sleep: associations with parents' perceptions of their nursery experience. *Birth.* 2001;28(4):249–253

245. McMullen SL, Lipke B, LeMura C. Sudden infant death syndrome prevention: a model program for NICUs. *Neonatal Netw.* 2009;28(1):7–12

246. Goodstein MH, Bell T, Krugman SD. Improving infant sleep safety through a comprehensive hospital-based program. *Clin Pediatr (Phila).* 2015;54(3):212–221

247. Kellams A, Parker MG, Geller NL, et al. TodaysBaby quality improvement: safe sleep teaching and role modeling in 8 US maternity units. *Pediatrics.* 2017;140(5):e20171816

248. Blair PS, Platt MW, Smith IJ, Fleming PJ; CESDI SUDI Research Group. Sudden infant death syndrome and sleeping position in pre-term and low birth weight infants: an opportunity for targeted intervention. *Arch Dis Child.* 2006;91(2):101–106

249. Oyen N, Markestad T, Skaerven R, et al. Combined effects of sleeping position and prenatal risk factors in sudden infant death syndrome: the Nordic Epidemiological SIDS Study. *Pediatrics.* 1997;100(4):613–621

250. Malloy MH. Prematurity and sudden infant death syndrome: United States 2005-2007. *J Perinatol.* 2013;33(6):470–475

251. Hwang SS, O'Sullivan A, Fitzgerald E, Melvin P, Gorman T, Fiascone JM. Implementation of safe sleep practices in the neonatal intensive care unit. *J Perinatol.* 2015;35(10):862–866

252. Hwang SS, Melvin P, Diop H, Settle M, Mourad J, Gupta M. Implementation of safe sleep practices in Massachusetts NICUs: a state-wide QI collaborative. *J Perinatol.* 2018;38(5):593–599

253. Heitmann R, Nilles EK, Jeans A, et al. Improving safe sleep modeling in the hospital through policy implementation. *Matern Child Health J.* 2017;21(11):1995–2000

254. Krugman SD, Cumpsty-Fowler CJ. A hospital-based initiative to reduce postdischarge sudden unexpected infant deaths. *Hosp Pediatr.* 2018;8(8):443–449

Trauma-Informed Care

- *Clinical Report*

CLINICAL REPORT Guidance for the Clinician in Rendering Pediatric Care

American Academy of Pediatrics
DEDICATED TO THE HEALTH OF ALL CHILDREN™

Trauma-Informed Care

Heather Forkey, MD, FAAP,[a] Moira Szilagyi, MD, PhD, FAAP,[b] Erin T. Kelly, MD, FAAP, FACP,[c] James Duffee, MD, MPH, FAAP,[d]
THE COUNCIL ON FOSTER CARE, ADOPTION, AND KINSHIP CARE, COUNCIL ON COMMUNITY PEDIATRICS, COUNCIL ON CHILD ABUSE AND NEGLECT, COMMITTEE ON PSYCHOSOCIAL ASPECTS OF CHILD AND FAMILY HEALTH

Most children will experience some type of trauma during childhood, and many children suffer from significant adversities. Research in genetics, neuroscience, and epidemiology all provide evidence that these experiences have effects at the molecular, cellular, and organ level, with consequences on physical, emotional, developmental, and behavioral health across the life span. Trauma-informed care translates that science to inform and improve pediatric care and outcomes. To practically address trauma and promote resilience, pediatric clinicians need tools to assess childhood trauma and adversity experiences as well as practical guidance, resources, and interventions. In this clinical report, we summarize current, practical advice for rendering trauma-informed care across varied medical settings.

INTRODUCTION

Experiences in childhood, both positive and negative, have a significant effect on subsequent health, mental health, and developmental trajectories. For many children and adolescents, traumatic experiences are all too common. Almost one-half of American children, or 34 million younger than 18 years, have faced at least 1 potentially traumatic early childhood experience.[1–7] Such traumas may include those originating outside the home, such as community violence, natural disasters, unintentional injuries, terrorism, immigrant or refugee traumas (including detention, discrimination,[6,8,9] or racism), and/or those involving the caregiving relationship, such as intimate partner violence, parental substance use, parental mental illness, caregiver death, separation from a caregiver, neglect, or abuse, originally defined as adverse childhood experiences (ACEs).[10] For many children, medical events, such as injury, medical procedures, and/or invasive medical treatments, can be traumatic. Given the robust science explaining the physiologic consequences of accumulated trauma experiences on the brain and body,[11–14] there have been calls for pediatric clinicians to address childhood trauma and child traumatic stress.[10,14–16] However,

abstract

[a]Department of Pediatrics, University of Massachusetts, Worcester, Massachusetts; [b]Divisions of General and Developmental-Behavioral Pediatrics, Department of Pediatrics, University of California, Los Angeles, Los Angeles, California; [c]Ambulatory Health Services, Philadelphia Department of Public Health, Philadelphia, Pennsylvania; and [d]Departments of Pediatrics and Psychiatry, Boonshoft School of Medicine, Wright State University, Dayton, Ohio

Drs Forkey, Szilagyi, Kelly, and Duffee were equally responsible for conceptualizing, writing, and revising the manuscript and considering input from all reviewers and the Board of Directors; and all authors approved the final manuscript as submitted.

DOI: https://doi.org/10.1542/peds.2021-052580

Address correspondence to Heather Forkey, MD. E-mail: heather.forkey@umassmemorial.org

PEDIATRICS (ISSN Numbers: Print, 0031-4005; Online, 1098-4275).

To cite: Forkey H, Szilagyi M, Kelly ET, et al. AAP COUNCIL ON FOSTER CARE, ADOPTION, AND KINSHIP CARE, COUNCIL ON COMMUNITY PEDIATRICS, COUNCIL ON CHILD ABUSE AND NEGLECT, COMMITTEE ON PSYCHOSOCIAL ASPECTS OF CHILD AND FAMILY HEALTH. Trauma-Informed Care. *Pediatrics.* 2021;148(2):e2021052580

practical guidance about how to consider, address, and operationalize this care, although necessary, has been insufficient.

Pediatric clinicians are on the front lines of caring for children and adolescents and, thus, have the greatest potential for early identification of and response to childhood trauma. Data indicate that, although pediatric providers intuitively understand the negative effects of trauma, they report a lack of knowledge, time, and resources as major barriers to providing trauma-informed care (TIC).[5,6] Yet, experts believe that the complete assessment of child and adolescent behavioral, developmental, emotional, and physical health requires consideration of trauma as part of the differential diagnosis to improve diagnostic accuracy and appropriateness of care.[17,18]

TIC is defined by the National Child Traumatic Stress Network as medical care in which all parties involved assess, recognize, and respond to the effects of traumatic stress on children, caregivers, and health care providers. This includes attention to secondary traumatic stress (STS), the emotional strain that results when an individual hears about the first-hand trauma experiences of another. In the clinical setting, TIC includes the prevention, identification, and assessment of trauma, response to trauma, and recovery from trauma as a focus of all services. TIC can be conceptualized in a public health stratification, as summarized in Table 1:

- primary prevention of trauma and promotion of resilience;
- secondary prevention and intervention for those exposed to potentially traumatic experiences, including caregivers, siblings, guardians, and health care workers; and
- tertiary care for children who display symptoms related to traumatic experiences.

This clinical report and the accompanying policy statement[19] address secondary prevention and intervention: practical strategies for identifying children at risk for trauma and/or experiencing trauma symptoms. "Children," unless otherwise specified, refers to youth from birth to 21 years of age. These clinical strategies and skills include the following[16,20]:

- knowledge about trauma and its potential lifelong effects;
- support for the caregiver-child relationship to build resilience and prevent traumatic stress reactions;
- screening for trauma history and symptoms;
- recognition of cultural context of trauma experiences, response, and recovery;
- anticipatory guidance for families and health care workers;
- avoidance of retraumatization;
- processes for referral to counseling with evidence-based therapies when indicated; and
- attention to the prevention and treatment of STS and associated sequelae.

Pediatricians have a powerful voice and reach that could promote the policies and procedures necessary to transform pediatric health care into a TIC system. This guidance for pediatric clinicians is organized around 5 strategies for implementation to become trauma informed: awareness, readiness, detection and assessment, management, and integration. The companion policy statement[19] outlines broad recommendations for implementing TIC in child health systems.

AWARENESS

Pediatric clinicians can promote resilience, identify adversity and trauma, and ameliorate the effects of adversity in their work with children and families. Although the epidemiology and physiology of trauma have been explored in the literature,[9,12,13,21,22] few concepts have been translated into the provision of practical TIC in pediatric settings.[6,16,23] Awareness of the science and epidemiology of trauma provides the scientific grounding for the practices of TIC.

TABLE 1 Range of Trauma Experiences, Symptoms, and Response

Potentially Traumatic Experiences	Trauma Symptoms (Table 5)	Office Response
None	None to some	Primary prevention: anticipatory guidance; resilience promotion
Single-incident or minor trauma	None or latent or mild	Secondary prevention: anticipatory guidance; resilience promotion; trauma-informed guidance; close monitoring: screen for trauma history and symptoms
Major event or cumulative	Mild to moderate	Secondary and tertiary prevention: anticipatory guidance; resilience promotion; psychoeducation; trauma-informed guidance, close monitoring, and follow-up; possible referrals to community services, mental health
Major event or cumulative	Moderate to severe	Tertiary prevention and treatment: anticipatory guidance; resilience promotion; psychoeducation; trauma-informed guidance, close monitoring, and follow-up; avoidance of retraumatization; referrals to community services; referral to evidence-based and evidence-informed trauma mental health services

Adapted from Forkey H, Griffin J, Szilagyi M. *Childhood Trauma and Resilience: A Practical Guide.* Itasca, IL: American Academy of Pediatrics; 2021.

Safe, Stable, and Nurturing Relationships

The most fundamental adaptational mechanism for any child is a secure relationship with a safe, stable, nurturing adult who is continuous over time in the child's life.[24] This is usually the child's parent or caregiver but can involve extended family and biological or fictive kin. It is in the protective context of this secure relationship that the child develops the varied resilience skills that will prevent or ameliorate the effects of cumulative adversities. The nurturing caregiver protects the child from harm, mediates the world for the child, and helps the child to develop the adaptive skills to manage stressful experiences. Physiology, in addition to psychology, is affected by protective relationships.[14,25–27]

Toxic Stress and Trauma

All children experience some stress and adversity at some point in life, but when it is managed within the context of these nurturing relationships, such events can be weathered and even used for growth. Adverse events that lead to the frequent or prolonged activation of the stress response (see Fig 1) in the relative absence of protective relationships has been termed "toxic stress" in the pediatric literature.[14] Toxic stress responses result from events that may be long lasting, severe in intensity, or frequent in occurrence. The available caregiver support is insufficient to turn off the body's stress response. It is critical to note that the toxic stress response has 2 components: the significant stressors and the relative insufficiency of protective relationships. In sum, there is a marked imbalance between stressors and protective factors.[28]

Toxic stress responses can result in potentially long-lasting or lifelong impairments in physical and mental health through biological processes that embed developmental, neurologic, epigenetic, and immunologic

Stress Responses

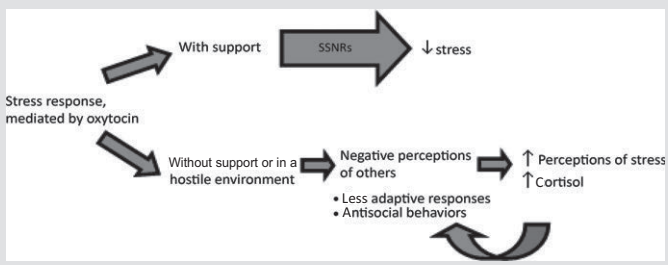
Freeze	• Originates in central nucleus of the amygdala and mediated by hypothalamus and superior colliculus[222] • Typically brief response, forces the organism to alert to danger • Can be followed by the fight-or-flight responses • Parasympathetic and vagal response can lead to dissociation or faint
Fight or flight	• Results from adrenal release of epinephrine and cortisol that allow the threat to be addressed • Short term: physiological changes, including increased heart rate and blood pressure • Excess or frequent activation in childhood can result in long-term changes in HPA axis function, which leads to dysregulation of the neuroendocrine stress response and consequent physiologic changes (see Table 2)[12,223]
Affiliate (gather social support, "tend and befriend")	• Higher brain response mediated by oxytocin,[224,225] appears to mediate stress within the social context by promoting the ability to look to others in the environment for support in managing a threat (social salience)[70,226] • With the provision of support, stress response declines[70,227] • Having no support or a hostile environment leads to negative perceptions of others, induces less adaptive responses and antisocial behaviors, and leads to increased perception of stress and increased cortisol[70,228-230] • Emerging science underlying the affiliative response elucidates how safe, stable, nurturing relationships can buffer adversity and promote resilience 

FIGURE 1 Stress responses. HPA, hypothalamic-pituitary-adrenal.

TABLE 2 Physiologic Effects of Trauma in Children

Area	Impact	Specifics	Implications and Associations
Brain connectivity[93]	Cortisol acts on rapidly developing brain structures	Amygdala overactive; hippocampus underactive; prefrontal cortex not accessible	Preliminary association with more severe clinical course in major depressive disorder
Epigenetic changes[21]	Methylation patterns impacted by threat, mediated by cortisol	Methyl groups attach to promoter region or come off promotor regions of genes, leading to the transcription or lack of transcription of genes	Adult stress and reactivity behavior[231,232]
Immune function[80]	Alteration of immune system in response to constant threat	Inflammatory system up-regulated; humoral immunity diminished; cytokine-induced "sickness behavior"[81] (feeling sick)	Symptoms including the following: decreased appetite, fatigue, mood changes including depression and irritability, poor cognitive function

changes.[12,14] The lifelong effects of toxic stress are statistically related to many adult illnesses, particularly those related to chronic inflammation, and causes for early mortality.[29] The robust literature on the physiologic effects of toxic stress is beyond the scope of this clinical report yet briefly summarized in Table 2.

Trauma is a broader term used to describe both a precipitant and a human response. The Substance Abuse and Mental Health Services Administration defines trauma as an event, series of events, or circumstances experienced by a person as physically or emotionally harmful that have long-lasting adverse effects on the person's functioning and well-being (emotional, physical, or spiritual).[16] This definition accounts for the fact that people may respond differently to potentially traumatic events and informs TIC with appreciation that the traumas people experience can result in behavioral changes that may allow them to manage the trauma in the short-term but can have lasting negative effects on conduct. These difficulties should not be viewed as malicious actions or even intentional but as consequences of adversity.[30]

Because these epidemiological and physiologic studies provide the background and impetus for TIC, understanding the terminology derived from this literature is important in appreciating the scope, variety, and nuances of TIC and how to actualize them. These are summarized in Table 3.

High-risk Populations

It is important to be aware that the exposures of some child populations and their families put them at particular risk of experiencing trauma but also that the components of TIC can benefit these children and families.[31–34] More than 7.4 million children, or nearly 1 in 10 children, are reported as potential victims of child abuse and neglect annually.[35] In 2019, more than 670 000 children spent time in foster care.[36] Children who remain at home after child protective services investigation or are moved to kinship care resemble their peers in foster care in having an extremely high prevalence of significant childhood trauma.[37–39] Immigrant and refugee children may have left poverty, war, and violence, may have encountered abuse or separation from family members, and can be at risk for deportation, detention, and separation and discrimination.[6,40,41] Poverty, or near poverty, affects approximately 43% of US children, and both urban and rural poverty have been linked with multiple stressors and increased risk of trauma.[42–44] Children of underrepresented racial, ethnic, and religious groups are more likely to be exposed to discrimination.[45,46] The psychological, interpersonal, and perhaps physiologic effects of trauma inflicted on a community (particularly because of race, identity, or ethnicity) may be passed to succeeding generations and is referred to as historical trauma.[47,48] Community violence and bullying, along with cyberbullying, are experienced by many children and recognized as traumatic exposures included in expanded definitions of ACEs.[49–51] Lesbian, gay, bisexual, transgender, and queer children and adolescents, children of color, American Indian and Alaskan native children, immigrant children, neurodiverse children and adolescents, and children and adolescents with overweight and obesity are all more likely to experience discrimination, both overt and as a series of microaggressions (small slights, insults, or indignities either intentional or unintentional) that accumulate over time.[52–54] Additionally, children of military families have a higher prevalence of trauma, abuse, grief, and loss.[55] Populations at higher risk for pediatric medical traumatic stress include preterm infants, children with complex and/or chronic medical conditions, and those suffering from serious injury or illness.[56] Up to 80% of children and family members experience trauma

TABLE 3 Definitions of Terminology in TIC

Terminology of Traumas	Definitions
Acute stress disorder and Post-traumatic stress disorder (PTSD)	Psychiatric diagnoses that include having experienced or witnessed a traumatic event and then having persistent symptoms that include the following: reexperiencing (intrusive thoughts, nightmares, or flashbacks); avoidance (feeling numb, refusing to talk about the event); hyperarousal (irritability, exaggerated startle response, always expecting danger); acute stress disorder: symptoms occur 3 d to 1 mo after traumatic exposure[81]; PTSD: symptoms must occur ≥3 mo after the trauma[233]
ACEs	Stressful or traumatic events, including child abuse and neglect, that occur within the primary caregiving relationship; often breach the parent-child relationship, which is fundamental to nurturing healthy development; linked in population studies to physiologic and behavioral changes impacting the health and well-being of patients over their life course with a wide array of health problems, including associations with substance misuse.[10,21,24,80] The original ACEs (from initial study published in 1998) are the following: physical abuse, sexual abuse, emotional abuse, physical neglect, emotional neglect, intimate partner violence, mother treated violently, substance misuse within household, household mental illness, parental separation or divorce, and incarcerated household member. Subsequent studies have expanded the original ACE panel to include other adversities,[9,234] including the following: experiencing racism, experiencing bullying, separation from caregiver (resulting from immigration, foster care, incarceration, death, or any other reason), witnessing violence, community violence,[49] adverse neighborhood experience,[235] and financial insecurity[236]
Complex childhood trauma (as defined by the National Child Traumatic Stress Network)	Encompasses both a child's exposure to multiple interpersonal traumatic events, including maltreatment and household dysfunction, and the broad, pervasive, and predictable impact this exposure has on the individual child[83,237]; can disrupt a child's attachment with caregivers, development, and sense of self
Developmental trauma disorder (DTD)	A proposed diagnosis based on evidence that children exposed to complex trauma are at risk for severe pervasive disruptions in their development in the domains of emotional health, physical health, attention, cognition, learning, behavior, interpersonal relationships, and sense of self; sometimes used interchangeably with complex childhood trauma; describes problems in affect dysregulation, negative self-concept, and difficulty with relationships that occur as a result of trauma-related developmental impairments; symptoms overlap or co-occur with several PTSD symptoms, but DTD includes a fuller spectrum of dysregulation resulting from the insults to multiple pathways in the developing brain when nurturing and is seen as a result of complex childhood trauma; more accurately describes the outcomes of such trauma in children than does the diagnosis PTSD[158,238]
Pediatric medical traumatic stress (PMTS)	The distress that children and family members experience during hospitalization for a perceived life-threatening diagnosis or while living with or caring for someone with life-altering chronic conditions[239–241]; often related to the person's subjective experience of the medical event rather than its objective severity and is mitigated by SSNRs that promote resilience
Secondary traumatic stress (STS)	A response that may occur in parents, other family members, and health care workers such as physicians, nurses, other hospital staff (including nonclinical staff), first responders, and therapists who are exposed to the suffering of others, particularly children[242]; may have many of the same long-term effects on health that affect children exposed to trauma; individual trauma histories can contribute to the reaction
Social determinants of health (SDoHs)	Conditions of the greater ecology or environment, occurring where people live, learn, work and play, which affect the neuroendocrine stress response and affect a wide range of health risks and outcomes[8,22]; can be mitigated by an SSNR and other protective factors and exacerbated by ACEs and intrafamilial and interpersonal traumas; examples include: poverty, food insecurity, homelessness, and lack of access to health care; examples that also overlap with the expanded ACEs include racism, discrimination, and community violence
Trauma	An event, series of events, or set of circumstances an individual experiences as physically or emotionally harmful that can have lasting adverse effects on the person's functioning and mental, physical, emotional, or spiritual well-being[14]; can occur outside caregiving relationships (eg, dog bites, natural disasters), within the context of the caregiving relationship (eg, exposure to domestic violence, various forms of abuse or disordered caregiving because of parental mental illness or substance use disorder), or in the context of relationships outside the family (racism, bias, discrimination, bullying)

symptoms after a life-threatening illness, injury, or painful medical procedure.[57]

READINESS

TIC transforms the fundamental questions in medical care from "What is wrong with you?" to "What happened to you?" and, finally, to "What's strong with you?" A trauma-informed approach acknowledges the biological effects of adversity without suggesting that childhood adversity is destiny. It requires a compassionate approach that does not suggest blame. It requires pediatric health care workers at every level to understand the context of a child's relationships, especially within the family, and ask, "What are the caregiver's strengths and challenges?" "What are the child's strengths and challenges?" and "Who supports you?" This changes the pediatric role from "I must fix you" to "I must understand you (and the relationships that created you and can help you heal)."[25,58] Thus, readiness includes an understanding of what provides resilience and how to promote it.

Relational Health Care

TIC is fundamentally relational health care, the ability to form and maintain safe, stable, and nurturing relationships (SSNRs). Pediatricians are able to support the caregiver-child relationship, the context in which there can be recovery from trauma and the restoration of resilience. Fundamental to these concepts is an understanding of attachment.

Attachment

Attachment describes the emotionally attuned give-and-take between caregiver and child and the trust, safety, and security provided to the child[59] that promotes healthy brain growth, development of accurate mental maps of self and others, development of resilience, and protection from trauma.[60] Fundamentally, the predictable compassionate availability of the caregiver promotes the secure attachment of the child.[61,62] Recent studies show attachment remains malleable beyond infancy, even into adolescence and adulthood, to some extent.[63,64]

Effective Parenting

Effective parenting encompasses the skills that caregivers bring to the task of parenting and is the context in which secure attachment develops and is relied on during and after traumatic experiences. Although caregivers approach parenting with a range of skills, attitudes, and beliefs rooted in their cultural and family contexts, studies have shown that effective or positive parenting has some universal features.[65–67]

It is through secure attachment with a predictably empathic caregiver that children learn to regulate their emotions. Children start by turning to a caregiver when upset. The caregiver comforts the child by touch, words, and compassion, which shuts down the stress response and restores emotional regulation. Secure attachment happens as a child predictably receives this sympathetic support from the caregiver when the child is distressed and the child comes to confidently anticipate that support. This relationship becomes a reliable source of safety, and the caregiver is a secure base from which the child can explore their environment.[62] Multiple studies have shown that a secure attachment relationship is the best means for building or rebuilding resilience in children; it is also the context for promoting healthy brain growth and development.[62,65,68,69] With these positive affiliative experiences, modulation of the stress response begins and includes the release of oxytocin, a potent hormone regulator of the sense of safety and well-being.[68,70]

Thus, the first step of TIC is to assess this aspect of the relationship, observing the child-caregiver interaction, including the caregiver's attention to the child, the caregiver's ability to read and respond to the child in developmentally appropriate ways, and the child's ease, comfort, and response to the caregiver. Discussion can begin by focusing on the caregiver's and child's strengths and noting the constructive aspects of the relationship while providing the caregiver with empathy. When attachment is strained, caregivers have often lost empathy for the child. The positive regard and attuned attentive listening provided before and while raising concerns supports the caregiver. The empathy provided to the caregiver thus allows the opportunity for them to reattune to the child.[62]

Resilience

Resilience is defined as a dynamic process of positive adaptation to or despite significant adversities.[71] This is not a static or innate quality but includes skills children can learn over time with reliable support from attachment figures. The development of resilience includes aptitudes that are attained through play, exploration, and exposure to a variety of normal activities and resources. Studies have shown that development can be robust, even in the face of severe adversity, if certain basic adaptational mechanisms of human development (resilience factors) are protected and in good working order. These mechanisms include attachment to a competent caregiver, cognitive development with opportunity for continued growth, mastery of age-salient developmental tasks, self-control or self-regulation, belief that life has meaning, hope for the future, a sense of self-efficacy, and a network of supportive relationships.[71] On the other hand, if those basic adaptational mechanisms or protective factors are absent or impaired before, during, or after the adversity, then the outcomes for children tend to be poorer[71] (see Table 4).

TABLE 4 Adaptational Mechanisms of Resilience

T	Thinking and learning brain, with opportunity for continued growth; cognitive development
H	Hope, optimism, faith, belief in a future for oneself
R	Regulation (self-regulation, self-control of emotions, behaviors, attention, and impulses)
E	Efficacy (self-efficacy) or sense that one can impact their environment or outcomes
A	Attachment, secure attachment relationship with safe, stable, and nurturing caregiver or competent caregiver
D	Development, mastery of age-salient developmental tasks
S	Social context, or the larger network of healthy relationships in which one lives and learns

Adapted from Masten AS. Ordinary magic. Resilience processes in development. *Am Psychol.* 2001;56(3)227–238; Forkey H, Griffin J, Szilagyi M. *Childhood Trauma and Resilience: A Practical Guide.* Itasca, IL: American Academy of Pediatrics; 2021.

Robust implementation of TIC is strength-based, building on family protective factors rather than emphasizing deficits. At almost every encounter, from early childhood through adolescence, pediatric care can include resilience promotion, building on identified strengths. Because resilience is a dynamic process of positive adaptation, routine anticipatory guidance about development or safety can be used to promote relational health and positive childhood experiences, including achievements at home, at school, and in neighborhoods, which enhance resilience.[72] When addressing adversities or concerns about development, surmounting the challenges can be framed with resilience and positive experiences as the goal.[73] For example, when speaking with a caregiver about a child learning to fall asleep on their own, sleep skills can be framed as building resilience by supporting self-regulation and self-efficacy. Alternatively, when a caregiver expresses concern about a child or teenager who had been sleeping until experiencing a traumatic event, the discussion can be framed around what resilience factors are being challenged (developmental skill mastery, self-efficacy, self-regulation) and which ones can be used to support the child's recovery (attachment and thinking).

DETECTION AND ASSESSMENT

Detection involves both surveillance and formal screening to identify children and families with the history of exposure to potentially traumatic experiences as well as those who exhibit signs and symptoms of trauma. Although TIC is common in social services and other mental health settings, in a health care environment, TIC can be conceptualized by using a medical model. Similar to other medical conditions, TIC includes purposeful triage, engagement, history-taking, surveillance and screening, examination, differential diagnosis, sharing of the diagnosis, and management, which may include office-based anticipatory guidance, referral, psychopharmacology, and/or follow-up or recommendations.

Surveillance for maladaptation after experiencing trauma includes consideration of all those who may be affected by exposure to the direct suffering of the child. Health care workers, such as first responders, nurses, social workers, trainees, physicians, and nonclinical hospital or clinic employees, may be deeply affected by witnessing or hearing about the traumatic experiences of children. Parents (biological, foster, kinship, or adoptive) are particularly at risk for prolonged trauma reactions that may impair their ability to care for and comfort their children. Siblings may also be affected, particularly when there is complex trauma or exposure to suffering, such as having a sibling with cancer or another life-altering disease that involves chronic pain.

Peri-trauma

Peri-trauma refers to situations in which medical providers are caring for children as the traumatic events are unfolding. One example is pediatric medical traumatic stress. Pediatric medical traumatic stress is a situation in which children experience medical procedures or other aspects of medical care as traumatic events. The effects of such trauma can be mitigated by attending to the child's and family's experience of medical care and reducing (as much as possible) frightening or painful aspects of necessary care and procedures. This mitigation can include asking children (and caregivers) about their fears and worries, optimizing pain management and comfort measures, and working with caregivers to increase their ability to provide effective support for their child. The Healthcare Toolbox includes a number of specific suggestions, including assessing distress (D), providing emotional support (E), and addressing the family needs (F)—a D, E, F protocol to follow the A, B, Cs of resuscitation.[74]

Another comprehensive strategy used by schools and community agencies when a mass trauma or disaster occurs is Psychological First Aid (PFA).[75] Developed by the National Child Traumatic Stress Network, PFA is an evidence-informed program that is designed to help children, families, adults, and other witnesses in the immediate aftermath of a disaster or terror event. Core skills for implementation of PFA are identical to TIC: establish an emotionally safe environment, connect with primary support persons (relational health), link to community resources, and provide psychoeducational materials to help understand the potential responses of children to the exposure.

Triage

The first step in medical care is to identify an emergency versus nonemergency situation. When dealing with trauma, its causes, or its consequences, consideration of whether a child may be emergently at risk requires assessment and response as a top priority. In practicing TIC, protocols and practices to identify and address child or family safety issues, both physical and psychological, are integral to care.

Trauma may result from children being in unsafe settings because of abuse, neglect, or impaired caregiving. When the practitioner suspects maltreatment or failure of the caregiver to protect a child at any point in a health encounter, referral to child protective services

is necessary and mandated. These issues need to be considered even before screening and addressed with standard protocols to respond to identified risks.[76–78]

Other immediate safety issues may arise when a consequence of trauma is self-harm or intent to injure others. Screening for suicidality, self-injury, or intent to harm others is included in TIC along with clear protocols for how to address positive endorsement of these issues.

Engagement

TIC creates a respectful and emotionally safe space in which to engage children, adolescents, and families around the discussion and management of these issues and to prevent retraumatization. Discussion of trauma may raise stress levels, and appropriate engagement reassures the child and family that the setting is safe. Culture can also affect how trauma is experienced and understood by families, and cultural awareness can ease the conversation. Engaging children and families begins with greeting the patient and family and being fully present in the moment while maintaining a balance between professionalism and friendliness. It involves initially asking open-ended questions, followed by more specific and probing questions as needed and that are elicited by caregiver and child or adolescent responses. It involves listening in an active, nonjudgmental, attuned way, reflecting back to the family what is heard for clarification and confirmation, seeking clarification when necessary, paraphrasing, attending to and reflecting on the emotions that accompany the information, and summarizing what is discussed. Implicit bias can affect the provider's ability to be nonjudgmental in these conversations.[46,79] Acceptance, curiosity, and empathy are conveyed to the patient or caregiver in the process of attentive listening.[61] Engagement also involves mutual regard between the provider and family. Adolescents and capable children bring their own perspective. Each brings expertise to the TIC of the child or adolescent. The provider has expertise in medicine, whereas the patient and family have expertise about the child, what happened, and their situation, beliefs, strengths, and culture.

When working with families and patients who have experienced trauma, the provider's body language, affect, and tone of voice can promote or inhibit care. Affect describes the facial and body expressions that reflect our emotional state. Individuals who have experienced trauma are more sensitive to body language, facial expressions, and tone of voice.[70] Approaching children slowly and calmly or letting them sit with a caregiver and using higher pitched, more musical speech may ease a child's tension because these sounds are associated with the release of oxytocin in the amygdala, resulting in calming of this threat-sensitive brain area. A shift to low tones during a discussion may alert a child or caregiver to potential danger and stimulate defensive responses.[61]

History

Much of the information needed to integrate TIC into practice may be obtained as part of the routine health evaluation. Social, developmental, and medical history are all opportunities to identify risks, stressors, and strengths. The health history provides an opportunity to assess child and family resilience factors, social connectedness, parenting attitudes, and skills. The review of systems allows the medical provider to collect symptoms of trauma that may not have been identified in the chief complaint but that can offer valuable insight into the current impact of trauma on the patient.[80,81] Symptoms may be functional, neurodevelopmental, or related to immune function.

1. Functional symptoms: Manifestation of the symptoms of trauma may evolve over time. Functional complaints can result after single-incident traumas (eg, automobile crash, hurricane) or may be early manifestations of complex trauma.[82–84] Sleep difficulty, changes in appetite, toileting concerns (eg, constipation, abdominal pain or enuresis), and challenges with school functioning (eg, poor attention or attendance) may be the early presentation of ongoing trauma.[84,85] Diagnostic criteria for attention-deficit/hyperactivity disorder and adjustment disorder overlap with some of these functional symptoms. When these signs and symptoms are noted, it can be useful to include trauma in the differential diagnosis.[17,86,87]
2. Neurodevelopmental symptoms: Some of the most recognizable manifestations of early trauma result from the effect on areas of the rapidly developing brain of young children. Developmental skill acquisition (higher brain) can be hindered as recognition of and response to threat is prioritized (lower brain).[88,89] Specific areas of the brain affected are the limbic system, hippocampus, and prefrontal cortex.[12,13,90–92] The prefrontal cortex is involved in cognition, emotional regulation, attention, impulse control, and executive function. Consequently, children may have developmental delay and behave as if they are younger than their actual age[89,93] (see Table 5 for an easy way to remember these effects). Other

TABLE 5 Most Common Symptoms of Trauma Exposure

F	Frets (anxiety and worry) and fears
R	Regulation difficulties (disorders of behaviors or emotions; hyperactive, impulsive, easily becomes aggressive or emotional; inattentive)
A	Attachment challenges (insecure attachment relationships with caregivers); poor peer relationships
Y	Yawning (sleep problems) and yelling (aggression, impulsivity)
E	Educational and developmental delays (especially cognitive, social-emotional, and communication)
D	Defeated (hopeless), depressed, or dissociated (separated from reality of moment, lives in own head)

Adapted from Forkey H, Griffin J, Szilagyi M. *Childhood Trauma and Resilience: A Practical Guide.* Itasca, IL: American Academy of Pediatrics; 2021.

observed symptoms may include the following:

- rapid, reflexive response to stimuli, reminders, or triggers[93,94];
- inattention, poor focus, hyperactivity, and difficulty completing tasks[86,95];
- difficulty tolerating negative mood so the child seeks ways to defuse the tension through hyperactivity, impulsive behaviors, aggression, self-harm, such as cutting and suicidality, or engagement in health risk behaviors (substance use, sexual activity)[89,95,96];
- reactions to stimuli, triggers, or reminders can be transient and flip suddenly back to "normal"; this appears to the observer as emotional lability[88,92]; and
- negative world view and self-narrative; flat affect; difficulty engaging socially or viewing themselves as worthless.[88,92,97]

3. Immune function symptoms: When a child is exposed to early, severe, or prolonged trauma, the immune system is chronically pressed into action, and, over time, changes can occur in the inflammatory system and humoral immunity.[80,89] A persistent inflammatory response can leave children vulnerable to diseases, such as asthma and metabolic syndrome.[80,98,99] Humoral immunity may be impaired so that children are more susceptible to infection. Additionally, immune system stimulation may result in the "sick syndrome," which is a perception of feeling unwell that can include headaches, stomachaches, and lethargy.[80,81]

Surveillance

Surveillance or monitoring is the process of recognizing children who might be at risk for being affected by trauma and is modeled after developmental surveillance. Surveillance is less formal than screening and can be conducted at every visit. Asking about caregivers' concerns, obtaining a trauma history, observing the child, and identifying risk and protective factors provides information about resilience supports and trauma exposure.[100] Surveillance requires attention to relationships and engagement. Questions such as "Has anything scary or concerning happened to you or your child since the last visit?" are a way to more specifically explore the possibility of adverse experiences.[85] Recognizing that certain symptoms may indicate exposure to childhood adversities, we can ask, "What has happened to you (or your family)?" For adolescents, these questions can be asked as part of the HEADSSS (questions about Home environment, Education and employment, Eating, peer-related Activities, Drugs, Sexuality, Suicide/depression, and Safety) psychosocial interview.[101,102] Questions that are considered less threatening are asked first and followed with questions that may be perceived as more intrusive.[101] Providers may be concerned that asking questions about a family's needs, a child's trauma history, or a child's symptoms may distress the child or caregiver, but studies in which this topic has been explored indicate that, when the topic is raised, families respond well to having the issues acknowledged and addressed in a supportive setting.[85,103,104]

Children only heal from trauma in the context of SSNRs, so it is also necessary to ask about the strengths that are already present in the family. Starting these conversations with questions about child, adolescent, or family strengths frames the conversation in a positive and resilience-focused way.[105,106] For instance, a clinician may ask how the child, adolescent, or family copes with stress, what a teenager does well, whether they have frequent family meetings to talk about solving problems, and whether each member of the family has someone to turn to for safety and comfort when they are upset. Trauma that occurs because of problems in the primary attachment relationship represents the greatest threat to the child or adolescent and may be the most challenging for providers to explore. Caregivers may have their own trauma histories or mental health struggles, substance use issues, and/or multiple stressors related to social determinants of health (SDoHs), including poverty, housing instability, and violence exposure that affect their parenting. Exploring parenting stressors, strengths, and attitudes in conversation can help the provider to pinpoint specific leverage points to help children but may also create an opportunity for the caregiver to reflect about the effects of their parenting or stressors on the child. TIC is compassionate and assumes that all caregivers love their children and are doing the best they can. It also assumes that children

are doing the best they can.[107,108] Adolescents should be included in these conversations and have a role in identifying strengths and challenges. Pediatricians who have cared for a family over time may already have considerable insight into the family's dynamics and be able to engage the caregivers in an empathic yet open conversation. Furthermore, compassionate surveillance can be combined with use of screeners or questionnaires to elicit more information.

Screening

Validated screeners used at preventive health care visits can provide valuable information about child development, mental health, and behavior.[109] They can be reassuring when normal or alert the pediatric provider to symptoms or risks when borderline or abnormal. Commonly used tools, such as the Ages and Stages Questionnaire,[110] the Pediatric Symptom Checklist,[111] the Strengths and Difficulties Questionnaire,[112] and the Patient Health Questionnaire-9[113] may elicit symptoms that are the possible result of trauma (developmental delays, social-emotional problems, anxiety, etc). Perinatal depression screening may not only identify symptoms of this illness but provide opportunities to explore maternal stressors and strengths.[114] Those exposed to known traumas can be evaluated by using standardized posttraumatic stress disorder (PTSD) screening tools such as the PTSD Reaction Index Brief Form,[115] and those exposed to medical traumas can be evaluated by using a tool such as the Psychosocial Assessment Tool.[116,117] The Pediatric Traumatic Stress Screening Tool in the Intermountain Care Process Model has been recently developed to screen for pediatric traumatic stress in the primary care setting, either as a universal screen or with targeted screening when traumas are known.[118] These tools effectively help identify the diagnostic criteria for PTSD, although they are not designed to identify the full spectrum of symptoms of complex trauma (developmental trauma disorder [DTD]).

Screening, per American Academy of Pediatrics (AAP) guidelines, suggests using instruments that are standardized and validated and have defined psychometric properties (sensitivity, specificity, positive predictive value). By that definition, there are currently no screening tools for ACEs and only a few validated screening tools for SDoHs. However, standardized (but not validated) tools are being used in some pediatric settings to assess ACEs and SDoHs and are using aggregate risk scoring to target providing increased support.[119–121] Many of the available screening tools expanded on the domains included in the original Centers for Disease Control and Prevention/Kaiser ACE study to include additional items applicable to urban and minority populations, including witnessing neighborhood violence and experiencing bullying or discrimination.[9] Parental ACE screening may offer the opportunity to align with caregivers and build a partnership to explore issues that may be affecting their parenting. Indeed, several recent studies suggest that parental ACEs can be linked with concerning outcomes for children.[122–125] Concurrent resilience screening offers the opportunity to identify protective factors that can buffer identified stressors, thus providing more nuanced understanding of a child's risk. Screening also offers the opportunity to then frame the discussion around promoting strengths in the caregiver-child relationship to protect a child from toxic stress and build adaptive skills.[107] Similar to ACE screening, there are few available standardized validated resilience screening tools, although the Connor-Davidson Resilience Scale[126] and Brief Resilience Scale[127] assess caregiver resilience.[128] (Readers are referred to the AAP Screening Technical Assistance Web site at https://www.aap.org/en-us/advocacy-and-policy/aap-health-initiatives/Screening/Pages/About-Us.aspx for developmental and SDoH screening tools.)

A limitation of ACE and SDoH screening tools is their lack of nuance: they identify risk factors that have been derived from epidemiological studies, not outcomes at the individual level.[129,130] Those outcomes are the result of the physiologic response to adversities. Although currently only available in the research setting, biomarkers of this physiologic response have the potential to be more accurate measures of the effects of adversity at the individual level.[131–133] Eventually, clinic-friendly, noninvasive biomarkers could also be used to identify patient-specific response to both stressors and therapeutic interventions.[134,135]

Screening health care workers for the effects of hearing about and addressing the trauma experiences of others is most commonly achieved with informal self-assessment strategies to identify symptoms or experiences that may be associated with burnout or STS.[136] Substance use disorder, depression, and suicidality may be associated with exposure to secondary trauma, and there appears to be overlap between burnout and STS.[137–144] An example of a screening tool for health care workers is the Professional Quality of Life Scale,[145] which includes subscales for compassion satisfaction, burnout, and STS.

Cultural considerations affect all aspects of TIC, including screening. Instruments that are not normed for the population or translated and validated in the language of the patient and family can result in misleading results. Thus, it is important to consider screening results cautiously with consideration of the family's culture and ethnicity in relation to the screening tool being used.[146]

Examination

Blood pressure measurement at preventive health visits or when stress is a potential etiologic factor for concerns is indicated.[147] Elevated blood pressure may be the first symptom of childhood traumatic stress, especially as youth age.[148,149] Abnormalities in hearing, vision, and growth parameters can be clues to adversities.[150,151] Overweight and obesity have been associated with ACEs.[152–154] Physical examination may reveal signs of neglect or abuse. The immunologic effect of trauma may result in inflammatory or infectious consequences identifiable on examination.[1,80,99,155,156] Children who have sustained cumulative ACEs and traumas may exhibit certain common behaviors the provider may witness during physical and mental health evaluation (refer to history and symptoms described earlier).

Differential Diagnosis Considerations and Comorbidities

The provider is encouraged to consider trauma as a possible etiology in the assessment of developmental, mental health, behavioral, and physical symptoms in all pediatric encounters because of the following: (1) the experience of adversity is so common; (2) the symptoms of trauma overlap with the symptoms of other common pediatric conditions[87,95]; and (3) failure to do so might lead to an incorrect or incomplete diagnosis and treatment, enabling the effects of trauma to further embed.[17,157,158] Trauma may be mistaken for other conditions, such as attention-deficit/hyperactivity disorder, and includes symptoms that overlap with other diagnostic categories, such as anxiety and depression.[86,87,159] It has been proposed that trauma may result in a different "ecophenotype" of common conditions that have a different trajectory and different response to common treatments.[93] Children may also have comorbid conditions, such as ADHD, anxiety, depression, or developmental and learning issues, because they frequently accompany childhood trauma. A more detailed description of diagnoses that are commonly confused with trauma or comorbid with it are covered in the AAP clinical report "Children Exposed to Maltreatment: Assessment and the Role of Psychotropic Medication."[87]

Diagnostic Continuum

Pediatric providers may encounter children with a wide range of symptoms resulting from trauma. As noted, trauma can result in short-term changes in behavior or have a more lasting impact depending on the child, the trauma itself, and the supports or emotional buffers in a child's life. When traumatic events are more severe, prolonged, or less buffered by a caregiver, effects on various aspects of functioning can be more severe.[1,160–163] Children exposed to chaotic households, abuse, or neglect, especially in the early years of life, may have more severe symptoms and symptoms that evolve over time.[94,159,164,165] Diagnostically, this may result in children who have functional symptoms (short-term problems with sleeping, eating, toileting), adjustment disorder, PTSD, or complex trauma symptoms.[163,166,167]

MANAGEMENT

Sharing the Diagnosis With Children and Caregivers

Some parents and caregivers may come to understand the role of adversities in their child's symptoms through discussion of the trauma history and symptoms, and others will require the provider to explain this connection before they can appreciate the provider's advice and recommendations. Psychoeducation is the first step in management of childhood trauma and includes empathic, nonjudgmental sharing of diagnostic information and provider concerns about the etiology of a child's symptoms The provider's role is to integrate the child or adolescent and caregiver's concerns, the child or adolescent's symptoms, and elements of a thorough history and examination into an explanation of why this raises a concern about trauma exposure or why trauma may be the underlying cause or one of the causes of a child's symptoms, much as is done for any diagnosis. A simple explanation of the pathophysiology of trauma may help the caregiver to move from frustration with the child or adolescent's behaviors or symptoms to empathy. In some situations, the explanation may also provide the caregiver with insight into their own history of trauma and its impact on their parenting behaviors or responses to their child's behaviors, or how an event that affected their child may have traumatized the caregiver as well.

Psychoeducation includes acknowledging that a trauma history can affect behavior and thoughts, with some discussion of how that happens. Table 6 has information on specific psychoeducation. The variable responses of children to trauma can be frustrating or confusing. Discussion of the emerging data on the biological sensitivity to context may be useful

TABLE 6 Responses to Trauma to Explain to Caregivers: Psychoeducation

Impacts of Trauma on Function and Behavior	Clinical Presentation
Changes in auditory processing	Children may lose the ability to hear sounds of safety (musical high-pitched voice) and be preferentially attuned to low-pitched sounds that warn of caregiver depression and anger.[247]
Changes in how children interpret facial expressions	Children may misinterpret the affects and emotions of others, particularly confusing anger and fear.[93]
Limited vocabulary for emotions	Children may also not accurately recognize or express their own emotions, leading them to act out or respond in ways that seem "off." What a child (or caregiver) identifies as "anger" may be disappointment, frustration, fear, grief, or anxiety.[88]
Negativity	Trauma results in children having overactive limbic systems with a focus on safety and a presumption of danger. This can result in strong negative reactions as the first response to a stimulus that might be benign or ambiguous.[61]
Triggers	Triggers can be physical (smells or sounds that recall details of the trauma) or emotional (feeling embarrassed or shamed, recalling how child felt during abuse). Prevention of exposures to reminders or triggers is the best approach. Triggers may be subtle, so educating and assisting caregivers with their identification is key. This helps caregivers understand a child's response.[167]
Learned Behavior	Behaviors that were adaptive for a child in a previous environment may be maladaptive in their current environment. These behaviors can evoke some of the same reactions from caregivers that the child experienced with other adults, reinforcing a familiar pattern of interactions that may not be productive in the new setting.[61]

Adapted from the National Child Traumatic Stress Network. Families and caregivers. Available at: https://www.nctsn.org/audiences/families-and-caregivers. Accessed January 11, 2021;[243] US Department of Health and Human Services, Administration for Children and Families. Resources on trauma for caregivers and families. Available at: https://www.childwelfare.gov/topics/responding/trauma/caregivers/. Accessed January 11, 2021[244]; and American Academy of Pediatrics. Parenting After Trauma: Understanding Your Child's Needs. Available at: https://www.aap.org/en-us/advocacy-and-policy/aap-health-initiatives/healthy-foster-care-america/Documents/FamilyHandout.pdf. Accessed June 24, 2021[245].

to caregivers.[168,169] Genetic variations in how a person responds to stress may contribute to a child's sensitivity to adversity.[170] Yet, those with high reactivity who are supported and learn to channel that reactivity to positive activities and passions may have the greatest potential.[168] This information, along with specific suggestions about how to support children, can address some of the consternation of caregivers regarding children's heterogeneous responses to both adversity and interventions.

Office-Based Anticipatory Guidance and Management

Trauma-informed anticipatory guidance provided by pediatricians can help families promote resilience and begin to address the effects of trauma. If screening for SDoHs is being conducted and/or social needs are identified, referral to applicable community-based services is indicated (eg, food bank, pro bono legal aid, etc). Having a list of community providers, such as Early Head Start, Head Start, evidence-based maternal, infant, and early childhood home visiting programs, state Maternal Child Health Title V programs, and Family to Family Health Information Centers ready for distribution, directly contacting the referral provider with the patient present, or providing formal care coordination all facilitate family engagement and help families connect to needed community resources. For older children and adolescents, trauma-informed schools and teenager crisis centers may be available in the community. In trauma-informed schools, personnel at all levels have a basic realization about trauma and an understanding of how trauma affects student learning and behavior in the school environment.[171,172]

Every encounter in an office setting, from those with young children to those with adolescents, is an opportunity to strengthen the attachment between a child and caregiver.[173] Through techniques such as reinforcing positive back-and-forth interactions between a parent and a child (serve and return), helping the caregiver to understand the child's experience (keeping the child's mind in mind), helping the children to learn words to describe a variety of emotions, and promoting self-reflection concerning the caregiver's own trauma history, the pediatric clinician can render primary prevention against the development of anxious and maladaptive attachment patterns and promote regulation.[82,174] Examples of relevant anticipatory guidance include advice, resources, or referrals to community programs, including Reach Out and Read[175–177]; developmentally appropriate play with others[178–180]; promoting positive, authoritative (in contrast to punitive or authoritarian) parenting styles[181–183]; and mindfulness.[184–186] Table 7 includes specific advice to promote regulation after trauma.

Referral for Treatment

The presence of complex symptoms, mental health diagnoses, substance abuse, and/or a significant trauma history are indications for referral to evidence-based trauma-informed mental health services.

TABLE 7 Anticipatory Guidance

	Office-Based Guidance to Promote Regulation After Trauma
Restoring safety	To reduce the stress response after trauma, caregivers can: repeatedly assure a child or teenager that they are safe now; allow the youth to express how they feel and listen attentively; provide extra physical contact (if appropriate) with hugs, touch, and rocking for younger children.
Routines	Routines or rituals also help reduce the stress response after the unpredictability and chaos of trauma by restoring a sense of order. Caregivers can use visual (pictorial schedule or charts) and verbal cues for well-defined mealtimes, sleep times, and rituals ("Before bed, we are going to brush teeth, read a story, sing a song, and then turn lights out"). Preparing children for changes in routines, or, for the child in foster care or the child of separated or divorced parents, for visitation, can reduce stress responses.
Relaxation techniques	Provide information verbally, with printed instructions or on phone apps that guide relaxation, meditation, and mindfulness. Refer to community programs that provide training in belly breathing, guided imagery, meditation, mindfulness, yoga, stretching, and massage, which can help to reduce the fight-or-flight responses and symptoms.[247]
Time-in or special time	Dedicated, child-chosen or child-directed play with a caregiver. Caregiver chooses a time that works for them and plans to spend 10 to 30 min with the child in fun activity of child's choosing. For infant or toddler, reading time is a good example of "time-in." Recommended for children from early childhood through adolescence.
Small successes	Children who experience trauma may have delays in skill development. Expectations may need to be tailored to the child's developmental level rather than actual age. It may take lots of repetition and practice before a skill or behavior is learned, so it is useful to celebrate and reward small steps toward desired behaviors.
Emotional container	Child may have strong emotions if reminded of trauma, and the emotions may be directed at the caregiver, although they are usually not about the caregiver. Caregiver needs to remain calm to model self-regulation and avoid retraumatizing the child.
Cognitive triangle	Thoughts impact feelings, which then impact behavior, which then reimpacts thoughts. For example, if children worry they cannot fall asleep, they will then feel nervous and stressed, and then not be able to fall asleep, reinforcing their cognitive belief that they cannot fall asleep. Similarly, if children think no one likes them, they will feel rejected and may lash out at another child, leading to rejection by that child and reinforcing their belief that they are not liked. It can help to identify this triangle and break the link between thoughts and emotions (through new experiences that link thought with different emotions) and/or the link between the emotions and the behavior ("It is ok to feel ___, but it is better to do ___ than to do ____." This technique involves labeling the emotions and teaching an alternative behavior.)
Distraction	Children who are dysregulating may benefit from distraction from the traumatic thoughts by suggesting a game, music, calling a friend, or deep breathing in a calm environment.
Positive parenting techniques	Positive parenting techniques have to be adapted to the age and developmental stage of the child, but they are principles that are known to work: (1) helping children identify and name their emotions; the next step for the child is to understand the emotion and then to learn healthy ways to express the emotion and build regulation skills; (2) reassuring safety and keeping the child safe both emotionally and physically; (3) attuned, attentive listening, which starts in infancy with "serve and return" but evolves into conversational exchanges over time; (4) setting appropriate boundaries and providing guidance through connecting and listening with children; it is best to teach rather than tell or command; for example, "We draw on paper, not on walls, because it is hard to wash markers off the walls"; (5) catching the child being good and offering the child positive, specific praise for good behaviors; (6) implementing rewards and privileges to create opportunities to develop skills; start small so the child can earn a reward quickly and then build up; (7) using positive language instead of "no" commands: for example, "We color on paper, not on the table," is a better way to approach a child who is drawing on the table than, "Stop that," Or, "we use gentle hands—we don't hit others"; (8) being a good role model as child mimics what they see rather than what they are told; (9) having some fun together as a family (time-in): read, talk, sing, play; (10) reinforcing positive skills as they develop: cooperation, politeness, appropriate assertiveness, kindness, etc; and (11) the law of natural consequences: sometimes the best lesson is letting the consequences play out (not cleaning your room means it will be a mess when your friends come over).

Adapted from Camoirano A. Mentalizing makes parenting work: a review about parental reflective functioning and clinical interventions to improve it. *Front Psychol.* 2017;8:14; Zuckerman B, Augustyn M. Books and reading: evidence-based standard of care whose time has come. *Acad Pediatr.* 2011;11(1)11–17; Zuckerman B, Khandekar, A. Reach Out and Read: evidence based approach to promoting early child development. *Curr Opin Pediatr.* 2010;22(4):539–544; Needlman R, Toker KH, Dreyer BP, Klass P, Medelsohn AL. Effectiveness of a primary care intervention to support reading aloud: a multicenter evaluation. *Ambul Pediatr.* 2005;5(4)209–215; Mendelsohn AL, Cates CB, Weisleder A, et al. Reading aloud, play, and social-emotional development. *Pediatrics.* 2018;141(5):e20173393; Shah R, DeFrino D, Kim Y, Atkins M. Sit Down and Play: a preventive primary care-based program to enhance parenting practices. *J Child Fam Stud.* 2017;26(2):540–547; Chang SM, Grantham-McGregor SM, Powell CA, et al. Integrating a parenting intervention with routine primary health care: a cluster randomized trial. *Pediatrics.* 2015;136(2)272–280; Girard LC, Doyle O, Tremblay RE. Maternal warmth and toddler development support for transactional models in disadvantaged families. *Eur Child Adolesc Psychiatry.* 2017;26(4):497–507; Weisleder A, Cates CB, Dreyer BP, et al. Promotion of positive parenting and prevention of socioemotional disparities. *Pediatrics.* 2016;137(2):e20153239; Shah R, Kennedy S, Clark MD, Bauer SC, Schwartz A. Primary care-based interventions to promote positive parenting behaviors: a meta-analysis. *Pediatrics.* 2016;137(5)e20153393; Perry-Parrish C, Copeland-Linder N, Webb L, Sibinga EMS. Mindfulness-based approaches for children and youth. *Curr Probl Pediatr Adolesc Health Care.* 2016;46(6):172–178; Bauer CCC, Caballero C, Scherer E, et al. Mindfulness training reduces stress and amygdala reactivity to fearful faces in middle-school children. *Behav Neurosci.* 2019;133(6):569–585; Ortiz R, Sibinga EM. The role of mindfulness in reducing the adverse effects of childhood stress and trauma. *Children (Basel).* 2017;4(3):16; Forkey H, Griffin J, Szilagyi M. Childhood Trauma and Resilience: A Practical Guide. Itasca, IL: American Academy of Pediatrics; 2021.

The most effective therapies are evidence-based treatments (EBTs) with demonstrated efficacy for children who have experienced trauma.[85,187,188] Treatments that are designated as evidence based have had the most rigorous evaluation, whereas evidence-informed treatments range from newly emerging practices that are building evidence support to less rigorously studied tools. Sege et al[189] published an overview of evidence-based individual and family-based psychotherapeutic interventions. Gleason et al[190] specifically outlined services for the treatment of young children. Having these services available on-site or through direct communication with colleagues in mental health (a "warm handoff") has been revealed to be the most effective approach.[191] It is important for caregivers who have their own history of trauma to seek individual therapy, and the pediatric provider may find it useful to have a list of adult mental health providers who address trauma. As research continues to elucidate the neurocognitive basis of trauma symptoms and methods to address those effects, new treatment modalities are being developed and may offer increased therapeutic resources for both adults and children.[192–194]

Even if therapies are not available on-site, it is useful to familiarize self and staff with evidence-based trauma therapies, how they work, how to refer locally and how to incorporate principals of treatment into pediatric anticipatory guidance. A quick reference for EBTs that includes a brief description of each and the level of evidence can be found on the California Evidence-Based Clearinghouse for Child Welfare (http://www.cebc4cw.org/). Some EBTs have been successfully adapted for telehealth,[195,196] and, in the wake of the coronavirus disease 2019 pandemic, opportunities for EBT via telehealth have expanded.[197] Telehealth is a mechanism to provide EBT in rural and other underresourced communities.[196]

Psychopharmacology

No medication, to date, is approved by the US Food and Drug Administration for trauma-specific symptoms or PTSD in children and adolescents. Medications may be judiciously considered for specific symptoms that are interfering with a child's ability to function normatively in specific ways.[72] Readers are referred to the AAP clinical report "Children Exposed to Maltreatment: Assessment and the Role of Psychotropic Medication" for discussion of medication use in identified comorbid mental health conditions.[87]

Role of Close Follow-up and Support

A commitment to working with the family over time may prevent or reduce feelings of abandonment or rejection, especially when community and mental health resources are in short supply. The pediatric provider who is continuous over time can continue to listen attentively and offer practical trauma-informed advice that reinforces resilience building and healing. Obtaining consent to share information with a mental health provider may also be reassuring to the caregiver or patient even after a referral and linkage to mental health care is established.

Integration

Once these aspects of care are part of a provider's repertoire of care, integrating knowledge about trauma into policies and procedures and daily practice are the next steps in creating a trauma-informed medical setting.[198,199]

Train All Staff in TIC

All staff, from schedulers to billers to nurses and care coordinators, can benefit from training in TIC that is thorough and discipline specific and includes information about physiology, presentation, recognition, and response.[15,200,201] This training would ideally promote patient empowerment and include caregiver and patient perspectives.

Implementing TIC in any setting is effective when there is consideration of clinic workflow to maintain efficiency. Specific strategies can include a warm and welcoming waiting room, clear communication of expectations and procedures, and providing choices when possible (eg, do you want blood pressure taken on right arm or left?).[201] As noted earlier, the care of a child who has experienced trauma requires an approach that is similar to addressing other health concerns. TIC can include members of the staff, all aware of and empowered to emphasize safety, patient self-efficacy, and a trauma-informed approach.[15,201] Use of formalized training in TIC for all staff has been found to be effective in changing staff-reported beliefs and behaviors for caregivers of children in residential care[202,203,204] and in improving child functioning and behavioral regulation.[204] In pediatrics, training of pediatrics residents caring for substance-exposed infants in TIC was effective at changing attitudes and improving therapeutic relationships.[205]

Office personnel may engage with caregivers and patients in ways that trigger strong emotions, especially if they themselves have experienced adversity or trauma. Financial considerations, scheduling, and conflict in the small spaces of an office can also be explored from a TIC perspective. Personnel would ideally engage in some planning

about how to handle a crisis or difficult situations that occasionally arise, such as the following: patients or caregivers who are indifferent or shut down, demanding, provocative, rejecting or hostile, or inattentive and distracted; or a child who is out of control and threatening to elope from the office. It is helpful to monitor one's own response when difficult situations arise and resist the urge to be angry or retaliate. It is less provocative to focus or comment on the emotion than the behavior: "I can see that you are angry, worried, sad, upset, etc," or "You probably don't want to be here right now." These responses are more affiliative and can help to shut down the stress response of the patient or caregiver whose fight-or-flight response may have been triggered by the health care setting, the interaction, or the medical stressor.

Integrated Health Care

Many providers find that the most efficient TIC can be provided by integrating physical and mental health services and social supports. Integrated care has been found to increase social-emotional screening rates[206] through colocation of services with clear strategies for medical provider introduction of the patient to the behavioral health consultant in real-time (warm handoff), by reducing the stigma of a mental health referral, or through facilitated or prearranged referral protocols.[191,207] Financial and staffing resource issues vary significantly by region, but investigating opportunities for primary care and mental health integration, social work, and/or formal engagement of referral sources and partnering organizations may increase the efficiencies of TIC. Providing case management to address the social modifiers of health (eg, referral to food bank, legal aid) can help to increase family resilience and prevent the consequences of trauma. Referring to resources has been revealed to be associated with increased employment, use of child care, and a decrease in the use of homeless shelters.[208]

Two-Generation Approach

Growing evidence has linked increasing parental ACE scores and negative effects on child health and development,[122,123,125,209] providing compelling evidence that taking a 2-generation approach is important. Families may customarily live in multigenerational family units, and this is a cultural norm for some. The opioid crisis has produced many kinship and grand-families, emphasizing the need for multigenerational care because both children and caregivers have suffered traumatic losses and may be influenced by their own trauma histories.[210] Addressing how adversity experienced by a caregiver in childhood may affect their parenting and resilience can have profound effects on a child's health and outcomes. This approach can include asking these questions in engagement, surveillance, and screening; careful consideration of how the provider or practice can and will respond to elicited issues is important before integrating this into practice flow.

Community Partnerships

Pediatric offices can develop methods to coordinate trauma-related care with schools, child care, early educators, courts, legal supports, child welfare services, and other community partners (see policy statement[19]).

Staff and Provider Support

Addressing the trauma experiences of others can have significant consequences for health providers and staff. Per the National Child Traumatic Stress Network, STS is the emotional distress that results when an individual hears about the first-hand trauma experiences of another.[136] The essential act of listening to trauma stories may take an emotional toll that compromises professional functioning and diminishes quality of life. Burnout is a syndrome characterized by a high degree of emotional exhaustion and depersonalization (ie, cynicism) and a low sense of personal accomplishment from work. Burnout refers more to general occupational stress and is not used to describe the effects of indirect trauma exposure specifically.[136] At least one meta-analysis concluded that job burnout contributes to, or at least increases the risk of, STS.[142] Recent surveys of medical students and residents reveal a high rate of depression (Patient Health Questionnaire-9 score >10) of 25% to 30%.[139,211] Some data indicate that more than 50% of the physician workforce in the United States suffers from burnout related to their profession.[212–214] For the individual physician, burnout can result in increased rates of apathy, depression, substance abuse, and suicide and can affect personal relationships.[139,212] STS similarly affects providers, although it is more often discussed in the mental health and child welfare literature rather than the medical literature.[144]

Detailed discussion of the response to burnout and STS is beyond the scope of this clinical report. However, effective TIC includes recognition of the effect of indirect trauma exposure on the workforce and safeguards to protect those caring for children and caregivers.[136,143] Acknowledgment that these are issues and providing resources to address them, with attention to leadership and supervision, have been cited as the most important first steps.[143,212,215] For both burnout and STS, support from the immediate supervisor and

organizational leadership have been demonstrated to be effective ways to combat the effects of trauma.[143,209] Team-based care, efficiencies in practice, and opportunities to share successes and frustrations with peers can all be helpful.[216–218] Promoting self-care remains an important part of TIC, with adequate time for rest, distance from the office or hospital, exercise, healthy diet, and prayer, meditation, or mindfulness shown to reduce symptoms of burnout and STS.[143,219,220] Such interventions are integral to developing and sustaining a trauma-informed practice and include all members of the health care team.

SUMMARY

TIC recognizes that exposure to adversities is common to many, if not most, children and that the developmental, behavioral, and health consequences can be profound and long lasting. Pediatric clinicians with an understanding of the physiology of both resilience and trauma are in a position to promote resilience, recognize and respond to traumas, and promote recovery.

Key Points

1. TIC is fundamentally relational health care, the ability to form and maintain SSNRs. Pediatric clinicians are well positioned to use a 2-generation approach, evaluate attachment relationships, and harness these attachments to encourage the caregiver's role in promoting regulation and resilience.
2. Providing TIC is achieved through common pediatric practices, starting with engagement and providing a safe setting for patients and families. Obtaining history, using surveillance or screening tools appropriate to the pediatric setting and clinical need, and effecting a response involving the pediatric provider and other community resources is consistent with addressing most health-related issues.
3. Trauma symptoms can vary, from changes in eating and sleeping to severe physical and mental health effects requiring extensive treatment. Individual differences in trauma symptoms relate to the interplay of exposures and buffering from SSNRs as well as genetic variations impacted by the early environment (biological differential sensitivity to context).
4. Treatment can begin in the office setting with psychoeducation and brief guidance for caregivers. Facilitating linkages to community resources for families to programs that promote positive parenting skills, regulation, and self-efficacy; address the SDoHs (poverty, housing, food insecurity, etc); or provide EBT further supports those at risk and can effectively treat those who are symptomatic.
5. Integrating this relational model of care to prevent and mitigate the impact of trauma so that all members of the care team feel supported and valued is integral to TIC. Addressing safety and supporting relationships that promote affiliative responses, decrease stress responses, and promote building resilience are principles of TIC for children, caregivers, and health care personnel.

Lead Authors

Heather Forkey, MD, FAAP
Moira Szilagyi, MD, PhD, FAAP
Erin T. Kelly, MD, FAAP, FACP
James Duffee, MD, MPH, FAAP

Council on Foster Care, Adoption, and Kinship Care Executive Committee, 2019–2021

Sarah H. Springer, MD, FAAP, Chairperson
Moira Szilagyi, MD, PhD, FAAP, Immediate Past Chairperson
Heather Forkey, MD, FAAP
Kristine Fortin, MD, MPH, FAAP
Mary Booth Vaden Greiner, MD, MS, FAAP
Todd J. Ochs, MD, FAAP
Anu N. Partap, MD, MPH, FAAP
Linda Davidson Sagor, MD, MPH, FAAP
Deborah L. Shropshire, MD, FAAP
Jonathan D. Thackeray, MD, FAAP
Douglas Waite, MD, FAAP
Lisa Weber Zetley, MD, FAAP

Liaisons

Jeremy Harvey – *Foster Care Alumni of America*
Wynne Shepard Morgan, MD – *American Academy of Child and Adolescent Psychiatry*
Camille Robinson, MD, FAAP – *Section on Pediatric Trainees*

Staff

Tammy Piazza Hurley
Mary Crane, PhD, LSW
Müge Chavdar, MPH

Council on Community Pediatrics Executive Committee, 2019–2021

James Duffee, MD, MPH, FAAP, Chairperson
Kimberly G. Montez, MD, MPH, FAAP, Vice Chairperson
Kimberley J. Dilley, MD, MPH, FAAP
Andrea E. Green, MD, FAAP
Joyce Javier, MD, MPH, MS, FAAP
Madhulika Mathur, MD, MPH, FAAP
Gerri Mattson, MD, FAAP
Kimberly Montez, MD, MPH, FAAP
Jacqueline L. Nelson, MD, FAAP
Mikah Owen, MD, MPH, FAAP
Kenya Parks, MD, MPH, FAAP
Christopher B. Peltier, MD, FAAP

Liaisons

Donene Feist – *Family Voices*
Rachel Nash, MD, MPH, MD – *Section on Pediatric Trainees*
Judith Thierry, DO, MPH, FAAP – *Committee on Native American Child Health*

ABBREVIATIONS

ACE: adverse childhood experience
DTD: developmental trauma disorder
EBT: evidence-based treatment
PFA: Psychological First Aid
PTSD: posttraumatic stress disorder
SDoH: social determinant of health
SSNR: safe, stable, and nurturing relationship
STS: secondary traumatic stress
TIC: trauma-informed care

FINANCIAL DISCLOSURE: The authors have indicated they have no financial relationships relevant to this article to disclose.

FUNDING: No external funding.

POTENTIAL CONFLICT OF INTEREST: The authors have indicated they have no potential conflicts of interest to disclose.

REFERENCES

1. Copeland WE, Keeler G, Angold A, Costello EJ. Traumatic events and posttraumatic stress in childhood. *Arch Gen Psychiatry*. 2007;64(5):577–584
2. Schilling EA, Aseltine RH Jr, Gore S. Adverse childhood experiences and mental health in young adults: a longitudinal survey. *BMC Public Health*. 2007;7:30
3. Burke NJ, Hellman JL, Scott BG, Weems CF, Carrion VG. The impact of adverse childhood experiences on an urban pediatric population. *Child Abuse Negl*. 2011;35(6):408–413
4. Lipschitz DS, Rasmusson AM, Anyan W, Cromwell P, Southwick SM. Clinical and functional correlates of posttraumatic stress disorder in urban adolescent girls at a primary care clinic. *J Am Acad Child Adolesc Psychiatry*. 2000;39(9):1104–1111
5. Suicide Prevention Resource Center; Substance Abuse and Mental Health Services Administration. Fact sheet: trauma among American Indians and Alaska natives. Missoula, MT: National Native Children's Trauma Center; 2016. Available at: https://www.sprc.org/resources-programs/fact-sheet-trauma-among-american-indians-alaska-natives. Accessed January 11, 2021
6. Miller KK, Brown CR, Shramko M, Svetaz MV. Applying trauma-informed practices to the care of refugee and immigrant youth: 10 clinical pearls. *Children (Basel)*. 2019;6(8):94

7. Bethell C, Davis MB, Gombojav N, Stumbo S, Powers K. Issue brief: a national and across-state profile on adverse childhood experiences among children and possibilities to heal and thrive. 2017. Available at: https://www.cahmi.org/wp-content/uploads/2018/05/aces_brief_final.pdf. Accessed January 11, 2021
8. Ellis WR, Dietz WH. A new framework for addressing adverse childhood and community experiences: the building community resilience model. *Acad Pediatr*. 2017;17(7S):S86–S93
9. Cronholm PF, Forke CM, Wade R, et al. Adverse childhood experiences: expanding the concept of adversity. *Am J Prev Med*. 2015;49(3):354–361
10. Garner AS, Shonkoff JP; Committee on Psychosocial Aspects of Child and Family Health; Committee on Early Childhood, Adoption, and Dependent Care; Section on Developmental and Behavioral Pediatrics. Early childhood adversity, toxic stress, and the role of the pediatrician: translating developmental science into lifelong health. *Pediatrics*. 2012;129(1):e224–e231
11. American Academy of Pediatrics. *Adverse Childhood Experiences and the Lifelong Consequences of Trauma*. Elk Grove Village, IL: American Academy of Pediatrics; 2014. Available at: https://www.aap.org/en-us/documents/ttb_aces_consequences.pdf. Accessed January 11, 2021
12. Anda RF, Felitti VJ, Bremner JD, et al. The enduring effects of abuse and related adverse experiences in childhood. A convergence of evidence from neurobiology and epidemiology. *Eur Arch Psychiatry Clin Neurosci*. 2006;256(3):174–186
13. Heim C, Shugart M, Craighead WE, Nemeroff CB. Neurobiological and psychiatric consequences of child abuse and neglect. *Dev Psychobiol*. 2010;52(7):671–690
14. Shonkoff JP, Garner AS; Committee on Psychosocial Aspects of Child and Family Health; Committee on Early Childhood, Adoption, and Dependent Care; Section on Developmental and Behavioral Pediatrics. The lifelong effects of early childhood adversity and toxic stress. *Pediatrics*. 2012;129(1):e232–e246
15. Marsac ML, Kassam-Adams N, Hildenbrand AK, et al. Implementing a trauma-informed approach in pediatric health care networks. *JAMA Pediatr*. 2016;170(1):70–77
16. Substance Abuse and Mental Health Services Administration. *SAMHSA's Concept of Trauma and Guidance for a Trauma-Informed Approach*. Rockville, MD: Substance Abuse and Mental Health Services Administration; 2014
17. Stein REK, Storfer-Isser A, Kerker BD, et al. Beyond ADHD: how well are we doing? *Acad Pediatr*. 2016;16(2):115–121
18. Horwitz SM, Storfer-Isser A, Kerker BD, et al. Barriers to the identification and management of psychosocial problems: changes from 2004 to 2013. *Acad Pediatr*. 2015;15(6):613–620
19. Duffee J, Szilagyi M, Forkey H, Kelly ET; American Academy of Pediatrics, Council on Community Pediatrics, Council on Foster Care, Adoption, and Kinship Care, Council on Child Abuse and Neglect, Committee on Psychosocial Aspects of Child and Family Health. Policy statement: trauma-informed care in child health systems. *Pediatrics*. 2021;148(2):e2021052579
20. National Child Traumatic Stress Network. *The 12 Core Concepts: Concepts for Understanding Traumatic Stress Responses in Children and Families*. Los Angeles, CA: National Child Traumatic Stress Network; 2007. Available at: https://www.nctsn.org/resources/12-core-concepts-concepts-understanding-traumatic-stress-responses-children-and-families. Accessed January 11, 2021
21. Houtepen LC, Vinkers CH, Carrillo-Roa T, et al. Genome-wide DNA methylation levels and altered cortisol stress reactivity following childhood trauma in humans. *Nat Commun*. 2016;7:10967
22. Felitti VJ, Anda RF, Nordenberg D, et al. Relationship of childhood abuse and household dysfunction to many of the leading causes of death in adults. The Adverse Childhood Experiences (ACE) Study. *Am J Prev Med*. 1998;14(4):245–258
23. Flynn AB, Fothergill KE, Wilcox HC, et al. Primary care interventions to prevent or treat traumatic stress in childhood: a systematic review. *Acad Pediatr*. 2015;15(5):480–492
24. Centers for Disease Control and Prevention. Essentials for childhood: creating Safe, stable, nurturing relationships and environments. Available at: https://www.cdc.gov/violenceprevention/childabuseandneglect/essentials.html. Accessed January 11, 2021
25. Garner AS, Forkey H, Szilagyi M. Translating developmental science to address childhood adversity. *Acad Pediatr*. 2015;15(5):493–502
26. Lahey BB, Rathouz PJ, Lee SS, et al. Interactions between early parenting and a polymorphism of the child's dopamine transporter gene in predicting future child conduct disorder symptoms. *J Abnorm Psychol*. 2011;120(1):33–45
27. Whittle S, Simmons JG, Dennison M, et al. Positive parenting predicts the development of adolescent brain structure: a longitudinal study. *Dev Cogn Neurosci*. 2014;8:7–17
28. McEwen BS, Gianaros PJ. Central role of the brain in stress and adaptation: links to socioeconomic status, health, and disease. *Ann N Y Acad Sci*. 2010;1186:190–222
29. Merrick MT, Ford DC, Ports KA, et al. Vital Signs: estimated proportion of adult health problems attributable to adverse childhood experiences and implications for prevention - 25 states, 2015–2017. *MMWR Morb Mortal Wkly Rep*. 2019;68(44):999–1005
30. Center for the Developing Child. ACEs and toxic stress: frequently asked questions. Available at: https://developingchild.harvard.edu/resources/aces-and-toxic-stress-frequently-asked-questions/. Accessed January 11, 2021
31. McHugo GJ, Kammerer N, Jackson EW, et al. Women, co-occurring disorders, and violence study: evaluation design and study population. *J Subst Abuse Treat*. 2005;28(2):91–107
32. Bethell C, Jones J, Gombojav N, Linkenbach J, Sege R. Positive childhood experiences and adult mental and relational health in a statewide sample: associations across adverse childhood experiences levels. *JAMA Pediatr*. 2019;173(11):e193007

33. Bethell CD, Gombojav N, Whitaker RC. Family resilience and connection promote flourishing among US children, even amid adversity. *Health Aff (Millwood)*. 2019;38(5):729–737

34. Zeanah P, Burstein K, Cartier J. Addressing Adverse childhood experiences: it's all about relationships. *Societies*. 2018;8(4):115

35. US Department of Health and Human Services, Administration for Children and Families, Administration on Children, Youth and Families, Children's Bureau. *Child Maltreatment*. Washington, DC: US Department of Health and Human Services; 2017. Available at: www.acf.hhs.gov/programs/cb/research-data-technology/statistics-research/child-maltreatment. Accessed January 11, 2021

36. Child Welfare Information Gateway. *Foster Care Statistics 2019*. Washington, DC: US Department of Health and Human Services, Children's Bureau; 2019. Available at: https://www.acf.hhs.gov/cb/report/afcars-report-27. Accessed January 11, 2021

37. Burgess AL, Borowsky IW. Health and home environments of caregivers of children investigated by child protective services. *Pediatrics*. 2010;125(2):273–281

38. Campbell KA, Thomas AM, Cook LJ, Keenan HT. Longitudinal experiences of children remaining at home after a first-time investigation for suspected maltreatment. *J Pediatr*. 2012;161(2):340–347

39. Horwitz SM, Hurlburt MS, Cohen SD, Zhang J, Landsverk J. Predictors of placement for children who initially remained in their homes after an investigation for abuse or neglect. *Child Abuse Negl*. 2011;35(3):188–198

40. Perez D, Sribney WM, Rodríguez MA. Perceived discrimination and self-reported quality of care among Latinos in the United States. *J Gen Intern Med*. 2009;24(Suppl 3):548–554

41. Wood LCN. Impact of punitive immigration policies, parent-child separation and child detention on the mental health and development of children. *BMJ Paediatr Open*. 2018;2(1):e000338

42. Johnson SB, Riis JL, Noble KG. State of the art review: poverty and the developing brain. *Pediatrics*. 2016;137(4):e20153075

43. National Advisory Committee on Rural Health and Human Services. *Exploring the Rural Context For Adverse Childhood Experiences: Policy Brief and Recommendations*. Washington, DC: US Department of Health and Human Services; 2018

44. Evans GW, English K. The environment of poverty: multiple stressor exposure, psychophysiological stress, and socioemotional adjustment. *Child Dev*. 2002;73(4):1238–1248

45. Hackman DA, Farah MJ. Socioeconomic status and the developing brain. *Trends Cogn Sci*. 2009;13(2):65–73

46. Trent M, Dooley DG, Dougé J; Section on Adolescent Health; Council on Community Pediatrics; Committee on Adolescence. Council on Community Pediatrics; Committee on Adolescence. The impact of racism on child and adolescent health. *Pediatrics*. 2019;144(2):e20191765

47. Heard-Garris NJ, Cale M, Camaj L, Hamati MC, Dominguez TP. Transmitting trauma: a systematic review of vicarious racism and child health. *Soc Sci Med*. 2018;199:230–240

48. Mohatt NV, Thompson AB, Thai ND, Tebes JK. Historical trauma as public narrative: a conceptual review of how history impacts present-day health. *Soc Sci Med*. 2014;106:128–136

49. Wade R Jr, Shea JA, Rubin D, Wood J. Adverse childhood experiences of low-income urban youth. *Pediatrics*. 2014;134(1):e13–e20

50. Nixon CL. Current perspectives: the impact of cyberbullying on adolescent health. *Adolesc Health Med Ther*. 2014;5:143–158

51. Finkelhor D, Turner HA, Shattuck A, Hamby SL. Violence, crime, and abuse exposure in a national sample of children and youth: an update. [published correction appears in JAMA Pediatr. 2014;168(3):286]. *JAMA Pediatr*. 2013;167(7):614–621

52. Roberts AL, Austin SB, Corliss HL, Vandermorris AK, Koenen KC. Pervasive trauma exposure among US sexual orientation minority adults and risk of posttraumatic stress disorder. *Am J Public Health*. 2010;100(12):2433–2441

53. Carroll G. Mundane extreme environmental stress and African American families: a case for recognizing different realities. *J Comp Fam Stud*. 1998;29(2):271–284

54. Huynh VW. Ethnic microaggressions and the depressive and somatic symptoms of Latino and Asian American adolescents. *J Youth Adolesc*. 2012;41(7):831–846

55. Siegel BS, Davis BE; Committee on Psychosocial Aspects of Child and Family Health and Section on Uniformed Services. Health and mental health needs of children in US military families. *Pediatrics*. 2013;131(6):e2002–e2015

56. Marsac ML, Kassam-Adams N, Delahanty DL, Widaman KF, Barakat LP. Posttraumatic stress following acute medical trauma in children: a proposed model of bio-psycho-social processes during the peri-trauma period. *Clin Child Fam Psychol Rev*. 2014;17(4):399–411

57. Brosbe MS, Hoefling K, Faust J. Predicting posttraumatic stress following pediatric injury: a systematic review. *J Pediatr Psychol*. 2011;36(6):718–729

58. Garner AS. Thinking developmentally: the next evolution in models of health. *J Dev Behav Pediatr*. 2016;37(7):579–584

59. Bretherton I. The origins of attachment theory: John Bowlby and Mary Ainsworth. *Dev Psychol*. 1992;28(5):759–775

60. Feldman R. The adaptive human parental brain: implications for children's social development. *Trends Neurosci*. 2015;38(6):387–399

61. Hughes DA, Baylin J. *The Neurobiology of Attachment-Focused Therapy: Enhancing Connection and Trust in the Treatment of Children and Adolescents*. New York, NY: W.W. Norton and Co; 2016

62. Allen JG. *Restoring Mentalizing in Attachment Relationships: Treating Trauma with Plain Old Therapy*. Arlington, VA: American Psychiatric Publishing; 2013

63. Cantor P, Osher D, Berg J, Steyer L, Rose T. Malleability, plasticity, and individuality: how children learn and develop in context. *Appl Dev Sci*. 2019;23(4):307–337

64. Ainsworth MD. Attachments beyond infancy. *Am Psychol*. 1989;44(4):709–716

65. Perry RE, Blair C, Sullivan RM. Neurobiology of infant attachment: attachment despite adversity and parental programming of emotionality. *Curr Opin Psychol.* 2017;17:1–6

66. Hoghughi M, Speight AN. Good enough parenting for all children–a strategy for a healthier society. *Arch Dis Child.* 1998;78(4):293–296

67. Winnicott DW. *The Maturational Process and the Facilitative Environment.* New York, NY: International Universities Press; 1965

68. Porges SW. Social engagement and attachment: a phylogenetic perspective. *Ann N Y Acad Sci.* 2003;1008: 31–47

69. Benoit D. Infant-parent attachment: definition, types, antecedents, measurement and outcome. *Paediatr Child Health.* 2004;9(8):541–545

70. Olff M, Frijling JL, Kubzansky LD, et al. The role of oxytocin in social bonding, stress regulation and mental health: an update on the moderating effects of context and interindividual differences. *Psychoneuroendocrinology.* 2013;38(9):1883–1894

71. Masten AS. Ordinary magic. Resilience processes in development. *Am Psychol.* 2001;56(3):227–238

72. Sege RD, Harper Browne C. Responding to ACEs With HOPE: health outcomes from positive experiences. *Acad Pediatr.* 2017;17(7S):S79–S85

73. Garner A, Yogman M; American Academy of Pediatrics, Committee on Psychosocial Aspects of Child and Family Health, Section on Developmental and Behavioral Pediatrics, Council on Early Childhood. Preventing childhood toxic stress: partnering with families and communities to promote relational health. *Pediatrics.* 2021;148(2):e2021052582

74. Children's Hospital of Philadelphia Research Institute. Basics of trauma-informed care. Available at: https://www.healthcaretoolbox.org/. Accessed January 11, 2021

75. Brymer M, Jacobs A, Layne C, et al. *Psychological First Aid Field Operations Guide.* 2nd ed. Los Angeles, CA: National Child Traumatic Stress Network and National Center for Posttraumatic Stress Disorder; 2006

76. Finkelhor D. Screening for adverse childhood experiences (ACEs): cautions and suggestions. *Child Abuse Negl.* 2018;85:174–179

77. Flaherty E, Legano L, Idzerda S; Council on Child Abuse and Neglect. Ongoing pediatric health care for the child who has been maltreated. *Pediatrics.* 2019;143(4):e20190284

78. Flaherty EG, Stirling J Jr; American Academy of Pediatrics. Committee on Child Abuse and Neglect. Clinical report—the pediatrician's role in child maltreatment prevention. *Pediatrics.* 2010;126(4):833–841

79. Schnierle J, Christian-Brathwaite N, Louisias M. Implicit bias: what every pediatrician should know about the effect of bias on health and future directions. *Curr Probl Pediatr Adolesc Health Care.* 2019;49(2):34–44

80. Johnson SB, Riley AW, Granger DA, Riis J. The science of early life toxic stress for pediatric practice and advocacy. *Pediatrics.* 2013;131(2):319–327

81. Dantzer R, O'Connor JC, Freund GG, Johnson RW, Kelley KW. From inflammation to sickness and depression: when the immune system subjugates the brain. *Nat Rev Neurosci.* 2008;9(1): 46–56

82. Jonson-Reid M, Wideman E. Trauma and very young children. *Child Adolesc Psychiatr Clin N Am.* 2017;26(3): 477–490

83. Cook A, Spinazzola J, Ford J, et al. Complex trauma in children and adolescents. *Psychiatr Ann.* 2005;35(5): 390–398

84. Substance Abuse and Mental Health Services Administration. *Recognizing and Treating Child Traumatic Stress.* Washington, DC: Substance Abuse and Mental Health Services Administration; 2004. Available at: https://www.samhsa.gov/child-trauma/recognizing-and-treating-child-traumatic-stress#signs. Accessed January 11, 2021

85. Cohen JA, Kelleher KJ, Mannarino AP. Identifying, treating, and referring traumatized children: the role of pediatric providers. *Arch Pediatr Adolesc Med.* 2008;162(5):447–452

86. Siegfried CB, Blackhear K; National Child Traumatic Stress Network and National Resource Center on ADHD.*Is it ADHD or Child Traumatic Stress? A Guide for Clinicians.* Los Angeles, CA, and Durham. NC: National Center for Child Traumatic Stress; 2016

87. Keeshin B, Forkey HC, Fouras G, MacMillan HL; American Academy of Pediatrics, Council on Child Abuse and Neglect, Council on Foster Care, Adoption, and Kinship Care, American Academy of Child and Adolescent Psychiatry, Committee on Child Maltreatment and Vioence, Committee on Adoption and Foster Care.. Children exposed to maltreatment: assessment and the role of psychotropic medication. *Pediatrics.* 2020;145(2):e20193751

88. Blaustein M, Kinniburgh K. *Treating Traumatic Stress in Children and Adolescents: How to Foster Resilience Through Attachment, Self-Regulation and Competency,* 2nd ed. New York, NY: The Guilford Press; 2019

89. De Bellis MD, Zisk A. The biological effects of childhood trauma. *Child Adolesc Psychiatr Clin N Am.* 2014;23(2): 185–222, vii

90. Bremner JD. Traumatic stress: effects on the brain. *Dialogues Clin Neurosci.* 2006;8(4):445–461

91. Lupien SJ, McEwen BS, Gunnar MR, Heim C. Effects of stress throughout the lifespan on the brain, behaviour and cognition. *Nat Rev Neurosci.* 2009;10(6):434–445

92. Penza KM, Heim C, Nemeroff CB. Neurobiological effects of childhood abuse: implications for the pathophysiology of depression and anxiety. *Arch Women Ment Health.* 2003;6(1):15–22

93. Teicher MH, Samson JA, Anderson CM, Ohashi K. The effects of childhood maltreatment on brain structure, function and connectivity. *Nat Rev Neurosci.* 2016;17(10):652–666

94. Miller LE. Perceived threat in childhood: a review of research and implications for children living in violent households. *Trauma Violence Abuse.* 2015;16(2):153–168

95. Teicher MH, Samson JA. Childhood maltreatment and psychopathology: a case for ecophenotypic variants as clinically and neurobiologically distinct subtypes. *Am J Psychiatry.* 2013; 170(10):1114–1133

96. Birn RM, Roeber BJ, Pollak SD. Early childhood stress exposure, reward pathways, and adult decision making. *Proc Natl Acad Sci USA*. 2017;114(51): 13549–13554

97. Syed SA, Nemeroff CB. Early life stress, mood, and anxiety disorders. *Chronic Stress (Thousand Oaks)*. 2017;1: 2470547017694461

98. Ringeisen H, Casanueva C, Urato M, Cross T. Special health care needs among children in the child welfare system. *Pediatrics*. 2008;122(1):e232–e241

99. Clougherty JE, Levy JI, Kubzansky LD, et al. Synergistic effects of traffic-related air pollution and exposure to violence on urban asthma etiology. *Environ Health Perspect*. 2007;115(8): 1140–1146

100. Centers for Disease Control and Prevention. Developmental monitoring and screening for health professionals. Available at: https://www.cdc.gov/ncbddd/childdevelopment/screening-hcp.html. Accessed January 11, 2021

101. Klein D, Goldenring JM, Adelman WP. HEEADSSS 3.0: the psychosocial interview for adolescents updated for a new century fueled by media. *Contemp Pediatr*. 2014;31(1):16–28

102. Goldenring JM, Rosen DS. Getting into adolescent heads: an essential update. *Contemp Pediatr*. 2004;21(1):64–90

103. Conn AM, Szilagyi MA, Jee SH, Manly JT, Briggs R, Szilagyi PG. Parental perspectives of screening for adverse childhood experiences in pediatric primary care. *Fam Syst Health*. 2018; 36(1):62–72

104. Colvin JD, Bettenhausen JL, Anderson-Carpenter KD, Collie-Akers V, Chung PJ. Caregiver opinion of in-hospital screening for unmet social needs by pediatric residents. *Acad Pediatr*. 2016;16(2):161–167

105. Wissow L, Anthony B, Brown J, et al. A common factors approach to improving the mental health capacity of pediatric primary care. *Adm Policy Ment Health*. 2008;35(4):305–318

106. Ginsburg K. Viewing our patients through a positive lens. *Contemp Pediatr*. 2007;24(1):65–76

107. Traub F, Boynton-Jarrett R. Modifiable resilience factors to childhood adversity for clinical pediatric practice. *Pediatrics*. 2017;139(5):e20162569

108. Greene R, Winkler J. Collaborative and Proactive Solutions (CPS): a review of research findings in families, schools, and treatment facilities. *Clin Child Fam Psychol Rev*. 2019;22(4):549–561

109. Lipkin PH, Macias MM; Council on Children With Disabilities, Section on Developmental and Behavioral Pediatrics. Promoting optimal development: identifying infants and young children with developmental disorders through developmental surveillance and screening. *Pediatrics*. 2020;145(1): e20193449

110. Squires J, Potter L, Bricker D. *The ASQ User's Guide*, 3rd ed. Baltimore, MD: Paul H. Brookes Publishing Co; 2009

111. Jellinek MS, Murphy JM, Little M, Pagano ME, Comer DM, Kelleher KJ. Use of the Pediatric Symptom Checklist to screen for psychosocial problems in pediatric primary care: a national feasibility study. *Arch Pediatr Adolesc Med*. 1999;153(3):254–260

112. Stone LL, Otten R, Engels RCME, Vermulst AA, Janssens JM. Psychometric properties of the parent and teacher versions of the strengths and difficulties questionnaire for 4- to 12-year-olds: a review. *Clin Child Fam Psychol Rev*. 2010;13(3):254–274

113. Richardson LP, McCauley E, Grossman DC, et al. Evaluation of the Patient Health Questionnaire-9 Item for detecting major depression among adolescents. *Pediatrics*. 2010;126(6): 1117–1123

114. Earls MF, Yogman MW, Mattson G, Rafferty J; Committee on Psychosocial Aspects of Child and Family Health. Incorporating recognition and management of perinatal depression into pediatric practice. *Pediatrics*. 2019;143(1):e20183259

115. Rolon-Arroyo B, Oosterhoff B, Layne CM, Steinberg AM, Pynoos RS, Kaplow JB. The UCLA PTSD Reaction Index for DSM-5 Brief Form: a screening tool for trauma-exposed youths. *J Am Acad Child Adolesc Psychiatry*. 2020;59(3): 434–443

116. Kazak A, Schneider S, Didonato S, Pai ALH. Family psychosocial risk screening guided by the Pediatric Preventative Psychosocial Health Model (PPPHM) using the Psychosocial Assessment Tool (PAT). *Acta Oncol*. 2015;54(5):574–580

117. Kazak AE, Hwang WT, Chen FF, et al. Screening for family psychosocial risk in pediatric cancer: validation of the Psychosocial Assessment Tool (PAT) Version 3. *J Pediatr Psychol*. 2018;43(7):737–748

118. Keeshin B, Byrne K, Thorn B, Shepard L. Screening for trauma in pediatric primary care. *Curr Psychiatry Rep*. 2020;22(11):60

119. Bethell CD, Carle A, Hudziak J, et al. Methods to assess adverse childhood experiences of children and families: toward approaches to promote child well-being in policy and practice. *Acad Pediatr*. 2017;17(7S):S51–S69

120. Purewal SK, Bucci M, Gutiérrez Wang L, et al. Screening for adverse childhood experiences (ACEs) in an integrated pediatric care model. *Zero Three*. 2016;36(3):10–17

121. Colvin JD, Bettenhausen JL, Anderson-Carpenter KD, et al. Multiple behavior change intervention to improve detection of unmet social needs and resulting resource referrals. *Acad Pediatr*. 2016;16(2):168–174

122. Shah AN, Beck AF, Sucharew HJ, et al; H2O Study Group. Parental adverse childhood experiences and resilience on coping after discharge. *Pediatrics*. 2018;141(4):e20172127

123. Folger AT, Eismann EA, Stephenson NB, et al. Parental adverse childhood experiences and offspring development at 2 years of age. *Pediatrics*. 2018;141(4): e20172826

124. Schickedanz A, Halfon N, Sastry N, Chung PJ. Parents' adverse childhood experiences and their children's behavioral health problems. *Pediatrics*. 2018;142(2):e20180023

125. Lê-Scherban F, Wang X, Boyle-Steed KH, Pachter LM. Intergenerational associations of parent adverse childhood experiences and child health outcomes. *Pediatrics*. 2018;141(6): e20174274

126. Connor KM, Davidson JRT. Development of a new resilience scale: the Connor-Davidson Resilience Scale (CD-

RISC). *Depress Anxiety.* 2003;18(2):76–82

127. Smith BW, Dalen J, Wiggins K, Tooley E, Christopher P, Bernard J. The brief resilience scale: assessing the ability to bounce back. *Int J Behav Med.* 2008;15(3):194–200
128. Windle G, Bennett KM, Noyes J. A methodological review of resilience measurement scales. *Health Qual Life Outcomes.* 2011;9:8
129. Anda RF, Porter LE, Brown DW. Inside the Adverse Childhood Experience Score: strengths, limitations, and misapplications. *Am J Prev Med.* 2020;59(2):293–295
130. Dube SR. Continuing conversations about adverse childhood experiences (ACEs) screening: a public health perspective. *Child Abuse Negl.* 2018;85:180–184
131. Shonkoff JP. Capitalizing on advances in science to reduce the health consequences of early childhood adversity. *JAMA Pediatr.* 2016;170(10):1003–1007
132. Boyce WT, Levitt P, Martinez FD, McEwen BS, Shonkoff JP. Genes, environments and time: the biology of adversity and resilience. *Pediatrics.* 2020;147(2):e20201651
133. Shonkoff JP, Boyce WT, Levitt P, Martinez F, McEwen B. Leveraging the biology of adversity and resilience to transform pediatric practice. *Pediatrics.* 2020;147(2):e20193845
134. Slopen N, McLaughlin KA, Shonkoff JP. Interventions to improve cortisol regulation in children: a systematic review. *Pediatrics.* 2014;133(2):312–326
135. Le-Niculescu H, Roseberry K, Levey DF, et al. Towards precision medicine for stress disorders: diagnostic biomarkers and targeted drugs. *Mol Psychiatry.* 2020;25(5):918–938
136. National Child Traumatic Stress Network. *Secondary Traumatic Stress: A Fact Sheet for Child-Serving Professionals.* Los Angeles, CA: National Child Traumatic Stress Network; 2011. Available at: https://www.nctsn.org/resources/secondary-traumatic-stress-fact-sheet-child-serving-professionals. Accessed January 11, 2021
137. Cieslak R, Shoji K, Douglas A, Melville E, Luszczynska A, Benight CC. A meta-analysis of the relationship between job burnout and secondary traumatic stress among workers with indirect exposure to trauma. *Psychol Serv.* 2014;11(1):75–86
138. Cocker F, Joss N. Compassion fatigue among healthcare, emergency and community service workers: a systematic review. *Int J Environ Res Public Health.* 2016;13(6):618
139. Dyrbye LN, Thomas MR, Massie FS, et al. Burnout and suicidal ideation among U.S. medical students. *Ann Intern Med.* 2008;149(5):334–341
140. Oreskovich MR, Shanafelt T, Dyrbye LN, et al. The prevalence of substance use disorders in American physicians. *Am J Addict.* 2015;24(1):30–38
141. Robins PM, Meltzer L, Zelikovsky N. The experience of secondary traumatic stress upon care providers working within a children's hospital. *J Pediatr Nurs.* 2009;24(4):270–279
142. Shoji K, Lesnierowska M, Smoktunowicz E, et al. What comes first, job burnout or secondary traumatic stress? Findings from two longitudinal studies from the U.S. and Poland. *PLoS One.* 2015;10(8):e0136730
143. Sprang G, Craig C, Clark J. Secondary traumatic stress and burnout in child welfare workers: a comparative analysis of occupational distress across professional groups. *Child Welfare.* 2011;90(6):149–168
144. van Mol MMC, Kompanje EJ, Benoit DD, Bakker J, Nijkamp MD. The prevalence of compassion fatigue and burnout among healthcare professionals in intensive care units: a systematic review. *PLoS One.* 2015;10(8):e0136955
145. The Center for Victims of Torture. Professional quality of life: elements, theory, and measurement. 2019. Available at: https://proqol.org/. Accessed January 11, 2021
146. Wilson JP, So-Kum Tang CC. *Cross-Cultural Assessment of Psychological Trauma and PTSD.* New York, NY: Springer Publishing; 2007
147. Flynn JT, Kaelber DC, Baker-Smith CM, et al; Subcommittee on Screening and Management of High Blood Pressure in Children. Clinical practice guideline for screening and management of high blood pressure in children and adolescents. *Pediatrics.* 2017;140(3):e20171904
148. Gooding HC, Milliren CE, Austin SB, Sheridan MA, McLaughlin KA. Child abuse, resting blood pressure, and blood pressure reactivity to psychosocial stress. *J Pediatr Psychol.* 2016;41(1):5–14
149. Su S, Wang X, Pollock JS, et al. Adverse childhood experiences and blood pressure trajectories from childhood to young adulthood: the Georgia stress and Heart study. *Circulation.* 2015;131(19):1674–1681
150. Szilagyi MA, Rosen DS, Rubin D, Zlotnik S; Council on Foster Care, Adoption, and Kinship Care; Committee on Adolescence; Council on Early Childhood. Health care issues for children and adolescents in foster care and kinship care. *Pediatrics.* 2015;136(4):e1142–e1166
151. Davis L, Barnes AJ, Gross AC, Ryder JR, Shlafer RJ. Adverse childhood experiences and weight status among adolescents. *J Pediatr.* 2019;204:71–76.e1
152. Javier JR, Hoffman LR, Shah SI; Pediatric Policy Council. Making the case for ACEs: adverse childhood experiences, obesity, and long-term health. *Pediatr Res.* 2019;86(4):420–422
153. Purswani P, Marsicek SM, Amankwah EK. Association between cumulative exposure to adverse childhood experiences and childhood obesity. *PLoS One.* 2020;15(9):e0239940
154. Heerman WJ, Krishnaswami S, Barkin SL, McPheeters M. Adverse family experiences during childhood and adolescent obesity. *Obesity (Silver Spring).* 2016;24(3):696–702
155. Exley D, Norman A, Hyland M. Adverse childhood experience and asthma onset: a systematic review. *Eur Respir Rev.* 2015;24(136):299–305
156. Gilbert LK, Breiding MJ, Merrick MT, et al. Childhood adversity and adult chronic disease: an update from ten states and the District of Columbia, 2010. *Am J Prev Med.* 2015;48(3):345–349
157. Heneghan A, Stein RE, Hurlburt MS, et al. Mental health problems in teens investigated by U.S. child welfare

agencies. *J Adolesc Health*. 2013;52(5):634–640

158. Ford JD, Grasso D, Greene C, Levine J, Spinazzola J, van der Kolk B. Clinical significance of a proposed developmental trauma disorder diagnosis: results of an international survey of clinicians. *J Clin Psychiatry*. 2013;74(8):841–849

159. Keeshin BR, Strawn JR. Psychological and pharmacologic treatment of youth with posttraumatic stress disorder: an evidence-based review. *Child Adolesc Psychiatr Clin N Am*. 2014;23(2):399–411, x

160. Carrion VG, Weems CF, Reiss AL. Stress predicts brain changes in children: a pilot longitudinal study on youth stress, posttraumatic stress disorder, and the hippocampus. *Pediatrics*. 2007;119(3):509–516

161. Gunnar M, Quevedo K. The neurobiology of stress and development. *Annu Rev Psychol*. 2007;58:145–173

162. McDonald MK, Borntrager CF, Rostad W. Measuring trauma: considerations for assessing complex and non-PTSD Criterion A childhood trauma. *J Trauma Dissociation*. 2014;15(2):184–203

163. van der Kolk B. Developmental trauma disorder. *Psychiatr Ann*. 2005;35(5):401–409

164. Ogle CM, Rubin DC, Siegler IC. The impact of the developmental timing of trauma exposure on PTSD symptoms and psychosocial functioning among older adults. *Dev Psychol*. 2013;49(11):2191–2200

165. Perry BD, Pollard RA, Blakley TL, Baker WL, Vigilante D. Childhood trauma, the neurobiology of adaptation, and "use-dependent" development of the brain: how "states" become "traits.". *Infant Ment Health J*. 1995;16(4):271–291

166. Scheeringa MS. Developmental considerations for diagnosing PTSD and acute stress disorder in preschool and school-age children. *Am J Psychiatry*. 2008;165(10):1237–1239

167. Treisman K. *Working with Relational and Developmental Trauma in Children and Adolescents*. New York, NY: Routledge; 2017

168. Obradović J, Bush NR, Stamperdahl J, Adler NE, Boyce WT. Biological sensitivity to context: the interactive effects of stress reactivity and family adversity on socioemotional behavior and school readiness. *Child Dev*. 2010;81(1):270–289

169. Boyce WT, Ellis BJ. Biological sensitivity to context: I. An evolutionary-developmental theory of the origins and functions of stress reactivity. *Dev Psychopathol*. 2005;17(2):271–301

170. Kennedy E. Orchids and dandelions: how some children are more susceptible to environmental influences for better or worse and the implications for child development. *Clin Child Psychol Psychiatry*. 2013;18(3):319–321

171. Cole SF, Eisner A, Gregory M, Ristuccia J. *Creating and Advocating for Trauma-Sensitive Schools*. Cambridge, MA: Trauma and Learning Policy Initiative; 2013

172. Overstreet S, Chafouleas SM. Trauma-informed schools: introduction to the special issue. *School Ment Health*. 2016;8(1):1–6

173. Allen B, Timmer SG, Urquiza AJ. Parent–child interaction therapy as an attachment-based intervention: theoretical rationale and pilot data with adopted children. *Child Youth Serv Rev*. 2014;47(Part 3):334–341

174. Camoirano A. Mentalizing makes parenting work: a review about parental reflective functioning and clinical interventions to improve it. *Front Psychol*. 2017;8:14

175. Zuckerman B, Augustyn M. Books and reading: evidence-based standard of care whose time has come. *Acad Pediatr*. 2011;11(1):11–17

176. Zuckerman B, Khandekar A. Reach Out and Read: evidence based approach to promoting early child development. *Curr Opin Pediatr*. 2010;22(4):539–544

177. Needlman R, Toker KH, Dreyer BP, Klass P, Mendelsohn AL. Effectiveness of a primary care intervention to support reading aloud: a multicenter evaluation. *Ambul Pediatr*. 2005;5(4):209–215

178. Mendelsohn AL, Cates CB, Weisleder A, et al. Reading aloud, play, and social-emotional development. *Pediatrics*. 2018;141(5):e20173393

179. Shah R, DeFrino D, Kim Y, Atkins M. Sit Down and Play: a preventive primary care-based program to enhance parenting practices. *J Child Fam Stud*. 2017;26(2):540–547

180. Chang SM, Grantham-McGregor SM, Powell CA, et al. Integrating a parenting intervention with routine primary health care: a cluster randomized trial. *Pediatrics*. 2015;136(2):272–280

181. Girard LC, Doyle O, Tremblay RE. Maternal warmth and toddler development: support for transactional models in disadvantaged families. *Eur Child Adolesc Psychiatry*. 2017;26(4):497–507

182. Weisleder A, Cates CB, Dreyer BP, et al. Promotion of positive parenting and prevention of socioemotional disparities. *Pediatrics*. 2016;137(2):e20153239

183. Shah R, Kennedy S, Clark MD, Bauer SC, Schwartz A. Primary care-based interventions to promote positive parenting behaviors: a meta-analysis. *Pediatrics*. 2016;137(5):e20153393

184. Perry-Parrish C, Copeland-Linder N, Webb L, Sibinga EMS. Mindfulness-based approaches for children and youth. *Curr Probl Pediatr Adolesc Health Care*. 2016;46(6):172–178

185. Bauer CCC, Caballero C, Scherer E, et al. Mindfulness training reduces stress and amygdala reactivity to fearful faces in middle-school children. *Behav Neurosci*. 2019;133(6):569–585

186. Ortiz R, Sibinga EM. The role of mindfulness in reducing the adverse effects of childhood stress and trauma. *Children (Basel)*. 2017;4(3):16

187. Foa EBKT, Friedman MJ, Cohen JA. *Effective Treatments for Posttraumatic Stress Disorder: Practice Guidelines From the International Society for Traumatic Stress Studies*, 2nd ed. New York, NY: Guilford Press; 2008

188. Dorsey S, McLaughlin KA, Kerns SEU, et al. Evidence base update for psychosocial treatments for children and adolescents exposed to traumatic events. *J Clin Child Adolesc Psychol*. 2017;46(3):303–330

189. Sege RD, Amaya-Jackson L; American Academy of Pediatrics Committee on Child Abuse and Neglect, Council on Foster Care, Adoption, and Kinship Care; American Academy of Child and Adolescent Psychiatry Committee on Child Maltreatment and Violence; National Center for Child Traumatic

Stress. Clinical considerations related to the behavioral manifestations of child maltreatment. *Pediatrics*. 2017;139(4):e20170100

190. Gleason MM, Goldson E, Yogman MW; Council on Early Childhood; Committee on Pyschosocial Aspects of Child and Family Health; Section on Developmental and Behavioral Pediatrics. Addressing early childhood emotional and behavioral problems. *Pediatrics*. 2016;138(6):e20163025

191. Asarnow JR, Rozenman M, Wiblin J, Zeltzer L. Integrated medical-behavioral care compared with usual primary care for child and adolescent behavioral health: a meta-analysis. *JAMA Pediatr*. 2015;169(10):929–937

192. Dunsmoor JE, Kroes MCW, Li J, Daw ND, Simpson HB, Phelps EA. Role of human ventromedial prefrontal cortex in learning and recall of enhanced extinction. *J Neurosci*. 2019;39(17): 3264–3276

193. Giustino TF, Fitzgerald PJ, Ressler RL, Maren S. Locus coeruleus toggles reciprocal prefrontal firing to reinstate fear. *Proc Natl Acad Sci USA*. 2019;116(17):8570–8575

194. Sloan DM, Marx BP, Lee DJ, Resick PA. A brief exposure-based treatment vs cognitive processing therapy for posttraumatic stress disorder: a randomized noninferiority clinical trial. *JAMA Psychiatry*. 2018;75(3):233–239

195. Jones AM, Shealy KM, Reid-Quiñones K, et al. Guidelines for establishing a telemental health program to provide evidence-based therapy for trauma-exposed children and families. *Psychol Serv*. 2014;11(4):398–409

196. Bashshur RL, Shannon GW, Bashshur N, Yellowlees PM. The empirical evidence for telemedicine interventions in mental disorders. *Telemed J E Health*. 2016;22(2):87–113

197. Conrad R, Rayala H, Diamon R, Busch B, Kramer N. Expanding telemental health in response to the COVID-19 pandemic. 2020. Available at: https://www.psychiatrictimes.com/view/expanding-telemental-health-response-covid-19-pandemic. Accessed January 11, 2021

198. Menschner C, Maul A, Center for Health Care Strategies. *Key Ingredients for Successful Trauma-Informed Care Implementation*. Hamilton, NJ: Center for Health Care Strategies; 2016, Available at https://www.chcs.org/resource/key-ingredients-for-successful-trauma-informed-care-implementation/. Accessed January 11, 2021

199. Schulman M, Menschner C. *Laying the Groundwork for Trauma Informed Care*. Hamilton, NJ: Center for Health Care Strategies; 2018. Available at https://www.chcs.org/resource/laying-groundwork-trauma-informed-care/. Accessed January 11, 2021

200. American Academy of Pediatrics. *Trauma Toolbox for Primary Care*. Elk Grove Village, IL: American Academy of Pediatrics; 2014. Available at: www.aap.org/en-us/advocacy-and-policy/aap-health-initiatives/healthy-foster-care-america/Pages/Trauma-Guide.aspx. Accessed January 11, 2021

201. Pediatric Integrated Care Collaborative. *Improving the Capacity of Primary Care to Serve Children and Families Experiencing Trauma and Chronic Stress: A Toolkit*. Baltimore, MD: Pediatric Integrated Care Collaborative; 2016. Available at: https://picc.jhu.edu/the-toolkit.html. Accessed January 11, 2021

202. Brown SM, Baker CN, Wilcox P. Risking connection trauma training: a pathway toward trauma-informed care in child congregate care settings. *Psychol Trauma*. 2012;4(5):507–515

203. Bryson SA, Gauvin E, Jamieson A, et al. What are effective strategies for implementing trauma-informed care in youth inpatient psychiatric and residential treatment settings? A realist systematic review. *Int J Ment Health Syst*. 2017;11:36

204. Murphy K, Moore KA, Redd Z, Malm K. Trauma-informed child welfare systems and children's well-being: a longitudinal evaluation of KVC's bridging the way home initiative. *Child Youth Serv Rev*. 2017;75:23–34

205. Schiff DM, Zuckerman B, Hutton E, Genatossio C, Michelson C, Bair-Merritt M. Development and pilot implementation of a trauma-informed care curriculum for pediatric residents. *Acad Pediatr*. 2017;17(7):794–796

206. Substance Abuse and Mental Health Services Administration. *The Integration of Behavioral Health into Pediatric Primary Care Settings*. Washington, DC: Substance Abuse and Mental Health Services Administration; 2017

207. Kolko DJ, Perrin E. The integration of behavioral health interventions in children's health care: services, science, and suggestions. *J Clin Child Adolesc Psychol*. 2014;43(2):216–228

208. Garg A, Toy S, Tripodis Y, Silverstein M, Freeman E. Addressing social determinants of health at well child care visits: a cluster RCT. *Pediatrics*. 2015;135(2):e296–e304

209. Sun J, Patel F, Rose-Jacobs R, Frank DA, Black MM, Chilton M. Mothers' adverse childhood experiences and their young children's development. *Am J Prev Med*. 2017;53(6):882–891

210. Feder KA, Letourneau EJ, Brook J. Children in the opioid epidemic: addressing the next generation's public health crisis. *Pediatrics*. 2019;143(1): e20181656

211. West CP, Tan AD, Habermann TM, Sloan JA, Shanafelt TD. Association of resident fatigue and distress with perceived medical errors. *JAMA*. 2009;302(12):1294–1300

212. Shanafelt TD, Noseworthy JH. Executive leadership and physician well-being: nine organizational strategies to promote engagement and reduce burnout. *Mayo Clin Proc*. 2017;92(1): 129–146

213. Shanafelt TD, Boone S, Tan L, et al. Burnout and satisfaction with work-life balance among US physicians relative to the general US population. *Arch Intern Med*. 2012;172(18):1377–1385

214. Shanafelt TD, Hasan O, Dyrbye LN, et al. Changes in burnout and satisfaction with work-life balance in physicians and the general US working population between 2011 and 2014 [published correction appears in *Mayo Clin Proc*. 2016;91(2):276]. *Mayo Clin Proc*. 2015;90(12):1600–1613

215. Shanafelt TD, Gorringe G, Menaker R, et al. Impact of organizational leadership on physician burnout and satisfaction. *Mayo Clin Proc*. 2015;90(4): 432–440

216. Shanafelt TD, Dyrbye LN, Sinsky C, et al. Relationship between clerical

burden and characteristics of the electronic environment with physician burnout and professional satisfaction. *Mayo Clin Proc.* 2016;91(7):836–848

217. Sinsky CA, Willard-Grace R, Schutzbank AM, Sinsky TA, Margolius D, Bodenheimer T. In search of joy in practice: a report of 23 high-functioning primary care practices. *Ann Fam Med.* 2013;11(3):272–278
218. Wallace JE, Lemaire J. On physician well being-you'll get by with a little help from your friends. *Soc Sci Med.* 2007;64(12):2565–2577
219. Horn DJ, Johnston CB. Burnout and self care for palliative care practitioners. *Med Clin North Am.* 2020;104(3):561–572
220. Ofei-Dodoo S, Cleland-Leighton A, Nilsen K, Cloward JL, Casey E. Impact of a mindfulness-based, workplace group yoga intervention on burnout, self-care, and compassion in health care professionals: a pilot study. *J Occup Environ Med.* 2020;62(8):581–587
221. Forkey H, Griffin J, Szilagyi M. *Childhood Trauma and Resilience: A Practical Guide.* Itasca, IL: American Academy of Pediatrics; 2021
222. Roelofs K. Freeze for action: neurobiological mechanisms in animal and human freezing. *Philos Trans R Soc Lond B Biol Sci.* 2017;372(1718):20160206
223. Shonkoff JP, Boyce WT, McEwen BS. Neuroscience, molecular biology, and the childhood roots of health disparities: building a new framework for health promotion and disease prevention. *JAMA.* 2009;301(21):2252–2259
224. Taylor SE, Klein LC, Lewis BP, Gruenewald TL, Gurung RA, Updegraff JA. Biobehavioral responses to stress in females: tend-and-befriend, not fight-or-flight. *Psychol Rev.* 2000;107(3):411–429
225. Taylor SE. Tend and befriend: biobehavioral bases of affiliation under stress. *Curr Dir Psychol Sci.* 2006;15(6):273–277
226. Bartz JA, Zaki J, Bolger N, Ochsner KN. Social effects of oxytocin in humans: context and person matter. *Trends Cogn Sci.* 2011;15(7):301–309
227. Romano A, Tempesta B, Micioni Di Bonaventura MV, Gaetani S. From autism to eating disorders and more: the role of oxytocin in neuropsychiatric disorders. *Front Neurosci.* 2016;9:497
228. Cardoso C, Valkanas H, Serravalle L, Ellenbogen MA. Oxytocin and social context moderate social support seeking in women during negative memory recall. *Psychoneuroendocrinology.* 2016;70:63–69
229. Shamay-Tsoory SG, Abu-Akel A. The social salience hypothesis of oxytocin. *Biol Psychiatry.* 2016;79(3):194–202
230. Bethlehem RAI, Baron-Cohen S, van Honk J, Auyeung B, Bos PA. The oxytocin paradox. *Front Behav Neurosci.* 2014;8:48
231. Chen J, Evans AN, Liu Y, Honda M, Saavedra JM, Aguilera G. Maternal deprivation in rats is associated with corticotrophin-releasing hormone (CRH) promoter hypomethylation and enhances CRH transcriptional responses to stress in adulthood. *J Neuroendocrinol.* 2012;24(7):1055–1064
232. Weaver ICG, Cervoni N, Champagne FA, et al. Epigenetic programming by maternal behavior. *Nat Neurosci.* 2004;7(8):847–854
233. American Psychiatric Association. *Diagnostic and Statistical Manual of Mental Disorders*, 5th ed. Washington, DC: American Psychiatric Publishing; 2013
234. Koita K, Long D, Hessler D, et al. Development and implementation of a pediatric adverse childhood experiences (ACEs) and other determinants of health questionnaire in the pediatric medical home: a pilot study. *PLoS One.* 2018;13(12):e0208088
235. Wade R Jr, Cronholm PF, Fein JA, et al. Household and community-level adverse childhood experiences and adult health outcomes in a diverse urban population. *Child Abuse Negl.* 2016;52:135–145
236. Child and Adolescent Health Measurement Initiative. 2019 National Survey of Children's Health: guide to topics and questions. Data Resource Center for Child and Adolescent Health supported by the US Department of Health and Human Services, Health Resources and Services Administration, Maternal and Child Health Bureau. 2020. Available at: https://www.childhealthdata.org/learn-about-the-nsch/topics_questions. Accessed April 21, 2021
237. National Child Traumatic Stress Network. Complex trauma. Available at: www.nctsn.org/trauma-types/complex-trauma. Accessed January 11, 2021
238. Schmid M, Petermann F, Fegert JM. Developmental trauma disorder: pros and cons of including formal criteria in the psychiatric diagnostic systems. *BMC Psychiatry.* 2013;13:3. DOI: https://doi.org/10.1186/1471-244X-13-3
239. Shah AN, Jerardi KE, Auger KA, Beck AF. Can hospitalization precipitate toxic stress? *Pediatrics.* 2016;137(5):e20160204
240. Rzucidlo SE, Campbell M. Beyond the physical injuries: child and parent coping with medical traumatic stress after pediatric trauma. *J Trauma Nurs.* 2009;16(3):130–135
241. National Child Traumatic Stress Network. Effects. Available at: https://www.nctsn.org/what-is-child-trauma/trauma-types/medical-trauma/effects. Accessed January 11, 2021
242. US Department of Health and Human Services, Administration for Children and Families. Secondary traumatic stress. Available at: https://www.acf.hhs.gov/trauma-toolkit/secondary-traumatic-stress. Accessed January 11, 2021
243. The National Child Traumatic Stress Network. Families and caregivers. Available at: https://www.nctsn.org/audiences/families-and-caregivers. Accessed January 11, 2021
244. US Department of Health and Human Services, Administration for Children and Families. Resources on trauma for caregivers and families. Available at: https://www.childwelfare.gov/topics/responding/trauma/caregivers/. Accessed January 11, 2021
245. American Academy of Pediatrics. Parenting After Trauma: Understanding Your Child's NeedsAvailable at: https://www.aap.org/en-us/advocacy-and-policy/aap-health-initiatives/healthy-foster-care-america/Documents/FamilyHandout.pdf. Accessed June 24, 2021

246. Porges S, Lewis GF. The polyvagal hypothesis: common mechanisms mediating autonomic regulation, vocalizations and listening. In: Brudzynski SM, ed. *Handbook of Mammalian Vocalization: An Integrative Neuroscience Approach*. New York, NY: Elsevier; 2009:255–264

247. Bethell C, Gombojav N, Solloway M, Wissow L. Adverse childhood experiences, resilience and mindfulness-based approaches: common denominator issues for children with emotional, mental, or behavioral problems. *Child Adolesc Psychiatr Clin N Am*. 2016;25(2):139–156

Trauma-Informed Care in Child Health Systems

- *Policy Statement*

POLICY STATEMENT Guidance for the Clinician in Rendering Pediatric Care

American Academy of Pediatrics
DEDICATED TO THE HEALTH OF ALL CHILDREN™

Trauma-Informed Care in Child Health Systems

James Duffee, MD, MPH, FAAP,[a] Moira Szilagyi, MD, PhD, FAAP,[b] Heather Forkey, MD, FAAP,[c] Erin T. Kelly, MD, FAAP, FACP,[d]
COUNCIL ON COMMUNITY PEDIATRICS, COUNCIL ON FOSTER CARE, ADOPTION, AND KINSHIP CARE, COUNCIL ON CHILD ABUSE AND NEGLECT, COMMITTEE ON PSYCHOSOCIAL ASPECTS OF CHILD AND FAMILY HEALTH

Recent progress in understanding the lifelong effects of early childhood adversities has clarified the need for an organized strategy to identify and intervene with children, adolescents, and families who may be at risk for maladaptive responses. Trauma-informed care (TIC) in child health care operationalizes the biological evidence of toxic stress with the insights of attachment and resilience to enhance health care delivery to mitigate the effects of trauma. The resulting pediatric health care delivery strategy promotes and restores resilience in children and adolescents, partners with families to support relational health, and reduces secondary trauma among pediatric health care clinicians. This policy statement summarizes what policy makers, legislators, and health care organizations need to consider in terms of infrastructure, resources, and financial support to facilitate the integration of TIC principles into all pediatric points of care. The accompanying clinical report describes the elements of TIC in the direct care of children, adolescents, and families and covers the spectrum from prevention to treatment. The recommendations in this statement and the clinical report build on other American Academy of Pediatrics policies that address the needs of special populations (such as children and adolescents in foster or kinship care, in immigrant and refugee families, or in poor or homeless families) and are congruent with American Academy of Pediatrics policies and technical reports concerning the role of pediatric clinicians in the promotion of lifelong health.

INTRODUCTION

Over the past 2 decades, basic science has explained how cumulative adverse childhood experiences in the relative absence of safe, stable, nurturing relationships (SSNRs)[1] alter neurohormonal stress responses, gene expression, telomere length, brain development, and immunity, enabling researchers to elucidate how the body biologically embeds

[a]*Departments of Pediatrics and Psychiatry, Boonshoft School of Medicine, Wright State University, Dayton, Ohio;* [b]*Divisions of General and Developmental-Behavioral Pediatrics, Department of Pediatrics, University of California, Los Angeles, Los Angeles, California;* [c]*Department of Pediatrics, University of Massachusetts Medical School, Worcester, Massachusetts; and* [d]*Ambulatory Health Services, Philadelphia Department of Public Health, Philadelphia, Pennsylvania*

Drs Duffee, Szilagyi, Forkey, and Kelly were equally responsible for conceptualizing, writing, and revising the manuscript and considering input from all reviewers and the Board of Directors; and all authors approved the final manuscript as submitted.

DOI: https://doi.org/10.1542/peds.2021-052579

Address correspondence to James Duffee, MD, MPH.
E-mail: james.duffee@wright.edu

PEDIATRICS (ISSN Numbers: Print, 0031-4005; Online, 1098-4275).

To cite: Duffee J, Szilagyi M, Forkey H, et al. Trauma-Informed Care in Child Health Systems. *Pediatrics*. 2021;148(2):e2021052579

childhood trauma. Recent studies of toxic stress support assertions that the origins of lifelong health are in early childhood and that chronic stress in childhood strongly predicts adult health status.[2,3] In the context of expanding evidence, pediatricians and others involved in community-based early childhood systems need strategies to mitigate the damaging effects of early childhood trauma and to promote resilience in children and families. Trauma-informed care (TIC) offers an organizing principle for pediatric practice that improves awareness of the spectrum of trauma-related symptoms, promotes an emotionally safe environment of care, and provides specific interventions to mitigate the effects of trauma exposure.[4,5] This policy statement presents recommendations for policy makers, legislators, and health care organizations for implementation of TIC into pediatric health systems. The accompanying clinical report[6] presents best-practice guidance for TIC in the direct care of children and adolescents.

BACKGROUND

TIC is defined by the National Child Traumatic Stress Network as medical care in which all parties involved assess, recognize, and respond to the effects of traumatic stress on children, caregivers, and health care providers. TIC also includes attention to secondary traumatic stress (STS), the emotional strain that results when an individual, whether a health care worker or parent, hears about or witnesses the traumatic experiences, past or present, of children.

TIC Promotes Relational Health and Resilience

Every pediatric encounter presents opportunities to promote family resilience and relational health.[7] Informed by research in infant mental health and neurodevelopment, early relational health refers to the establishment of foundational relationships during the first 3 years of life that are central to successful physiologic, emotional, and moral development of the young child.[8] Relational health, in a more general sense, is applicable to all age groups, is dyadic, and includes the capacity of both the child and caregiver to enter into a safe, secure, nurturing relationship allowing both to thrive.[1,9,10] Strong foundational relationships support resilience and buffer stress in children, so they can be considered primary prevention of stress-related disturbance. Trauma-informed practices also support relational health and family resilience as important protective factors for those who have been exposed to persistent adversity or potentially traumatic events (see Fig 1).

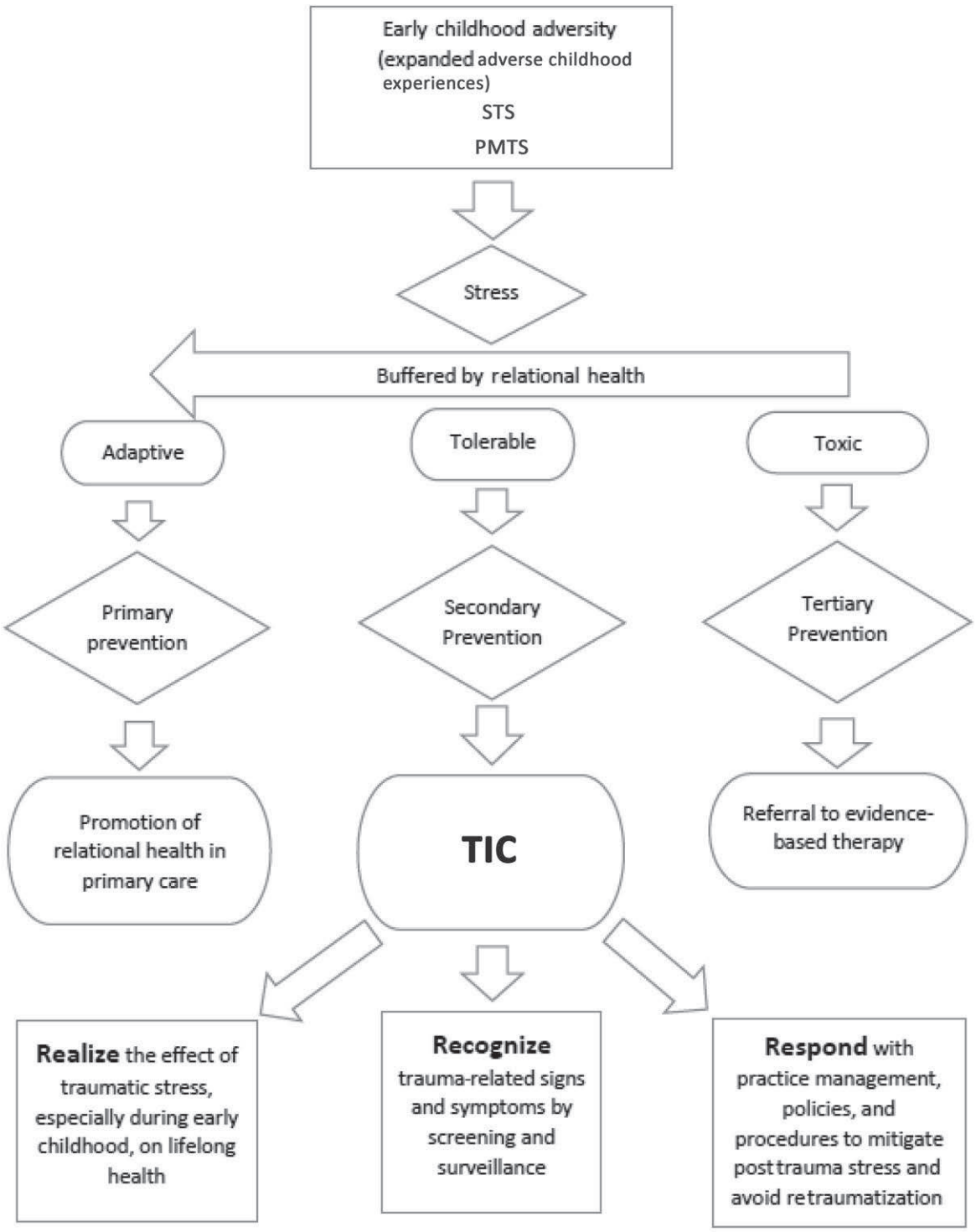
Human neuroendocrine–immune networks respond to internal and external sensors that identify danger and safety by activating in dangerous circumstances and deactivating when danger has subsided.[11] Toxic stress responses occur with prolonged activation of the neuroendocrine–immune system and dysregulation of homeostasis (or allostasis if multiple systems are involved)[12] in the absence of buffering by SSNRs. Toxic stress responses can result in lifelong impairments in physical, mental, and relational health.[13]

The concept of toxic stress adds an important physiologic basis to the study of attachment and our understanding of trauma. Trauma is defined as an event, series of events, or circumstances experienced by a person as physically or emotionally harmful that can have long-lasting adverse effects on the person's functioning and well-being (emotional, physical, or spiritual).[14] Attachment theory describes the deep and enduring relationship between a child and adult caregiver that ideally provides a secure base from which the child can develop and explore the world.[15]

Resilience is the dynamic process of adaptation to or despite significant adversity by using protective factors and learned skills to manage stressful circumstances.[16] Resilience may allow a person to experience tolerable rather than toxic stress in response to adversity. Some characteristics of resilient children include strong executive functions (self-control of attention and impulses) and a strong personal identity, often related to a cultural or faith tradition.[17] However, most important to both resilience and relational health is the capacity for young children to form at least one stable, caring, and supportive relationship.[9,18]

Exposure to Trauma Is Common

Almost half of American children, or 34 million younger than 18 years, have faced at least one potentially traumatic early childhood experience.[19] More than 1 in 7 adults report exposure during childhood to 4 or more adverse childhood experiences such as abuse, neglect, or other household adversity,[20] including intimate partner violence or parental incarceration. Certain populations are at higher risk for trauma exposure, both physical and emotional. In surveys, poverty or financial stress is the most commonly reported childhood adversity, second only to loss of a parent.[21,22] Exposure to divorce, child maltreatment, sexual abuse, intimate partner violence, bullying, parental mental illness, parental substance use problems, and community violence are also common.[21] Specific populations at high risk for trauma include children and adolescents who



397

FIGURE 1 Pediatric approach to TIC.

identify as LGBTQ, have developmental or behavioral problems,[23–25] are in foster or kinship care, are incarcerated, are living in deep poverty, or are immigrants. Potentially traumatic environmental and community-level conditions include economic stress, school or community violence,

adverse experiences during and after immigration, natural disasters, pandemics, and mass-casualty events such as shootings or bombings.

Racism is a common cross-cutting risk factor. Racial, ethnic, or religious bigotry magnifies the risk inherent to other special populations.[26] Experiences ranging from hate crimes, police profiling, bullying, or microaggressions to covert discrimination are traumatic events and may be internalized as trauma by those who are victims, indirectly or directly, of the events.[27,28] Historical trauma refers to the collective, transgenerational emotional and psychological injury of specific ethnic, racial, or cultural groups and their descendants who have experienced major events of oppression such as genocide, forced displacement, or slavery.[29,30] Originally applied to children of the Holocaust, the concept is now applied to American Indian and Alaskan native people, African American people, Mexican American people, Japanese American people, and other groups of people who have experienced mass trauma.[30] Investigators link historical "soul wounding" to current health and behavioral disorders including substance use disorder, domestic violence, and suicide, particularly in Indigenous communities.[29,31] Children separated from families during immigration and/or detained in group facilities overseen by the Office of Refugee Resettlement are a recent special population at severe risk for long-term sequelae resulting from forced family separation.[32,33]

The Effects of Early Life Trauma Are Felt Over the Life Course

In November 2019, the Centers for Disease Control and Prevention reviewed the emerging literature linking early childhood adversity with adult illnesses[20,34] and analyzed survey data from 25 states over 2 years.[3,35] Researchers concluded that reducing exposure to early childhood trauma and mitigating posttrauma effects would generally and significantly reduce adult morbidity and mortality. Using logistic regression modeling, they estimated potential reductions in incidence from low for obesity (1.7%) to high for heavy drinking, chronic obstructive pulmonary disease, and depression (23.9%, 27.0%, and 44.1%, respectively). Recommendations included creating healthy communities, supporting SSNRs, and developing programs that apply primary (reducing exposure to childhood adversity) and secondary prevention (mitigating the effects of exposure) on the basis of principles of TIC.

There Is Need for a Child-Specific Trauma Nosology

The *Diagnostic and Statistical Manual of Mental Disorders, Fifth Edition* (DSM-5) presents a list of trauma-related disorders ranging from mild (adjustment disorder) to severe (posttraumatic stress disorder [PTSD]).[36] Two additional categories, reactive attachment disorder and disinhibited social engagement disorder, are specific to young children (please see the DSM-5 for complete diagnostic criteria). This nosology can be expanded to describe other presentations common in pediatric health care settings: developmental trauma disorder (DTD), pediatric medical traumatic stress (PMTS), and STS, the last being most relevant for health care workers, family members, and caregivers.

DTD

The diagnosis of PTSD, as outlined in the current DSM-5, does not adequately describe the variable presentations of trauma manifestations in children across developmental stages.[37] Children with complex trauma histories often exhibit heterogeneous developmental symptoms as well as difficulties with intimate relationships and with regulation of attention and impulse control.[38] DTD is a proposed new diagnostic category that incorporates these differences and attempts to better describe the disturbances that occur in multiple developmental domains.[39] The omission of DTD in the DSM-5 has been controversial,[40] and the search for a better nosology of trauma, including DTD, is ongoing.[41]

PMTS

PMTS refers to the distress that patients and family members experience during hospitalization for a perceived life-threatening diagnosis or while living with or caring for individuals with life-altering chronic conditions.[42] PMTS is underrecognized and rarely addressed despite its high prevalence.[43,44] Up to 80% of ill or injured children and their families may have traumatic stress reactions after a life-threatening illness, injury, or procedure.[45] In some surveys, up to 20% of parents of children admitted to a PICU develop PTSD within a few months.[45] The suffering of family members and caregivers is often not addressed because of existing structural and reimbursement obstacles for multigenerational care.

Although research on PMTS (and on pediatric postintensive care syndrome)[46,47] is ongoing, researchers in 1 study found that approximately 10% of children developed PTSD 3 to 5 months after major surgery, and 28% developed posttraumatic stress symptoms (PTSS) resulting in functional disability by parent report.[48] PTSS can also occur after a severe injury or diagnosis of an illness such as cancer. In another family study,

more than 10% of children had persistent functional impairment from PTSS at 6 weeks and 1 year after a potentially life-threatening injury or diagnosis, and 15% of mothers and 8% of fathers met criteria for PTSD at 1 year.[49]

STS

As described earlier, STS may occur in parents, other family members, and health care workers such as physicians, nurses, other hospital staff, first responders, and therapists. STS may have many of the same long-term effects on health that affect children exposed to trauma.[50] Some health care workers may also develop disabling posttrauma symptoms that can interfere with quality of life both at work and home. Health care workers may have their own trauma histories that contribute to their reactions when exposed to the suffering of others. Nonclinical staff may also experience STS triggered by their own trauma histories, especially if the health care facility is located in an area with high adversity and nonclinical staff live in the vicinity.

Burnout and STS

Preliminary evidence exists of a synergistic effect among STS, depression, and burnout in affected health care workers.[51] STS in combination with burnout has been associated with a significant increase in the frequency of medical errors.[52,53] Depression, anxiety, and suicide are greater risks for physicians than for the general population. In the United States, the rate of suicide among female physicians is 130% higher than among women who are not physicians; the rate for male physicians is 40% higher than for men who are not physicians.[51] Burnout includes a spectrum of pathologic conditions that develop in the context of occupational stress and is almost twice as prevalent among physicians. The risk among nurses for burnout, depression, and STS is even higher. More than half of nurses reported suboptimal mental or physical health,[54] approximately 35% reported a high degree of emotional exhaustion,[55] and 18% reported depression in national surveys. Reports of posttraumatic stress among health care workers related to the coronavirus disease 2019 pandemic prompted worldwide concern for increased awareness and trauma-informed support for the mental health of all involved.[56]

CORE ELEMENTS OF TRAUMA-INFORMED SYSTEMS

Core principles that can be helpful for policy development, outlined by the National Council on Behavioral Health (2019)[57] are outlined in the following sections. Implementation of TIC at a practice level is described in detail in the accompanying clinical report.[6]

Safe Physical and Emotional Environment

The health care organization, workspace, and every encounter should be characterized by compassion, cultural humility, equity, collaboration, and safety for families and employees. An emotionally safe workplace includes acknowledgment of and particular attention to racial and gender discrimination, including implicit bias both in rendering care and workplace human relations. A review of health care settings from the viewpoints of patients, families, and staff can uncover practices, processes, or details in the environment that are potentially traumatizing.

Leadership Commitment to TIC

Hospital and health system leadership can annually review policies and procedures to ensure a safe work environment and setting to provide TIC, to reduce STS and burnout, and to promote sensitivity to the needs of trauma survivors.[58] The alignment of financial and human capital resources to support an optimal health environment in all levels and locations of care is extremely important. Surveys designed to assess system readiness for implementation are available and can be adapted for pediatric health care settings.

Surveillance and standardized screening to assess staff and patients for trauma exposure, symptoms, and strengths are important components of trauma-informed pediatric care. Universal screening, when implemented within the larger context of trauma-informed approaches and endorsed and supported by administrative leadership, reduces stigma and allows standardized responses such as time off or referral to an employee assistance program. Families and youth may be queried at the point of care, such as at the time of hospital admission. Formal screening should always be for the benefit of children and adolescents, avoid retraumatization, and identify protective as well as risk factors.[59] More specific information about screening is included in the accompanying clinical report.[6]

Patient and Family Empowerment

Involvement of families and youth in the development of TIC policies and practices, particularly regarding cultural, historical, and gender issues, is essential to building an environment of support and mutuality.[14] Both formal and informal structures, such as Family Advisory Councils and family-centered rounds,[60] create a cultural expectation of collaboration and enable the health care team to understand the strengths and vulnerabilities of individual families

and of the populations served. When appropriate, tribal elders, traditional healers, and other faith community leaders can be included in developing individual care plans or institutional quality-improvement efforts. A whole-person, whole-family, whole-community perspective promotes improved awareness of how cultural backgrounds affect the perception of trauma, safety, and privacy.[61,62]

TIC Continuous Through the Health Care System

TIC, from a public health perspective, includes primary, secondary, and tertiary prevention strategies. Primary prevention is a comprehensive approach that addresses social determinants of health (such as structural racism, poverty, and violence) that are often root causes of community trauma.[63] Promotion of relational health and other resilience factors (such as strong executive function and self-efficacy) may be considered primary prevention.[64] Following the fourth edition of *Bright Futures: Guidelines for Health Supervision of Infants, Children, and Adolescents*, promotion of early childhood relational health is a core purpose of both pediatric primary care and early childhood education.[65]

The National Child Traumatic Stress Network includes the promotion of child and family resilience, enhancement of protective factors, awareness of parent or caregiver trauma, and involvement of families in program development and evaluation as secondary prevention.[66] Trauma-informed therapies (eg, trauma-focused cognitive behavioral therapy) for symptomatic children and youth are considered tertiary prevention. These therapies are especially important for high-risk populations as identified earlier.[67–70]

Attachment-based dyadic therapies, such as parent–child interaction therapy, may serve to prevent development of persistent traumatic stress symptoms in high-risk families[71] and may be considered both secondary and tertiary prevention.

Recruitment and Training of a Trauma-Informed and Compassionate Workforce

Recruitment and pre-employment practices may help discern the capacity for empathy among prospective employees.[72] Training and education of all administrators, clinicians, and staff, both clinical and nonclinical, can promote the appreciation of the lifelong effects of trauma on child and adolescent development and family resilience and the implementation of trauma-aware practices. Continuous quality-improvement programs translate new knowledge and skills about childhood trauma into supervision, training, and patient care.

Prevention of STS requires specific training of all staff to raise awareness, promote resilience, and explore the interaction among STS, burnout, depression, substance use, and professional quality of life. Supportive supervision and peer mentoring offer opportunities for all employees to reflect on their own trauma histories and to promote compassion, nonjudgmental attitudes and collaboration.[73]

Coordination of Care Across Family-Serving Systems in the Community

Trauma-informed health care systems establish and support collaborative, interdisciplinary relationships among community and public health agencies that serve children and adolescents to coordinate care for children, adolescents, and families exposed to trauma. Schools,[74] juvenile justice programs,[75] mental health professionals,[76] home visiting services, child welfare systems,[76] and foster care agencies[77] are natural partners for pediatric health organizations in promoting community resilience. Many have established TIC programs. Community early intervention programs can help prevent and mitigate adversity and often have the advantage of caring for young children in their natural environment as home visitors.[78–80]

RECOMMENDATIONS FOR SYSTEM-LEVEL IMPLEMENTATION

Federal and State Funding

Federal agencies such as the Centers for Disease Control and Prevention can continue and expand research to improve understanding of the developmental effects of trauma and the efficacy of specific interventions for historically resilient populations. Urgently needed are successful strategies to interrupt the intergenerational transfer of family violence. Strategies are also crucial to blunt the impact of historical trauma in communities of color and in American Indian and Alaskan native populations in the United States.[30] It is particularly important to identify the origins of and successfully mitigate community violence, including racism, misogyny, and religious, ethnic, and cultural bias.

State-level resources can be directed to implementation, dissemination, and evaluation of trauma-informed community programs, such as interagency and multigenerational strategies for opioid dependency. One example of a state interagency, multigenerational treatment program is Ohio START (Sobriety, Treatment and Reducing Trauma).[81] States could develop a communication infrastructure to

facilitate data sharing, improve interdisciplinary/interagency cooperation, and engage community partners including foundations and academic institutions.

Federal guidelines can require that state Medicaid programs ensure comprehensive coverage for all children and adolescents and pregnant mothers without regard for legal or immigration status and mandate that coverage include mental health and substance use disorder services. Financing that increases access to high-quality, comprehensive, coordinated, culturally competent health care for high-risk populations is a high priority. Federal and state regulations can require all insurers, including Medicaid and private health insurers, to include coverage for TIC elements, including surveillance, screening, diagnosis, counseling, case management, follow-up, community collaboration, mental health care, and home visiting.

Large Health Systems, Insurers, and Managed Care Organizations

In large health systems, leadership can align its mission and financing with the core elements of trauma-informed systems.[82] Supporting TIC includes payment for trauma-informed, integrated mental health services, care coordination, rigorous case management, and seamless referral networks for intensive treatment. Prevention of secondary trauma, including care of affected health care workers, should be built into the mission of the health system.

Academic Centers and Children's Hospitals

Academic health centers train and educate the next generation of physicians, nurses, and ancillary health personnel and can promote the transformation to TIC in all health settings through education, research, and advocacy. Children's hospitals and health systems can model mental health integration[83] and trauma-informed practices throughout all service lines.[84] Because children's hospitals embrace population health management and community advocacy, they may serve as the anchor institution collaborating with community agencies to address social adversity at the neighborhood level while promoting TIC services.[85] Together with community pediatric care systems, academic health centers and children's hospitals can integrate core elements of education into workforce training for health care workers and community partners such as first responders, child welfare workers, teachers, and juvenile justice personnel.[86,87]

SUMMARY OF RECOMMENDATIONS

Federal and State Government

- Continue and expand research funding for the National Institutes of Health, Centers for Disease Control and Prevention, Substance Abuse and Mental Health Services Administration, and other federal agencies to improve the understanding of the root causes and developmental effects of trauma and effective interventions.
- Support epidemiological research of at-risk populations emphasizing prevention, early identification, and mitigation of the effects of community trauma.
- Facilitate interdisciplinary and interagency cooperation and data sharing to promote seamless care, research data collection, and amplification of promising practices in TIC.
- Engage national partners, foundations, and academic institutions in cross-systems planning to support early relational health.
- Support curriculum development and implementation through mechanisms such as the Agency for Healthcare Research and Quality.
- Expand health care coverage and payment for enhanced services such as integrated mental and social care.
- Mandate coverage for TIC services by government and private payers, including screening, diagnosis, office-based management, counseling, case management, community collaboration, and home visiting.

Large Health Systems and Managed Care Organizations

- Commit to becoming a trauma-informed system of care and integrate clinical practice of TIC into all services.
- Recruit, retain, and train a trauma-informed workforce.
- Expand and improve system-wide strategies for identification and treatment of all children and adolescents affected by traumatizing experiences.
- Build seamless referral networks for intensive treatment when indicated.
- Develop care models and fair payment mechanisms to promote implementation of TIC, including practice-level case management.
- Promote system-wide trauma-informed quality-improvement programs.
- Support engagement by including family advisors and employees in service planning and quality improvement, with particular emphasis on cultural, ethnic, gender, and racial concerns.

- Develop, implement, and evaluate policies and procedures to reduce retraumatization and STS and to identify, support, and refer for treatment health care workers who are symptomatic from traumatic stress.

American Academy of Pediatrics, American Academy of Pediatrics Chapters, and Academic Institutions

- Develop curricula on trauma and resilience for trainees, practicing pediatricians, and their teams.
- Support community collaboration with agencies that serve children and adolescents to create a seamless trauma-informed system of care.
- Develop and share quality improvement and maintenance of certification modules at state, chapter, and national levels.
- Develop a comprehensive research agenda for TIC in pediatric health systems.
- Partner with organizations such as the National Child Traumatic Stress Network to investigate new models of integrated care including pediatric and psychiatric telenetworks.
- Include questions about TIC in periodic surveys of pediatricians.
- Evaluate intervention and treatment strategies in collaboration with federal and state initiatives and mental health partners.
- Provide workshops, seminars, or online modules to train cross-system professionals about childhood trauma and resilience.

LEAD AUTHORS

James Duffee, MD, MPH, FAAP
Moira Szilagyi, MD, PhD, FAAP
Heather Forkey, MD, FAAP
Erin T. Kelly, MD, FAAP

COUNCIL ON COMMUNITY PEDIATRICS, 2019–2021

James Duffee, MD, MPH, FAAP, Chairperson
Kimberly G. Montez, MD, FAAP, Vice Chairperson
Kimberley J. Dilley, MD, MPH, FAAP
Andrea E. Green, MD, FAAP
Joyce Javier, MD, MPH, MS, FAAP
Madhulika Mathur, MD, MPH, FAAP
Gerri Mattson, MD, FAAP
Jacqueline L. Nelson, MD, FAAP
Mikah Owen, MD, MPH, FAAP
Kenya Parks, MD, MPH, FAAP
Christopher B. Peltier, MD, FAAP

LIAISONS

Donene Feist – *Family Voices*
Rachel Nash, MD, MPH – *Section on Pediatric Trainees*
Judith Thierry, DO, MPH, FAAP - *Committee on Native American Child Health*

STAFF

Dana Bennett-Tejes, MA, MNM

COUNCIL ON FOSTER CARE, ADOPTION, AND KINSHIP CARE EXECUTIVE COMMITTEE, 2019–2021

Sarah H. Springer, MD, FAAP, Chairperson
Moira Ann Szilagyi, MD, PhD, FAAP, Past Chairperson
Heather C. Forkey, MD, FAAP
Kristine Fortin, MD, MPH, FAAP
Mary Booth Vaden Greiner, MD, MS, FAAP
Todd J. Ochs, MD, FAAP
Anu N. Partap, MD, MPH, FAAP
Linda Davidson Sagor, MD, MPH, FAAP
Deborah L. Shropshire, MD, FAAP
Jonathan David Thackeray, MD, FAAP
Douglas Waite, MD, FAAP
Lisa Weber Zetley, MD, FAAP

LIAISONS

Jeremy Harvey – *Foster Care Alumni of America*
Wynne Shepard Morgan, MD – *American Academy of Child and Adolescent Psychiatry*
Camille Robinson, MD, FAAP – *Section on Pediatric Trainees*

STAFF

Tammy Piazza Hurley
Mary Crane, PhD, LSW
Müge Chavdar, MPH

COUNCIL ON CHILD ABUSE AND NEGLECT, 2019–2021

Suzanne B. Haney, MD, MS, FAAP, Chairperson
Andrew P. Sirotnak, MD, FAAP, Immediate Past-Chairperson
Andrea Gottsegen Asnes, MD, FAAP
Amy R. Gavril, MD, MSCI, FAAP
Rebecca Greenlee Girardet, MD, FAAP
Amanda Bird Hoffert Gilmartin, MD, FAAP
Nancy D. Heavilin, MD, FAAP
Sheila M. Idzerda, MD, FAAP
Antoinette Laskey, MD, MPH, MBA, FAAP
Lori A. Legano, MD, FAAP
Stephen A. Messner, MD, FAAP
Bethany A. Mohr, MD, FAAP
Shalon Marie Nienow, MD, FAAP
Norell Rosado, MD, FAAP

LIAISONS

Heather C. Forkey, MD, FAAP – *Council on Foster Care, Adoption, and Kinship Care*
Brooks Keeshin, MD, FAAP – *American Academy of Child and Adolescent Psychiatry*
Jennifer Matjasko, PhD – *Centers for Disease Control and Prevention*
Anish Raj, MD – *Section on Pediatric Trainees*
Elaine Stedt, MSW, ACSW – *Administration for Children, Youth and Families, Office on Child Abuse and Neglect*

STAFF

Tammy Piazza Hurley
Müge Chavdar, MPH

ABBREVIATIONS

DSM-5: *Diagnostic and Statistical Manual of Mental Disorders, Fifth Edition*
DTD: developmental trauma disorder
PMTS: pediatric medical traumatic stress
PTSD: posttraumatic stress disorder
PTSS: posttraumatic stress symptoms
SSNR: safe, stable, nurturing relationship
STS: secondary traumatic stress
TIC: trauma-informed care

FINANCIAL DISCLOSURE: The authors have indicated they have no financial relationships relevant to this article to disclose.

FUNDING: No external funding.

POTENTIAL CONFLICT OF INTEREST: The authors have indicated they have no potential conflicts of interest to disclose.

REFERENCES

1. Centers for Disease Control and Prevention. Essentials for childhood: creating safe, stable, nurturing relationships and environments. Available at: https://www.cdc.gov/violenceprevention/childabuseandneglect/essentials.html. Accessed January 11, 2021
2. Center on the Developing Child. The Foundations of Lifelong Health Are Built in Early Childhood. Cambridge, MA: Center on the Developing Child at Harvard University; 2010. Available at: www.developingchild.harvard.edu. Accessed June 24, 2021
3. Merrick MT, Ford DC, Ports KA, et al. Vital signs: estimated proportion of adult health problems attributable to adverse childhood experiences and implications for prevention - 25 states, 2015–2017. *MMWR Morb Mortal Wkly Rep*. 2019;68(44):999–1005
4. Substance Abuse and Mental Health Services Administration. National Child Traumatic Stress Initiative. Available at: https://www.samhsa.gov/child-trauma. Accessed January 11, 2021
5. National Child Traumatic Stress Network. Interventions. Available at: https://www.nctsn.org/treatments-and-practices/trauma-treatments/interventions. Accessed January 11, 2021
6. Forkey H, Szilagyi M, Kelly ET, Duffee J; American Academy of Pediatrics, Council on Foster Care, Adoption, and Kinship Care, Council on Community Pediatrics, Council on Child Abuse and Neglect, and Committee on Psychosocial Aspects of Child and Family Health. Trauma-informed care. *Pediatrics*. 2021;148(2):e2021052580
7. Oral R, Ramirez M, Coohey C, et al. Adverse childhood experiences and trauma informed care: the future of health care. *Pediatr Res*. 2016;79(1–2):227–233
8. FrameWorks Institute. *Building Relationships: Framing Early Relational Health*. Washington, DC: FrameWorks Institute; 2020. Available at: https://www.frameworksinstitute.org/wp-content/uploads/2020/06/FRAJ8069-Early-Relational-Health-paper-200526-WEB.pdf. Accessed January 11, 2021
9. National Scientific Council on the Developing Child. *Supportive Relationships and Active Skill-Building Strengthen the Foundations of Resilience: Working Paper 13*. Cambridge, MA: Center for the Developing Child, Harvard University; 2015. Available at: https://developingchild.harvard.edu/resources/supportive-relationships-and-active-skill-building-strengthen-the-foundations-of-resilience/. Accessed January 11, 2021
10. Centers for Disease Control and Prevention. *Preventing Adverse Childhood Experiences: Leveraging the Best Available Evidence*. Atlanta, GA: National Center for Injury Prevention and Control, Centers for Disease Control and Prevention; 2019. Available at: https://www.cdc.gov/violenceprevention/pdf/preventingACES.pdf. Accessed January 11, 2021
11. Johnson SB, Riley AW, Granger DA, Riis J. The science of early life toxic stress for pediatric practice and advocacy. *Pediatrics*. 2013;131(2):319–327

12. McEwen BS. Stressed or stressed out: what is the difference? *J Psychiatry Neurosci.* 2005;30(5):315–318

13. Shonkoff JP, Garner AS; Committee on Psychosocial Aspects of Child and Family Health; Committee on Early Childhood, Adoption, and Dependent Care; Section on Developmental and Behavioral Pediatrics. The lifelong effects of early childhood adversity and toxic stress. *Pediatrics.* 2012;129(1). Available at: www.pediatrics.org/cgi/content/full/129/1/e232

14. Substance Abuse and Mental Health Services Administration. *SAMHSA's Concept of Trauma and Guidance for a Trauma-Informed Approach.* Rockville, MD: Substance Abuse and Mental Health Services Administration; 2014

15. Bowlby J. *A Secure Base: Parent-Child Attachment and Healthy Human Development.* New York, NY: Basic Books; 1988

16. Masten AS. Resilience theory and research on children and families: past, present and future. *J Fam Theory Rev.* 2018;10(1):12–31

17. Chen Y, VanderWeele TJ. Associations of religious upbringing with subsequent health and well-being from adolescence to young adulthood: an outcome-wide analysis. *Am J Epidemiol.* 2018; 187(11):2355–2364

18. Sege R, Linkenbach J. Essentials for childhood: promoting healthy outcomes from positive experiences. *Pediatrics.* 2014;133(6) Available at: www.pediatrics.org/cgi/content/full/133/6/e1489

19. Bethell C, Davis MB, Gombojav N, Stumbo S, Powers K. *A National and Across State Profile on Adverse Childhood Experiences Among Children and Possibilities to Heal and Thrive: Issue Brief October 2017.* Baltimore, MD: Johns Hopkins Bloomberg School of Public Health; 2017

20. Felitti VJ, Anda RF, Nordenberg D, et al. Relationship of childhood abuse and household dysfunction to many of the leading causes of death in adults. The Adverse Childhood Experiences (ACE) Study. *Am J Prev Med.* 1998;14(4): 245–258

21. Cronholm PF, Forke CM, Wade R, et al. Adverse childhood experiences: expanding the concept of adversity. *Am J Prev Med.* 2015;49(3):354–361

22. Sacks V, Murphey D. The prevalence of adverse childhood experiences, nationally, by state, and by race/ethnicity. 2018. Available at: https://www.childtrends.org/wp-content/uploads/2018/02/ACESBriefUpdatedFinal_ChildTrends_February2018.pdf. Accessed January 11, 2021

23. Berg KL, Shiu CS, Feinstein RT, Acharya K, MeDrano J, Msall ME. Children with developmental disabilities experience higher levels of adversity. *Res Dev Disabil.* 2019;89:105–113

24. Schüssler-Fiorenza Rose SM, Xie D, Stineman M. Adverse childhood experiences and disability in U.S. adults. *PM R.* 2014;6(8):670–680

25. Hoover DW, Kaufman J. Adverse childhood experiences in children with autism spectrum disorder. *Curr Opin Psychiatry.* 2018;31(2):128–132

26. Trent M, Dooley DG, Dougé J; Section on Adolescent Health; Council on Community Pediatrics; Committee on Adolescence; Council on Community Pediatrics; Committee on Adolescence. The impact of racism on child and adolescent health. *Pediatrics.* 2019;144(2): e20191765

27. Huynh VW. Ethnic microaggressions and the depressive and somatic symptoms of Latino and Asian American adolescents. *J Youth Adolesc.* 2012;41(7): 831–846

28. Heard-Garris NJ, Cale M, Camaj L, Hamati MC, Dominguez TP. Transmitting trauma: a systematic review of vicarious racism and child health. *Soc Sci Med.* 2018;199:230–240

29. Mohatt NV, Thompson AB, Thai ND, Tebes JK. Historical trauma as public narrative: a conceptual review of how history impacts present-day health. *Soc Sci Med.* 2014;106:128–136

30. Sotero MM. A conceptual model of historical trauma: implications for public health, practice and research. *J Health Dispar Res Pract.* 2006;1(1):93–108

31. Brave Heart MYH. The historical trauma response among natives and its relationship with substance abuse: a Lakota illustration. *J Psychoactive Drugs.* 2003;35(1):7–13

32. Linton JM, Griffin M, Shapiro AJ; Council on Community Pediatrics. Detention of immigrant children. *Pediatrics.* 2017;139(5):e20170483

33. Wood LCN. Impact of punitive immigration policies, parent-child separation and child detention on the mental health and development of children. *BMJ Paediatr Open.* 2018;2(1):e000338

34. Bellis MA, Hughes K, Ford K, Ramos Rodriguez G, Sethi D, Passmore J. Life course health consequences and associated annual costs of adverse childhood experiences across Europe and North America: a systematic review and meta-analysis. *Lancet Public Health.* 2019;4(10):e517–e528

35. Jones CM, Merrick MT, Houry DE. Identifying and preventing adverse childhood experiences: implications for clinical practice. *JAMA.* 2020;323(1):25–26

36. American Psychiatric Association. *Diagnostic and Statistical Manual of Mental Disorders*, 5th ed. Washington, DC: American Psychiatric Publishing; 2013

37. D'Andrea W, Ford J, Stolbach B, Spinazzola J, van der Kolk BA. Understanding interpersonal trauma in children: why we need a developmentally appropriate trauma diagnosis. *Am J Orthopsychiatry.* 2012;82(2):187–200

38. Rahim M. Developmental trauma disorder: an attachment-based perspective. *Clin Child Psychol Psychiatry.* 2014; 19(4):548–560

39. van der Kolk BA. Developmental trauma disorder. *Psychiatr Ann.* 2005;35(5):401

40. Bremness A, Polzin W. Commentary: developmental trauma disorder: a missed opportunity in DSM V. *J Can Acad Child Adolesc Psychiatry.* 2014;23(2):142–145

41. Schmid M, Petermann F, Fegert JM. Developmental trauma disorder: pros and cons of including formal criteria in the psychiatric diagnostic systems. *BMC Psychiatry.* 2013;13:3

42. Kazak AE, Kassam-Adams N, Schneider S, Zelikovsky N, Alderfer MA, Rourke M. An integrative model of pediatric medical traumatic stress. *J Pediatr Psychol.* 2006;31(4):343–355

43. Shah AN, Jerardi KE, Auger KA, Beck AF. Can hospitalization precipitate toxic

stress? *Pediatrics*. 2016;137(5):e20160204

44. Rzucidlo SE, Campbell M. Beyond the physical injuries: child and parent coping with medical traumatic stress after pediatric trauma. *J Trauma Nurs*. 2009; 16(3):130–135
45. National Child Traumatic Stress Network. Medical trauma: effects. Available at: https://www.nctsn.org/what-is-child-trauma/trauma-types/medical-trauma/effects. Accessed January 11, 2021
46. Watson RS, Choong K, Colville G, et al. Life after critical illness in children-toward and understanding of pediatric post-intensive care syndrome. *J Pediatr*. 2018;198:16–24
47. Goldberg R, Mays M, Halpern NA. Mitigating post-intensive care syndrome-family: a new possibility. *Crit Care Med*. 2020;48(2):260–261
48. Ari AB, Peri T, Margalit D, Galili-Weisstub E, Udassin R, Benarroch F. Surgical procedures and pediatric medical traumatic stress (PMTS) syndrome: Assessment and future directions. *J Pediatr Surg*. 2018;53(8):1526–1531
49. Landolt MA, Ystrom E, Sennhauser FH, Gnehm HE, Vollrath ME. The mutual prospective influence of child and parental post-traumatic stress symptoms in pediatric patients. *J Child Psychol Psychiatry*. 2012;53(7):767–774
50. Administration for Children and Families. Secondary traumatic stress. Available at: https://www.acf.hhs.gov/trauma-toolkit/secondary-traumatic-stress. Accessed January 11, 2021
51. Dyrbye LN, Shanafelt TD, Sinsky CA, et al. *Burnout Among Health Care Professionals: A Call to Explore and Address This Underrecognized Threat to Safe, High-Quality Care: Discussion Paper*. Washington, DC: National Academy of Medicine; 2017
52. Melnyk BM, Orsolini L, Tan A, et al. A national study links nurses' physical and mental health to medical errors and perceived worksite wellness. *J Occup Environ Med*. 2018;60(2): 126–131
53. Shoji K, Lesnierowska M, Smoktunowicz E, et al. What comes first, job burnout or secondary traumatic stress? Findings from two longitudinal studies from the U.S. and Poland. *PLoS One*. 2015; 10(8):e0136730
54. Paton F. Depressed nurses more likely to make medical errors. *Nursing News*. October 31, 2017. Available at: https://nurseslabs.com/depressed-nurses-likely-make-medical-errors. Accessed June 24, 2021
55. McHugh MD, Kutney-Lee A, Cimiotti JP, Sloane DM, Aiken LH. Nurses' widespread job dissatisfaction, burnout, and frustration with health benefits signal problems for patient care. *Health Aff (Millwood)*. 2011;30(2):202–210
56. Walton M, Murray E, Christian MD. Mental health care for medical staff and affiliated healthcare workers during the COVID-19 pandemic. *Eur Heart J Acute Cardiovasc Care*. 2020;9(3):241–247
57. National Council for Behavioral Health. *Fostering Resilience and Recover: A Change Package for Advancing Trauma-Informed Primary Care*. Washington, DC: National Council for Behavioral Health; 2019. Available at: https://www.thenationalcouncil.org/wp-content/uploads/2019/12/FosteringResilienceChangePackage_Final.pdf?daf=375ateTbd56. Accessed January 11, 2021
58. Fallot RD, Harris M. *Creating Cultures of Trauma-Informed Care (CCTIC): A Self-Assessment and Planning Protocol Community Connections*. Washington, DC: Trauma-Informed Care Project; 2009. Available at: https://www.theannainstitute.org/CCTICSELFASSPP.pdf. Accessed June 24, 2021
59. Garg A, Boynton-Jarrett R, Dworkin PH. Avoiding the unintended consequences of screening for social determinants of health. *JAMA*. 2016;316(8):813–814
60. National Institute for Children's Health Quality. Creating a patient and family advisory council: a toolkit for pediatric practices. 2012. Available at: https://www.nichq.org/sites/default/files/resource-file/PFAC%20Updated.pdf. Accessed June 24, 2021. Accessed January 11, 2021
61. Benner GJ. Comprehensive trauma-informed care for the whole community: the whole child initiative model. *Educational Considerations*. 2019;44(2):8
62. Center for Healthcare Strategies. Key ingredients for successful trauma-informed care implementation. 2016. Available at: www.chcs.org/media/ATC_whitepaper_040616.pdf. Accessed January 11, 2021
63. Rawles PD. The link between poverty, the proliferation of violence and the development of traumatic stress among urban youth in the united states to school violence. 2010. Available at: http://forumonpublicpolicy.com/Vol2010.no4/archive.vol2010.no4/rawles.pdf. Accessed January 11, 2021
64. Garner A, Yogman M; American Academy of Pediatrics, Committee on Psychosocial Aspects of Child and Family Health, Section on Developmental and Behavioral Pediatrics, Council on Early Childhood. Preventing childhood toxic stress: partnering with families and communities to promote relational health. *Pediatrics*. 2021;148(2): e2021052582
65. Hagan JF, Shaw JS, Duncan PM, eds. *Bright Futures: Guidelines for Health Supervision of Infants, Children, and Adolescents*. 4th ed. Itasca, IL: American Academy of Pediatrics; 2017
66. National Child Traumatic Stress Network. Essential elements. Available at: https://www.nctsn.org/trauma-informed-care/trauma-informed-systems/healthcare/essential-elements. Accessed January 11, 2021
67. Gleason MM, Goldson E, Yogman MW; Council on Early Childhood; Committee on Psychosocial Aspects of Child and Family Health; Section on Developmental and Behavioral Pediatrics. Addressing early childhood emotional and behavioral problems. *Pediatrics*. 2016;138(6):e20163025
68. Council on Early Childhood; Committee on Psychosocial Aspects of Child and Family Health; Section on Developmental and Behavioral Pediatrics. Addressing early childhood emotional and behavioral problems. *Pediatrics*. 2016;138(6):e20163023
69. Machtinger EL, Cuca YP, Khanna N, Rose CD, Kimberg LS. From treatment to healing: the promise of trauma-

informed primary care. *Womens Health Issues*. 2015;25(3):193–197

70. Annie E. Casey Foundation. Trauma-informed practice with young people in foster care. Issue brief #5. 2012. Available at: www.aecf.org/resources/trauma-informed-practice-with-young-people-in-foster-care/. Accessed January 11, 2021
71. Allen B, Timmer SG, Urquiza AJ. Parent-child interaction therapy as an attachment-based intervention: theoretical rationale and pilot data with adoptive children. *Child Youth Serv Rev*. 2014;47(3):334–341
72. The Chadwick Trauma-Informed Systems Dissemination and Implementation Project. Secondary traumatic stress in child welfare practice. Trauma-informed guidelines for organizations. 2016. Available at: www.chadwickcenter.com/wp-content/uploads/2017/08/stsinchildwelfarepractice-trauma-informedguidelinesfororganizations.pdf. Accessed January 11, 2021
73. Head Start. Reflective supervision. Available at: https://eclkc.ohs.acf.hhs.gov/family-engagement/building-partnerships-guide-developing-relationships-families/reflective-supervision. Accessed January 11, 2021
74. Children's Defense Fund. Addressing children's trauma. A toolkit for Ohio's schools. 2015. Available at: https://www.cdfohio.org/wp-content/uploads/sites/6/2018/07/addressing-childrens-trauma-issue-brief-JULY2015.pdf. Accessed June 24, 2021
75. National Child Traumatic Stress Network. Essential elements of a trauma-informed juvenile justice system. Available at: https://www.nctsn.org/sites/default/files/resources//essential_elements_trauma_informed_juvenile_justice_system.pdf. Accessed January 11, 2021
76. Chadwick Trauma-Informed Systems Project. *Creating Trauma-Informed Child Welfare Systems: A Guide for Administrators*, 2nd ed. San Diego, CA: Chadwick Center for Children and Families; 2013
77. Schilling S, Fortin K, Forkey H. Medical management and trauma-informed care for children in foster care. *Curr Probl Pediatr Adolesc Health Care*. 2015;45(10):298–305
78. Beckmann KA. Mitigating adverse childhood experiences through investments in early childhood programs. *Acad Pediatr*. 2017;17(7, suppl):S28–S29
79. Center on the Developing Child. A science-based framework for early childhood policy. Available at: https://developingchild.harvard.edu/resources/a-science-based-framework-for-early-childhood-policy/. Accessed January 11, 2021
80. Duffee JH, Mendelsohn AL, Kuo AA, Legano LA, Earls MF; Council on Community Pediatrics; Council on Early Childhood; Committee on Child Abuse and Neglect. Early childhood home visiting. *Pediatrics*. 2017;140(3):e20172150
81. Ohio START. (Sobriety, Treatment and Reducing Trauma). Available at: https://ohiostart.org/. Accessed January 11, 2021
82. Marsac ML, Kassam-Adams N, Hildenbrand AK, et al. Implementing a trauma-informed approach in pediatric health care networks. *JAMA Pediatr*. 2016;170(1):70–77
83. Dayton L, Agosti J, Bernard-Pearl D, et al. Integrating mental and physical health services using a socio-emotional trauma lens. *Curr Probl Pediatr Adolesc Health Care*. 2016;46(12):391–401
84. Wissow LS. Introducing psychosocial trauma-informed integrated care. *Curr Probl Pediatr Adolesc Health Care*. 2016;46(12):389–390
85. Zuckerman D, ed. *Hospitals Building Healthier Communities: Embracing the Anchor Mission*. College Park, MD: The Democracy Collaborative at the University of Maryland; 2013. Available at https://community-wealth.org/content/hospitals-building-healthier-communities-embracing-anchor-mission. Accessed January 11, 2021
86. Ko SJ, Ford JD, Kassam-Adams N, et al. Creating trauma-informed systems: child welfare, education, first responders, health care, juvenile justice. *Prof Psychol Res Pr*. 2008;39(4):396–404
87. Child Welfare Information Gateway. The importance of a trauma-informed children's welfare system. 2015. Available at: https://www.childwelfare.gov/pubs/issue-briefs/trauma-informed. Accessed January 11, 2021

Tuberculosis Infection in Children and Adolescents: Testing and Treatment

- *Clinical Report*
  - *PPI: AAP Partnership for Policy Implementation*
    See Appendix 1 for more information.

CLINICAL REPORT Guidance for the Clinician in Rendering Pediatric Care

American Academy of Pediatrics
DEDICATED TO THE HEALTH OF ALL CHILDREN™

Tuberculosis Infection in Children and Adolescents: Testing and Treatment

Dawn Nolt, MD, MPH, FAAP,[a] Jeffrey R. Starke, MD, FAAP,[b] COMMITTEE ON INFECTIOUS DISEASES

Tuberculosis (TB) remains an important problem among children in the United States and throughout the world. There is no diagnostic reference standard for latent tuberculosis infection (also referred to as tuberculosis infection [TBI]). The tuberculin skin test (TST) has many limitations, including difficulty in administration and interpretation, the need for a return visit by the patient, and false-positive results caused by cross-reaction with Mycobacterium bovis–bacille Calmette-Guerin vaccines and many nontuberculous mycobacteria. Interferon-gamma release assays (IGRAs) are blood tests that use antigens specific for M tuberculosis; as a result, IGRAs yield fewer false-positive results than the TST. Both IGRAs and the TST have reduced sensitivity in immunocompromised children, including children with severe TB disease. Both methods have high positive predictive value when applied to children with risk factors for TBI, especially recent contact with a person who has TB disease. The advantages of using IGRAs and diminished experience with the placement and interpretation of the TST favor expanded use of IGRAs in children in the United States. There are now several effective and safe regimens for the treatment of TBI in children. For improved adherence to therapy, the 3 rifamycin-based regimens are preferred because of their short duration. Daily isoniazid can be used if there is intolerance or drug interactions with rifamycins. A TB specialist should be involved when there are questions regarding testing interpretation, selection of an appropriate treatment regimen, or management of adverse effects.

INTRODUCTION

Tuberculosis (TB) remains an important disease in the United States and throughout the world. Approximately 9000 new cases occur each year in the United States.[1] Of the 5175 children and adolescents younger than 18 years with TB disease reported in the United States from 2010 to 2017, 32% were born in other countries.[2] Infants and young children (younger

abstract

[a]*Department of Pediatrics, Division of Infectious Diseases, Oregon Health and Science University, Portland, Oregon; and* [b]*Department of Pediatrics, Division of Infectious Diseases, Baylor College of Medicine, Houston, Texas*

The authors have indicated they have contributed equally to the writing of this article and approved the final manuscript as submitted.

DOI: https://doi.org/10.1542/peds.2021-054663

PEDIATRICS (ISSN Numbers: Print, 0031-4005; Online, 1098-4275).

FINANCIAL DISCLOSURE: The authors have indicated they do not have a financial relationship relevant to this article to disclose.

FUNDING: No external funding.

POTENTIAL CONFLICT OF INTEREST: The authors have indicated they have no potential conflicts of interest to disclose.

To cite: Nolt D, Starke JR; AAP Committee on Infectious Diseases. Tuberculosis Infection in Children and Adolescents: Testing and Treatment. *Pediatrics*. 2021;148(6):e2021054663

than 4 years) have the highest rate for tuberculosis infection (TBI) progressing to TB disease rapidly after exposure, within a few weeks to several months. Children who move to the United States from countries with high TB burden (eg, Asia, Middle East, Africa, Latin America, countries of the former Soviet Union) often received no testing for TBI, expanding the pool of infected children in the United States. Some of these children developed TB disease or are evaluated and treated for TBI after emigrating, but many have untreated TBI and are at risk for developing TB disease later in life. In addition, many US-born children who have been infected with *Mycobacterium tuberculosis* within the United States or abroad have gone undetected.

In most children and adolescents, initial infection with *M tuberculosis* is eliminated or contained by host defenses, and the person remains asymptomatic. However, residual bacilli may remain viable and become active again to cause TB disease. Treatment of TBI substantially reduces the risk of developing TB disease in children who adhere to therapy by 90% in both the immediate and distant future.[3] Therefore, the goal of testing for TBI is to identify individuals who are at risk for developing TB disease and will benefit from treatment.[4–6]

In the pediatric population, infants and children (younger than 4 years) and adolescents are at higher risk of progressing from TBI to TB disease than are primary school-aged children. The risk of progression in infants younger than 12 months with untreated TBI is 40% to 50%, decreases to 25% in children 1 to 2 years of age, drops to 5% to 10% in school-aged children, and is 10% to 15% in adolescents (Table 1). Epidemiological factors also define risk of infection: children who were born and lived in or have traveled to an area of the world with a high prevalence of TB and those who have had a household or family member with TB disease or TBI are at higher risk for TBI than the general population. As a result, selective testing for TBI of children on the basis of their risk factors has been adopted as the main strategy in the United States.[7,8]

Although the diagnosis of TB disease is confirmed by the detection of *M tuberculosis* in a clinical sample, there is no diagnostic gold standard for diagnosis of TBI.[3,9,10] Two available but imperfect methods for identification of TBI are the tuberculin skin test (TST) and the interferon-γ release assay (IGRA). Both methods depend on cell-mediated immunity and provide immunologic evidence of host sensitization to antigens of *M tuberculosis*. Neither method can distinguish between TBI and TB disease, and both methods display suboptimal performance in immunocompromised patients, who are at greatest risk for progression of TBI to TB disease.

GENERAL TESTING CONSIDERATIONS

Both the TST and IGRA depend on the host immune response to specific antigens found in *M tuberculosis*. Determining the sensitivity and specificity of both test types for children is difficult. They were studied and compared initially in children with culture-confirmed TB disease because microbiologic confirmation is the only real proof of TB disease. However, children with culture-proven TB disease tend to have more severe manifestations and clinical illness. Increased severity of disease may result in immunosuppression and diminish the sensitivity of tests that rely on the immune response, such as both the IGRA and TST. As a result, the sensitivity of both test types can be low for TB disease.[11,12] Children with less severe TB disease often do not have microbiologic confirmation, lacking the absolute proof of infection that is needed to accurately assess test sensitivity and specificity, and many studies have used less reliable methods of clinical diagnosis of TB disease instead. The major difficulty for interpreting studies of the relative performance of the TST and IGRA is that there is no gold standard test, so it is difficult to determine for discordant test results whether the negative test result is more specific or the positive test result is more sensitive.

TABLE 1 Age-Associated Risk of Progression From TBI to TB Disease

Age	Risk of Progression from TBI to Disease if Untreated, %
<12 mo	40–50
1–2 y	25
School-aged	5–10
Adolescents	10–15
Adults	5–10

Risk of progression is also increased in immunocompromised individual and those recently infected with *M tuberculosis*.

The TST

The TST is the intradermal injection of 5 TU of purified protein derivative (PPD) or 2 tuberculin units (TU) of PPD-RT23, the latter used predominantly in Europe. PPD tuberculin solution contains dozens of TB antigens, with the exact composition varying among batches and preparations. Many of these antigens also are present in environmental nontuberculous mycobacteria (NTM) prevalent throughout the United States and in the bacille Calmette-Guérin (BCG) vaccines. A patient who mounts a cell-mediated response to tuberculin antigens has a delayed-type hypersensitivity response usually within 48 to 72 hours, causing measurable induration at the injection site.

TST results can be difficult to interpret. The test depends on accurate intradermal injection, which should be performed by an experienced individual. Interpretation requires that the patient returns in 48 to 72 hours. Correct interpretation of the reaction involves careful measurement of induration that should be determined by a provider with experience in this measurement. The measurement should be recorded to the nearest millimeter of the transverse diameter of the induration (Fig 1). Reaction size can vary (on average) within the same individual by 15%, which has been described when the test is placed simultaneously on both arms.[13] The variability in measuring induration among experienced observers also varies by about 15% and is much greater among inexperienced personnel and untrained people, especially family members.[13] Therefore, family members should not be allowed to interpret a TST result. False-negative TST results can be caused by improper handling of the tuberculin solution, improper placement of the test, and incorrect interpretation of the results.[13]

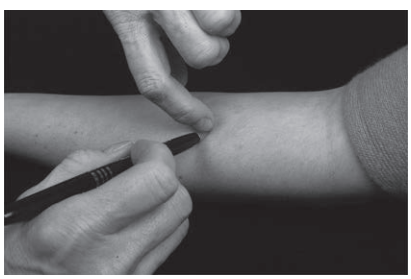


FIGURE 1 Measurement of TST reaction. The technician is marking the widest edges of the patient's induration (a hard, dense, raised formation) with a pen for accurate measurement of the TST reaction. To locate the skin test site, the arm should be inspected in good light and on a firm surface. A light, gentle motion is used to sweep the fingertips over the surface of the forearm to locate the margins or edges of induration. As in this image, the widest edges of the induration are marked with a pen, using the fingertips as a guide. A millimeter ruler is then used to measure the diameter of the induration between the 2 marks. Image courtesy of CDC/Gabrielle Benenson.

Induration at the site of the TST is caused by migration of mostly mononuclear cells to the area and the inflammatory process secondary to these cells' response. This response can be attributable to infection with *M tuberculosis*, exposure to NTM, or receipt of BCG vaccine. The patient's history and the size of the induration help to determine which of these 3 potential causes may be likely associated with TST reaction. People with exposure to environmental NTM often have indurations $<$10 mm, but larger reactions are not uncommon. Among populations with a low prevalence of TB but a high prevalence of exposure to environmental NTM, such as in the United States, the distribution of reactions between individuals with TBI and those with NTM exposure overlap to a considerable degree.[7] The most effective way to minimize false-positive results is to avoid testing individuals who lack a risk factor for TBI (Table 2).

To improve TST performance, the practice has been to vary the cutoff for the size of the TST reaction considered positive to optimize the sensitivity and specificity of the result. The cutoff is set at $\geq$15 mm to optimize specificity for people lacking TBI risk factors but who are tested for administrative reasons, $\geq$10 mm for people with a risk factor for TBI, and $\geq$5 mm to optimize sensitivity for people at high risk of having or developing TB disease if they have TBI (clinical evidence of TB disease, recent TB exposure, or significant immune compromise).[14]

BCG vaccines are administered in countries with high TB burden because they reduce the risk of disseminated (miliary) and central nervous system TB in children.[15] Interpretation of TST results in BCG recipients who are known contacts of a person with TB disease or at high risk for TB disease is the same as for people who have not received BCG vaccine. For a foreign-born child, history of BCG vaccination should be determined by examination of the vaccination record and the finding of a typical BCG scar, usually located on the deltoid region of either arm. Many of the antigens in PPD also are found in *M bovis*-BCG, the organism in the BCG vaccines. Some individuals who are not infected with *M tuberculosis* may express induration in response to the TST that reflects previous receipt of a BCG vaccination. The size of the TST reaction varies with the strain and dose of vaccine,[16] the route of administration,[17] age at vaccination,[18] the time interval since vaccination,[19] and the number of BCG doses. Approximately half of infants who received a BCG vaccination will respond with significant induration to a TST. Although most, perhaps as many as 90%, of children 5 years or older who received a BCG vaccine as an infant will not have a positive response to a TST (unless also infected with *M tuberculosis*, which may not be prevented by BCG vaccination), some will retain this response, causing a false-positive result. The induration often measures $<$10 mm but can be $>$15 mm.[7,20] Children born in countries with a high TB burden (Table 2) are candidates for selective testing for TBI, but a large number of false-positive results occur when the TST is used on children who have received a BCG vaccine. Children who have received a BCG vaccination also may be subject to "boosting" from the TST, the immunologic recall of

TABLE 2 Risk Factors for Increased Risk of Acquiring TBI and/or Progressing to TB Disease

Contacts of people with confirmed or suspected contagious TB (contact investigation)
Children with radiographic or clinical findings suggesting TB disease
Children immigrating from countries with endemic infection (eg Asia, Middle East, Africa, Latin America, countries of the former Soviet Union), including international adoptees
Children with history of significant travel[a] to countries with endemic infection who have substantial contact with the resident population
Children with HIV infection
Children with other medical conditions, including diabetes mellitus, chronic renal failure, malnutrition, or congenital or acquired immunodeficiencies and children receiving TNF-α antagonists, which may enhance the possibility for progression to severe disease

[a] Determination of significant travel should account for the frequency of travel and the duration of time. Testing should be conducted 8–10 wk after completion of travel, to allow for the known incubation period of *M tuberculosis*.

hypersensitivity to antigens in the PPD that are also present in *M bovis*-BCG, which creates a false-positive TST result.[21,22]

False-negative TST results can occur because of limited ability of certain children with TBI or TB disease to mount an appropriate delayed-type sensitivity response, especially those who are immunosuppressed either by disease (such as advanced HIV infection, advanced TB, cancer, or malnutrition) or who receive immunosuppressive treatments (such as corticosteroids, cancer chemotherapy, and immunomodulating biological agents, especially the tumor necrosis factor-α [TNF-α] inhibitors or live-virus vaccines). Unfortunately, children for whom the TST has diminished sensitivity are those individuals most likely to progress to TB disease if infected.[3]

In summary, there are limitations to both the sensitivity and the specificity of the TST. The positive predictive value of the TST is much greater when it is applied to individuals who have a recognized risk factor for TBI. When the TST is used for individuals lacking risk factors, the vast majority of the positive results may be falsely positive, and this problem is accentuated in children who received a BCG vaccine.[7] One large study using latent class analysis (a method of analysis that creates a statistical gold standard when no such test is available) demonstrated that the positive predictive value of the TST for TBI among foreign-born children younger than 5 years, most of whom had received a BCG vaccine, was 10%, meaning that 90% of the positive results were presumably falsely positive.[23] In addition, the test has poor sensitivity in immunocompromised children, who have the greatest risk of progression to TB disease. Because of these limitations, some experts have called for the "retirement" of the TST in favor of the IGRA.[24]

The IGRA

IGRAs are ex vivo blood tests that detect interferon-γ (IFN-γ) release from a patient's $CD4^+$ and $CD8^+$ T lymphocytes after stimulation by antigens found on *M tuberculosis* complex (which includes *M tuberculosis*, *M bovis*, *M africanum*, *M microti*, and *M canetti*). Two IGRAs are available commercially: the QuantiFERON-TB Gold Plus assay (QFT; Qiagen, Hilden, Germany), which has largely replaced the previously used and studied QuantiFERON-TB Gold In-Tube assay, and the T-SPOT.TB assay (T-SPOT; Oxford Immunotec, Abingdon, United Kingdom). However, the studies of QFT published before 2017 used the QuantiFERON-TB Gold In-Tube assay. Both the QFT and T-SPOT use early secreted antigenic target 6 (ESAT-6) and culture filter protein 10 (CFP-10) encoded by genes located within the region of difference 1 (RD1) locus of the *M tuberculosis* genome. The RD1 antigens used in the 2 IGRAs are not encoded in the genomes of *M bovis*-BCG strains, although they are present on wild-type *M bovis*, or most species of NTM, specifically not on the *M avium* complex organisms that are the most ubiquitous pathogenic environmental NTMs. The RD1 antigens may be found on other NTM strains that are rare causes of human disease (*M marinum*, *M kansasii*, *M szulgai*, and *M flavescens*). As a result, because the antigens in IGRAs are not found on most clinically relevant NTM and *M bovis*-BCG strains, one would expect that IGRAs will be more specific than the TST, yielding fewer false-positive results. Like the TST, IGRAs do not distinguish between TBI and TB disease.[25]

Test Characteristics

Both IGRAs are performed with positive and negative controls. The QFT assay is an enzyme-linked immunosorbent assay (ELISA) whole blood test. The QFT has 2 TB antigen tubes: tuberculosis antigen tube 1 (TB1) and tuberculosis antigen tube 2 (TB2). TB1 contains peptides from ESAT-6 and CFP-10, which are designed to elicit an immune response from $CD4^+$ T-helper lymphocytes. TB2 contains an additional set of peptides targeted for a cell-mediated immune response from $CD8^+$ cytotoxic T lymphocytes, included to bolster overall test sensitivity. The test result is considered positive when the IFN-γ response to the TB antigens (contained in TB1 and

TB2) is above the test cutoff of 0.35 IU/mL (after subtracting the negative control value from the test antigen value). If the test result is negative but the positive control also shows a poor response (a positive control failure from immunosuppression), or the background response in the negative control is too high (a negative control failure, perhaps from high baseline IFN-γ production attributable to systemic inflammation[26]), the result is considered indeterminate (neither negative nor positive). In this situation, testing on a different specimen is recommended.[27]

The T-SPOT assay is an enzyme-linked immunosorbent spot (ELISPOT) assay performed on peripheral blood mononuclear cells that have been incubated with peptides from ESAT-6 and CFP-10. The result is reported as the number of IFN-γ producing T-cells (spot-forming cells). The test result is considered positive when the number of spots in the test sample, after subtracting the number of spots in the negative control, exceeds a specific threshold of $\geq$8 spots; the test result is negative if there are 4 or fewer spots. Results with a corrected spot count of 5, 6, or 7 are considered borderline (equivocal), and retesting on a different specimen is recommended by the manufacturer. If the positive control shows a poor response ($<$20 spots), or if the background response in the negative control is too high ($\geq$10 spots), the result is termed invalid or indeterminate (neither negative nor positive).[9] In this situation, testing on a different specimen is recommended.[27]

Although there are standard manufacturer instructions for performing IGRAs, concerns have been raised about the reproducibility of the results on serial performance. Serial testing of health care workers at low risk of TBI have revealed cases of unexplained cases of low-level positive IGRA results reverting to negative on repeat testing.[28] Nkurunungi et al[29] performed T-SPOT tests on 405 Ugandan children at age 5 years and then repeated the test 3 weeks later. Of 79 children who had an initial positive T-SPOT result, only 30 (38%) had a positive result 3 weeks later, whereas 96% of the children with an initial negative result had a negative result on repeat testing. The test agreement was better among children who were household contacts of a person with TB (κ = 0.77) than among noncontacts (κ = 0.29). The majority of the reversions and conversions occur among low-level results, usually between 0.35 and 1.0 IU/mL for QFT, although they can occur at higher levels.[30,31] The exact cause(s) of low-level false-positive results are unknown, but there appear to be seasonal variations that might explain increased nonspecific reactivity in the assay.[32]

A further explanation of low-level positive IGRA results is the concept of test-retest variability.[33] For example, a test with 80% sensitivity and 70% specificity and a 5% test-retest variability would be associated with a conversion rate of 3.7% in the absence of TBI and a reversion rate of 7.7%. However, a test with 80% sensitivity and 95% specificity but 10% test-retest variability would be associated with a conversion rate of 5.5% and a reversion rate of 57%. T-lymphocyte assays are susceptible to test-retest variability by numerous factors, including manufacturing issues; sample collection issues, such as inconsistencies in specimen collection, inadequate blood volume, delays in isolation and incubation of cells, and inadequate shaking (mixing) of the IGRA collection tubes; and laboratory issues caused by systematic or random error.[34] Efforts to reduce test variability through better specimen collection and handling and laboratory standardization will minimize low-level false-positive results.[3,33]

Published studies have shown a variety of differences in outcomes between the 2 basic IGRA techniques, ELISA (QFT) and ELISPOT (T-SPOT). However, these differences have been small and inconsistent among studies, and the preponderance of evidence supports the conclusion that, in terms of accuracy, neither IGRA is strongly preferred over the other.

General Aspects of Studies in Children

The major difficulty for interpreting studies of TBI is determining, for discordant test results between the TST and IGRAs, whether the negative test result is attributable to enhanced test specificity or whether the positive test result is attributable to enhanced test sensitivity. Four systematic reviews and meta-analyses of the available studies of the use of IGRAs in children were published in 2011 and 2012[35–38]; analysis of the studies was hampered by the heterogeneous methodologies used, including varying definitions of a clinical case of TB disease. Some of the early published studies used ELISA and ELISPOT techniques that were different from those that currently are commercially available. More recent rigorous studies using commercially available assays have clarified some issues. Studies have been performed in countries with both low and high TB burden, which often differ greatly in the severity of TB disease, rates of malnutrition in children, availability of TB diagnostic tools, structures of households where transmission often occurs, and the use of various

BCG strains and vaccination techniques.

Test Specificity in Children

Although there are variable results among individual published studies, the strongest and most consistent result is that IGRAs have a higher specificity for TBI, especially in settings of low TB burden and for BCG-vaccinated children.[39–43] This conclusion is based on comparison of test results across exposure gradients of contact investigations in schools and the community in otherwise low-burden settings.[44,45] In their meta-analysis, Sun et al[37] included 7 studies that assessed IGRA specificity in populations with rates of BCG vaccination ranging from 0% to 100%. The specificity of ELISPOT was 89% for BCG-vaccinated and 95% for BCG-unvaccinated children, compared with a TST specificity of 49% for BCG-vaccinated and 93% for BCG-unvaccinated children: agreement (measured by κ scores) between the TST and IGRA in BCG-unvaccinated children was higher than in vaccinated children, probably because of false-positive TST results caused by previous BCG vaccination. Lighter et al[44] found that among 207 children in New York, only 23% of the children with a positive TST result had a positive QFT, and, unlike the TST results, positive QFT results correlated with increased risk of TB exposure. Chun et al[46] also found among 227 BCG-vaccinated children in South Korea that QFT results were more closely associated with exposure to a TB case than were TST results.

The most convincing evidence of increased specificity of IGRAs would be to determine rates of progression to TB disease among untreated children who have positive TST results and negative IGRA results. Ling et al[47] evaluated how clinicians in Montreal used IGRA results to determine management of children. Among 55 children with positive TST results and negative QFT results who were part of TB contact investigations, the negative QFT result changed management in only 3 children; 52 children received isoniazid. However, of 201 children with positive TST results and negative QFT results who were tested in school and immigration screenings, 145 did not receive treatment, and none developed TB disease in 1 year of follow-up. Researchers in a prospective multicenter trial in the United Kingdom studied 431 children who were recently exposed in their household to an infectious case of TB; 18 children with a positive TST but negative IGRA result went untreated, and none developed TB disease.[48] A large multicenter trial in the United States performed a TST and IGRA on 3593 children at risk for TBI and/or progression to TB disease (mostly because of birth in a country with high burden of disease). Of 533 children with positive TST and negative IGRA results who were not treated for TBI, including 54 children younger than 2 years, none progressed to disease over a 2-year period.[10] Lowenthal et al[49] reviewed the results from California of testing for TBI among children moving to the United States from 2002 to 2013. Among 4035 children who had a positive TST result before entry, only 23% had a positive IGRA result after entry, and as expected, the proportion with a positive IGRA increased with age, reflecting higher risk of true infection over time. Finally, among 762 healthy children with a preimmigration positive TST result arriving to Sweden, only 33% with a BCG scar had a positive QFT result, compared with 76% without a BCG scar.[50]

However, low-level (<1.00 IU/mL for QFT, <8 spots for T-SPOT) false-positive IGRA results do occur, not because of cross-reaction with BCG vaccination or NTM but caused by nonspecific reactivity or technical factors in testing. Low-level IGRA test conversions (negative to positive) and reversions (positive to negative) occur frequently among low-risk health care workers in serial testing programs and do not represent TBI. Although there are no specific data for children, it is recommended that if a patient has an unexpected low-level positive IGRA result, either the same test should be repeated or a different test should be performed, and action should be taken on the second result. The best way to minimize false-positive results with any test of TBI is to test only children with legitimate risk factors for TBI.

The sum of all published studies supports the concept that IGRAs are more specific than TST in children of all ages.[51] Despite the greater apparent specificity of IGRAs, the decision to treat or not in a patient with a positive TST result and a negative IGRA result should be based on clinical judgment that takes into consideration the risk of progression to disease and the degree of exposure. For example, children who were recently exposed to a case of contagious TB disease should be considered to have TBI if either the TST or IGRA result is positive, because they have a high risk of progressing rapidly to TB disease.

Test Sensitivity in Children

The analysis of studies in children of the sensitivity of IGRAs compared with TST is far more difficult, and the results have been highly variable. The earliest information came from the meta-analyses of studies of children with TB disease, diagnosed by either culture or clinical diagnosis.[35–38] Sun et al[37] found a sensitivity for all TB disease

in children of 70% for ELISA (mostly QFT [range, 57% to 96%]), 62% for ELISPOT (mostly T-SPOT [range, 40% to 100%]), and 71% for TST (range, 43% to 100%). When the analysis was divided into cases of culture-confirmed TB and clinically diagnosed TB, the sensitivities were 85% and 64% for ELISA (mostly QFT), 76% and 58% for ELISPOT (mostly T-SPOT), and 85% and 66% for the TST, respectively. All 3 tests had lower sensitivity in clinically diagnosed cases; there are many possible explanations, including misdiagnosis of TB in the clinically diagnosed group.[52] Another study conducted in a setting with high TB burden also found low sensitivity of IGRAs and the TST for TB disease, which did not add value to the clinical data and conventional tests for diagnosis of TB disease in these children.[53] A systematic review and meta-analysis (15 studies included) of the performance of TST and IGRAs in immunocompetent children with microbiologically confirmed TB disease calculated the sensitivities of the TST, QFT, and T-SPOT to be 88.2%, 89.6%, and 88.5%, respectively.[54] Kay et al[55] analyzed California TB registry data for 778 patients 18 years or younger with laboratory-confirmed TB. Among children ages 5 to 18 years, the sensitivity of the IGRA was 96% vs 83% for the TST; IGRA sensitivity compared with TST in children ages 2 to 4 years was 91% vs 91% (so equivalent), and the sensitivity compared with TST in children younger than 2 years was 80% vs 87%. A smaller study in Italy of children with TB disease demonstrated the sensitivity of QFT to be 93.3% vs 86.5% for the TST.[56] The sum of all published studies suggests that the sensitivity of IGRAs in settings of low TB burden is comparable to the TST, with both being less sensitive in settings of high TB burden and for extrapulmonary TB disease.[11,39]

There is some evidence that the sensitivity is increased when both a TST and IGRA are performed and the child is considered infected if either test result is positive. Hill et al[57] investigated child household contacts of adult TB cases in the Gambia. Overall agreement between the TST and ELISPOT was 83%, with each test result being positive in 32% of the children, and neither test was affected by BCG vaccination. An additional Gambian study demonstrated a 10% sensitivity benefit for using both a TST and IGRA in children at high risk.[58]

Indeterminate/Invalid Results in Children

Indeterminate (preferably called invalid in relation to the T-SPOT test) results occur most commonly when the test sample is negative but the positive control has insufficient activity but also occur when the background activity in the negative control is too high. Indeterminate/invalid results often occur because of technical factors, most frequently inadequate shaking of the IGRA tubes after the patient's sample has been added.[3] Rates of indeterminate/invalid results among children varied in early studies between 0% and 35%,[36,59–61] but the reported rates have been lower (0% to 8%) with the more recent versions of the commercially available tests.[32,34,62–64] Rego et al[65] reviewed 645 947 T-SPOT assays, finding 0.6% invalid and 1.8% borderline results. When 5044 borderline tests were repeated, 59.2% were negative, 20.0% were positive, and 20.2% remained borderline; the subject's age did not affect the results. Indeterminate/invalid rates generally are higher among individuals with compromised immune systems whose T lymphocytes cannot mount an adequate response to the positive control, especially people living with HIV infection[62,66]; these rates also have been noted to be higher in children with poorly controlled inflammatory bowel disease, hepatitis, malaria, and helminthic infection.[67,68] Some researchers have found that otherwise healthy children younger than 3 years are more likely to have indeterminate/invalid test results than older children and adolescents.[69–72] However, authors of a recent systematic review and meta-analysis of 133 studies using IGRAs to diagnose TB found a 4% rate of invalid results and no difference between children 0 to 7 years of age and those 8 years or older.[73]

Test Performance in Immune-Compromised Children

Data are scarce for determining the sensitivity and specificity of IGRAs for immune-compromised children, who are at increased risk of developing TB disease if they are infected with *M tuberculosis*. There are scant data for children living with HIV infection, because IGRAs are generally not available in areas with high TB burden where there is also a high burden of HIV infection. Systematic reviews of the performance of IGRAs in people living with HIV infection, mostly adults, have concluded that the T-SPOT test may be slightly more sensitive than the QFT (72% vs 61%), but neither was more sensitive than the TST.[66,74,75] Several small studies have included children living with HIV infection with varied results; in general, the IGRAs have less concordance with the TST in children with advanced HIV infection, especially if they have concomitant malnutrition.[76–78] The risk of TB disease among people with HIV infection remains higher than that of the general population, and the cadence of TB testing in

HIV-infected patients is discussed elsewhere.[79]

Researchers in 2 small studies have examined the performance of IGRAs and the TST in children with cancer. Stefan et al found that among 37 children with untreated cancer in Cape Town, South Africa, a region with extremely high rates of TB, 7 had positive results with at least 1 test; there was a higher rate of positive results with the T-SPOT, poor concordance among the TST and IGRAs, and a high rate of test failure because of low lymphocyte counts in patients.[80] During a contact investigation of 18 children in a pediatric hematology-oncology hospital unit after a patient was found to have pulmonary TB, only 2 patients had a positive T-SPOT result, and this test had more invalid/indeterminate results than the QFT.[81]

Screening for TB risk factors should be performed before any immunosuppressing therapy is given, but it is especially important before therapy with immunomodulating biological agents, such as monoclonal antibodies against TNF-α.[3] This topic has been the subject of many small adult studies.[82,83] Most of the adult patients in these studies also had been treated with a variety of other immunosuppressing agents, which may have affected the results of the TST or IGRAs. Rates of indeterminate/invalid results were higher than usual in the adult patients because of immune suppression by both disease and drugs. Within one small study of 79 children in Greece receiving antirheumatic treatment (only 18 were tested before treatment with an anti–TNF-α drug), patients with a risk factor for TBI were 27.6 times more likely to have a positive QFT result, and no child had a positive TST result.[84] For these children, test sensitivity is more important than specificity because of the increased risk of progression of TBI to TB disease. The current evidence does not consistently suggest that IGRAs are better than the TST in identifying immunosuppressed individuals who will benefit from treatment of TBI. It is commonly recommended that all patients who will be receiving an immunomodulating biological agent, regardless of specific TB risk factors, should be tested for TBI before starting the therapy. Many experts have suggested that to increase sensitivity, both the TST and an IGRA should be performed initially for patients who also have a risk factor for TBI, and appropriate treatment of TBI should be started if either test result is positive once TB disease has been ruled out.[82–88] Patients whose initial test results for TBI are negative should be screened annually for new TBI risk factors, but annual testing is not generally recommended in the absence of a new risk factor while on continued immunosuppression.

Effect of Age on Test Results

There has been a hesitancy to use IGRAs in children younger than 5 years because of a lack of data for this age group and concerns about inadequate sensitivity of the IGRAs. Because infants and young children (younger than 4 years) are more likely than older children to have progression from untreated TBI to TB disease and young children are more prone to develop serious forms of TB, failure to accurately diagnose TBI in this age group can have dire consequences.[14] Resolution of this issue has been hampered by the lack of a reference standard for TBI. The earliest studies suggested that IGRA sensitivity is diminished in young children, but the results were inconsistent.[36] However, subsequent studies have demonstrated better performance of newer versions of the commercially available IGRAs in young children than previously reported. Debord et al[89] found that among 19 children with TB disease, 6 of 10 children younger than 2 years and 9 of 9 children who were 2 to 5 years of age had a positive QFT result. Moyo et al[90] studied 397 children in South Africa who were younger than 3 years and were suspected of having TB disease. Agreement between the QFT and TST was 94%, but both tests had lower sensitivity for TB disease (38% for QFT and 35% for the TST) than has been reported in older age groups.

Although the IGRAs have low sensitivity for detecting TB disease in young children whose immune responses may be blunted by malnutrition and TB itself, it is not clear whether they have a higher sensitivity for detecting TBI in otherwise healthy young children. Pavic et al[91] studied 142 healthy BCG-vaccinated children in Croatia who recently had been exposed to infectious TB disease. Both the QFT and TST had proportions of positive results that were associated with degree of exposure, and there was no evidence that age affected QFT performance. Critselis et al[72] performed a TST and QFT in 761 healthy Greek children in 4 age groups who were referred for several indications. Among the 198 children younger than 5 years (74 children were younger than 2 years), infants with positive QFT results produced a greater mean titer of IFN-γ than older children and adolescents. Agreement between the TST and QFT results was not significantly different between younger and older children. Velasco-Arnaiz et al[92] found that among 39 children younger than 5 years with confirmed TB disease (15 children were younger than 2 years), the sensitivity of QFT was 93%, and in 79 children with either

TBI or TB disease, there was no correlation between age and antigen-stimulated IFN-γ responses. From 2005 to 2008, the San Francisco TB program followed 146 untreated TST-positive/QFT-negative children, including 44 children younger than 2 years, and none developed TB disease.[93]

It is clear that the use of the TST in infants and young children who received a BCG vaccine will lead to many false-positive results caused by cross-reaction with the BCG. Although some experts currently support the use of IGRAs to test for TBI in infants and toddlers, especially those at low risk of TBI who have received a BCG vaccine, others do not recommend their routine use in children younger than 2 years until additional supportive data are available. In summary, if an IGRA is performed in an infant or young child, a positive result likely indicates infection with *M tuberculosis*, but a negative result does not rule it out. A negative result for either a TST or an IGRA should be considered as especially unreliable in infants younger than 3 months. The rates of indeterminate/invalid results appear to be higher in infants and toddlers than in older children.

TABLE 3 Comparison of the TST and IGRAs

Characteristic	TST	IGRA
Antigens used	Many: PPD	3 (QFT) or 2 (T-SPOT)
Sample	Intradermal injection	Blood draw
Patient visits required	2	1
Distinguish between TBI and disease	No	No
Cross-reactivity with BCG	Yes	No
Cross-reactivity with NTM	Yes	Only rare species[a]
Differing threshold for positive values by level of risk for TBI	Yes	No
Causes boosting	Yes	No
Subject to boosting by previous TST	Yes	Unknown but possible
Durability over time (stays positive with or without treatment)	Yes	Unknown but likely
Difficulties with test reproducibility	Yes	Yes
Location of need for trained staff	"Bedside"	Laboratory
Age <2 y[b]	Recommended	Acceptable
Estimated specificity in BCG-unvaccinated children, %	95–100	90–95
Estimated specificity in BCG-vaccinated children, %	49–65	89–100
Estimated sensitivity (confirmed TB disease), %	75–85	80–85
Estimated sensitivity (clinical TB disease), %	50–70	60–80

[a] *Mycobacterium marinum*, *Mycobacterium kansasii*, *Mycobacterium szulgai*, and *Mycobacterium flavescens*.
[b] Negative result of either the TST or an IGRA should be considered especially unreliable in a child younger than 3 mo.

STRATEGIES FOR THE USE OF IGRAs IN CHILDREN

Some of the major differences between the TST and IGRAs are summarized in Table 3. The basis for deciding which diagnostic test to use is fundamentally different for a child than for an adult, and it differs between the diagnosis of TBI and TB disease. When testing otherwise healthy individuals, the purpose of the TST or an IGRA is to determine if the person is infected with *M tuberculosis* and will benefit from treatment. The positive predictive value of both tests for the development of TB disease is low in adults and children 5 years or older, because only 5% to 10% of those who test positive and go untreated will develop TB disease in their lifetime. In these groups, test specificity is important to avoid massive overtreatment of individuals with false-positive results. However, children younger than 2 years with untreated TBI have a 25% to 50% risk of developing TB disease within 1 year, so optimizing test sensitivity is important for this age group. In addition, children tend to tolerate the treatment of TBI much better than adults, so their risk of adverse events caused by treatment is less. However, test specificity is also an issue for the youngest children, especially if they have received a BCG vaccine or have a likelihood of exposure to NTM in their environment; testing them with only the TST will lead to an appreciable proportion of false-positive results when the prevalence of TBI is low, as in the United States.

Both the TST and IGRAs are imperfect methods. As a result, only children who have a risk factor for TBI or TB disease, have a disease or condition that may require significant therapeutic immunosuppression, or are suspected of having TB disease should be tested. However, a negative result from either type of test is not reliable for excluding the presence of TB disease. Deciding which test to use involves a consideration of sensitivity and specificity. When high specificity is desired (for example, otherwise low-risk BCG-vaccinated children), the IGRAs are the clearly superior tests. Neither method has a clear advantage in sensitivity; when sensitivity is the main concern, such as recent contact with a contagious case of TB disease, a positive result with either the TST or IGRA should be considered indicative of infection with *M tuberculosis*. When sensitivity is paramount, such as high suspicion of TB disease or testing a child who has a TB risk factor and who will soon receive an immunomodulating biological agent, performing both an IGRA and a TST should be strongly considered, with a positive result for either test leading to the child being diagnosed with TBI. Performing both tests will lower the overall specificity and lead to some false-positive results, but in children with a high risk of

progression to TB disease, this is an acceptable trade-off.

Summary of Recommendations Regarding Testing

Table 4 shows potential strategies for testing. Some specific points are as follows:

- Only children who have a risk factor for TBI or are at risk for progressing to disease, are suspected of having TB disease, or who have an immunosuppressive disease or about to start immunosuppressive therapy should be tested with a TST or an IGRA.
- There is no compelling evidence to support the use of one IGRA (QFT, T-SPOT) over the other.
- If the child of any age has been exposed to an infectious case of TB disease, he or she should be evaluated and, if determined not to have TB disease, given a full course of treatment of TBI if either a TST or IGRA result is interpreted to be positive.
- Even with a negative initial test result, contacts of a person with known TB disease should be retested in 8 to 10 weeks, usually with the same test, regardless of whether the initial test used was a TST or IGRA.
- ^ For exposed contacts with impaired immunity (eg, HIV infection) and all contacts younger than 5 years, treatment of possible TBI should be initiated, even if the initial TST or IGRA result is negative, once TB disease is excluded (often referred to as "window prophylaxis"). If the TST or IGRA result still is negative with repeat testing in 8 to 10 weeks, treatment can be discontinued. If a TST or IGRA result of a contact becomes positive, the regimen for TBI should be completed.
- For children who have received a BCG vaccine and have no known exposure to a contagious TB case and no other TB risk factor other than birth in a foreign country, 2 strategies can be used[9]:
  (1) an IGRA can be used and the result acted on; or
- (2) a TST can be performed, and if the result is negative, no further testing is necessary; if the result is positive, an IGRA should be performed and its result acted on.
- When evaluating a child of any age for TB disease, both a TST and one or both IGRAs can be performed to maximize sensitivity. However, neither method can be used to rule out TB disease, and a negative result of either the TST or an IGRA should be considered especially unreliable in a child younger than 3 months.
- Indeterminate/invalid IGRA results are more common in very young children (younger than 2 years) and immunosuppressed patients. When an IGRA result is indeterminate/invalid, either a repeat IGRA test using the same or the other IGRA can be performed, ensuring proper technique of specimen collection and processing, or a TST can be performed.
- For children without TB risk factors other than foreign birth who have an unexpected low-level positive IGRA result (QFT <1.00 IU/mL, T-SPOT with 5–7 spots), a second diagnostic test, either an IGRA or a TST, should be performed; the child is considered infected only if results of both tests are positive.[9]
- Although IGRAs are more expensive than the TST, their use may be more cost-effective than the TST because of time savings for the family and the elimination of many false-positive results.[94]
- A TB specialist should be involved when there is a question about testing interpretation.
- Early communication with public health authorities during evaluation for a positive test result in children is strongly encouraged.

TABLE 4 Suggested Uses of TST and IGRA in Children

TST preferred, IGRA acceptable[a]
Children younger than 2 y[b]
IGRA preferred[a]
Children 2 y or older, especially those who have received BCG vaccine
Children of any age who are unlikely to return for the TST reading
Both[c] the TST and an IGRA should be considered when:
The initial and repeat IGRA results are indeterminate or invalid
The initial test (TST or IGRA) result is negative and:
There is clinical suspicion of TB disease[c] (to maximize sensitivity)
The child has a risk factor and is at high risk of progression and poor outcome (especially therapy with an immunomodulating biological agent, such as a TNF-α antagonist)[c,d]
An initial TST is positive and:
The child has a history of BCG vaccination
Additional evidence is needed to increase adherence with therapy

[a] In situations of testing obligated by law or credentialing bodies in person unlikely to be uninfected with TB, IGRA is preferred.[9]

[b] Many experts will use an IGRA in children of any age, especially if the child has received a BCG vaccine but have no other significant risk factors other than foreign birth. However, data from children in this age group are few.

[c] A positive result of either test is considered significant in these groups.

[d] The clinician should obtain the complementary test (eg, if a TST was initially performed, then IGRA should be obtained for a complete set).

TREATMENT OF TBI

Rationale

The goal of treatment is to prevent TBI from progressing to TB disease and to diminish the reservoir for future TB cases. All children who have TBI should receive a course of therapy. The risk of developing TB disease is highest during the 6 months after infection and remains high for 2 years.[95] Not all people with TBI have the same level of risk of progression to disease. Three

high-risk groups bear special attention for disease progression:

1. Infants and young children (particularly those younger than 2 years) may progress rapidly to disease (40% to 50% of infected children younger than 1 year; 25% of infected children 1–2 years of age) including meningitis or miliary disease (15% of infected children younger than 1 year; 5% to 7% of infected children 1–2 years of age).
2. Postpubertal adolescents (older than 12 years) who also have the risk of progression to adult-type disease.
3. Children and adolescents with immunocompromising conditions or receiving certain immunosuppressing treatments, including patients with diabetes mellitus, chronic renal failure, malnutrition, congenital or acquired immunodeficiencies; patients with malignancy; patients receiving TNF-α antagonists or blocking agents; and patients preparing for or experiencing organ or hematologic transplant.

There are several barriers to completion of treatment of TBI. Children with infection are asymptomatic, and families do not readily observe a response to treatment[96] and often do not appreciate a clear need to continue medications. Pediatric formulations of anti-TB medications are not generally available in the United States, requiring compounding or adaptation of adult formulations such as crushing pills or opening capsules (see "Administration of Antituberculosis Medication to Children"). Medical providers for children and adolescents should be familiar with all the regimens available to treat TBI to select the best regimen for the individual child and family. The regimen ultimately prescribed for children should be safe, effective, and relatively inexpensive, allow easy administration to young children, and result in a high completion rate. The one characteristic that consistently inversely correlates with completion of treatment is the length of treatment: the shorter the duration, the higher the completion rate.

General Principles

The practitioner should be cognizant of the following principles and assumptions when caring for pediatric patients with TBI:

- Infants and children with TBI who have been recently infected have an increased risk of rapid disease development, and young age at infection predicts more years at risk for disease progression into adulthood.
- Assume that the causative *M tuberculosis* is susceptible to multiple drugs unless specific knowledge of drug resistance is available. The incidence of isoniazid resistance among TB isolates from US patients is approximately 9%,[97] and the incidence of rifampin resistance is $<1\%$.[98] The assumption is negated if the source case is known to have a drug-resistant isolate.
- A thorough physical examination and high-quality chest radiographs (posterior-anterior and lateral views) should be performed before starting treatment. It is crucial to ensure that TB disease is not inadvertently treated with an inadequate drug regimen; otherwise, the risk of developing drug-resistant TB while on therapy is high (particularly with monotherapy with isoniazid or rifampin). Chest radiographs rule out lung parenchymal disease and any enlarged thoracic adenopathy,[95] and the physical examination helps to exclude extrapulmonary TB (including adenopathy and hepatosplenomegaly). If evidence of TB disease is found, additional diagnostic procedures should be performed, and the treatment regimens will be different from those for TBI.
- Anti-TB treatment regimens that are efficacious in adults will be effective in children. Performing efficacy trials exclusively in children to mirror those previously conducted in study populations of both adults and children (which enrolled $>100\,000$ patients on isoniazid) would be difficult and expensive. Extensive experience has shown that treatment regimens for both TBI and TB disease that are effective in adults also will be effective in children. Rather than focusing on efficacy, studies regarding TB regimens in children are designed to assess and improve medication safety, tolerability, pharmacokinetics, and adherence.
- Laboratory testing before or during treatment is not necessary in otherwise healthy pediatric patients. The use of isoniazid monotherapy for pediatric TBI causes low rates of hepatotoxicity ($<1\%$). Alternate regimens, which may include 2 drugs but for a shorter duration, are even less hepatotoxic than the 9 months of isoniazid monotherapy. This reduced toxicity stems, in part, from the overall decreased time of drug exposure.[99,100] However, increased risk of hepatotoxicity can be experienced by children who are obese and have nonalcoholic steatohepatitis, are taking other potentially hepatotoxic medications (especially anticonvulsants), are pregnant in the first 12 weeks of gestation, or have underlying liver disease. These children should have baseline hepatic function tests (alanine transaminase, aspartate

transaminase) and periodic laboratory monitoring (eg, monthly) during therapy.

- Completion of regimens for TBI in high-risk groups (including children and adolescents) is imperative. Historically, medication regimens for TBI have been through self-administered therapy (SAT). Although completion of isoniazid by SAT was >80% within the context of a research study, completion rates decrease to approximately 60% in the real world because of patient fatigue or drug intolerance.[101] Adherence may be improved by directly observed therapy (DOT), when medications are administered directly to the patient by a health care professional or trained third party (not a relative or friend) who observes and documents that the patient ingests each dose of medication. There has been success in administering DOT through school-based health centers.[102] DOT should be considered for treatment of children and adolescents with TBI who are at high risk of rapid progression to disease. When well conducted, DOT is a package of services, including enablers and reinforcements, designed to help the patient and family complete therapy.
  - DOT provides the highest rates of medication completion (approximately 80% to 95%).[96] It requires both financial and staff resources, usually from the local health department, and can be time consuming for the staff and families. The time and resources required often make DOT unacceptable to patients and providers.
  - SAT-hybrid models may be alternate methods for improving patient compliance. One example is self-administration, with text reminders from providers.[99,103] A successful program in Houston, Texas, has been SAT-based, but the health department delivers the medications to the patient's home on a monthly basis and contacts the family weekly to support the treatment.[100]
  - Video DOT may be used in lieu of the traditional in-person DOT strategy, provided the patient has a personal device and that privacy restrictions of the Health Insurance Portability and Accountability Act are applied.[104,105] Video DOT may be synchronous (in real time) or asynchronous (video clips are recorded and then uploaded for later review).
- Children with adequate anti-TB treatment need not be retested. The test of infection (either TST or IGRA) remains positive after adequate treatment and should not be used as a test of cure or as surveillance for emergence of TB disease.

Treatment Selection

Anti-TB drugs kill or inhibit multiplication of *M tuberculosis*, thereby arresting progression of infection and preventing most complications. Historically, the dominant regimen was 6 to 9 months of isoniazid monotherapy by SAT. Other alternatives to treatment of TBI have emerged, with similar rates of efficacy to protect against development of disease. Factors to consider in regimen selection include the child's age and requirement for liquid formulations, need for speedy treatment (such as a pending stem cell or solid organ transplant), use of concomitant hepatotoxic medications, concurrent HIV infection, and suspected infection with drug-resistant *M tuberculosis*. If therapy is completed successfully, there is no need to perform additional tests or chest radiographs unless a new exposure is documented or the child develops a clinical illness consistent with TB, the latter being extremely rare in North America. A TB specialist should be involved if questions arise regarding selection of an appropriate treatment regimen or management of adverse effects.

Specific Drugs

Isoniazid

Pediatric experience with isoniazid is extensive and well published. Isoniazid can inhibit pyridoxine metabolism; however, otherwise healthy children and adolescents in the United States given recommended doses rarely develop associated peripheral neuritis or seizures and do not need pyridoxine supplements as a preventive measure. However, isoniazid overdose, as in a suicide attempt, can lead to generalized seizures that are difficult to control unless large doses of pyridoxine are administered. Routine pyridoxine supplementation is recommended for exclusively breastfed infants and for children and adolescents on meat- and milk-deficient diets; children with nutritional deficiencies, including all symptomatic children living with HIV infection; and pregnant adolescents and women. Bioavailability of isoniazid is improved with administration on an empty stomach, although dyspepsia may be alleviated with small amounts of food.

Hepatotoxicity caused by isoniazid is rare in otherwise healthy children, and routine laboratory testing is not necessary (Table 5). There can be transiently mild elevations of transaminases, with no clinical consequence given that these resolve spontaneously. When testing is indicated because of development of clinical signs or symptoms (eg, abdominal pain, vomiting, jaundice) that could be caused by hepatitis, hepatotoxicity may be defined as

transaminase elevations of 2 to 3 times the upper limit of normal if the patient is symptomatic, or >5 times the upper limit of normal if the patient is asymptomatic.[106]

Rifampin

Rifampin is a rifamycin that, because of its short half-life, must be administered daily. Rifampin is readily available by prescription, including a standard compounded liquid formulation for young children. Bioavailability of rifampin is improved with administration on an empty stomach, although dyspepsia may be alleviated with small amounts of food (Table 5).

A major concern with using any rifamycin-containing regimen is drug–drug interactions. These interactions should be appreciated as the number of pediatric immunocompromised patients (such as those undergoing treatment of HIV infection, with oncologic diseases, or who are transplant recipients) increases. The rifamycins are potent inducers of the hepatic CYP 450 enzyme. This increased enzymatic activity will heighten metabolism of classes of antiretroviral drugs such as the protease inhibitors. Conversely, the rifamycins may increase the exposure to specific immunosuppressive drugs, necessitating a dose reduction of agents such as tacrolimus and cyclosporine.

An additional drug interaction concern with rifampin is that it can lower the effectiveness of oral contraceptives. Female adolescents taking rifampin must be counseled that they should rely on other forms of birth control while taking this medication. Also, patients should be warned that rifampin will cause urine, sweat, saliva, and tears to turn a red-brown color and can cause staining of contact lenses.

Rifapentine

Rifapentine is a rifamycin with a long half-life allowing for weekly administration, versus the daily dosing of rifampin. The bioavailability of rifapentine is enhanced by food (particularly products containing fat, such as milk or egg), and this medication should be given as possible with fatty food. The dosing of the 2 components (isoniazid, rifapentine) varies by weight and age of the patient (Table 6). The drug-drug interactions with rifapentine appear less when compared with those of rifampin.

Treatment Regimens for TBI

Once-Weekly Dosing of Isoniazid and Rifapentine (3HP) (12 Doses)

This regimen includes the use of isoniazid and rifapentine, given once weekly, for 12 doses. The regimen is commonly referred to as once-weekly dosing of isoniazid and rifapentine (3HP): the H is the international symbol for isoniazid, the P is the symbol for rifapentine, and the 3 refers to a treatment length of 3 months. The 3HP regimen is considered complete if at least 11 doses have been taken over 16 weeks. This regimen has similar efficacy to 9 months of isoniazid (see below) but is associated with higher completion rates in adults,[99] children, and adolescents.[100,107]

When first introduced, 3HP was prescribed under DOT, and rifapentine was available only through local health departments. However, an open-label, phase 4 clinical trial of adult patients (18 years or older) demonstrated noninferiority for completion rates and safety of 3HP given by SAT compared with DOT.[103] As a result, the Centers for Disease Control and Prevention (CDC) has recommended that 3HP may be given via SAT when DOT is not available or feasible.[108,109] Because the study did not include children or adolescents, it is not known whether the similarity of completion rates observed in adults given 3HP by SAT or DOT would be seen in children and adolescents. Use of DOT may be preferred for patients at increased risk of rapid progression to TB disease (recent contacts of infectious cases, immune-compromised patients, age younger than 5 years, some adolescents).

The 3HP regimen, despite the use of 2 agents, appears to be equally or less hepatotoxic than 9 months of isoniazid monotherapy.[100] Providers should be cognizant that the pill burden of this regimen may be high; a child weighing 25 kg would need to take 6 tablets (4 of rifapentine, 2 of isoniazid) simultaneously.

This regimen is recommended for children 2 years or older (there is a paucity of data on rifapentine pharmacokinetics in very young children). 3HP can be used in HIV-infected individuals barring drug-drug interactions with antiretroviral medications.

4 Months of Daily Rifampin (4R) (120 Doses)

The 4-month regimen of daily rifampin (4R) is usually taken by SAT (15–20 mg/kg per dose, maximum 600 mg per dose). Rifampin is bactericidal against *M tuberculosis*. Therapy is deemed completed if 120 doses have been administered within 6 months. Efficacy is similar to 9 months of isoniazid, but the shorter period allows for a significantly higher rate of completion.[110–112]

Drug–drug interactions preclude it as a regimen for HIV-infected individuals. Because HIV-infected individuals with low $CD4^+$ T-lymphocyte counts may have subclinical TB disease, using

TABLE 5 Characteristics of Medications Used in Pediatric Patients With TBI

Drug	Common Adverse Effects	Bioavailability	Drug-Safety Monitoring for All Agents
Isoniazid	Hepatotoxicity Peripheral neuropathy Gastrointestinal upset (common, particularly if isoniazid is taken on empty stomach) Diarrhea Rash	Best if on empty stomach, although small amounts of food may alleviate dyspepsia	• Otherwise healthy patient: no baseline LFTs needed. If symptomatic on treatment, obtain LFTs • Patient with existing liver disease or with concomitant hepatotoxic drugs: baseline and periodic (often monthly) LFTs recommended
Rifampin	Gastrointestinal upset (common, particularly if these are taken on empty stomach) Hepatotoxicity Rash Thrombocytopenia Hypersensitivity response (rare in children) Orange discoloration of body fluids (urine, sweat, tears)	Best if on empty stomach, although small amounts of food may alleviate dyspepsia	
Rifapentine		Should be given with fatty food to enhance absorption	

Adapted from Cruz AT, Ahmed A, Mandalakas AM, Starke JR. Treatment of latent tuberculosis infection in children. *J Pediatr Infect Dis.* 2013;2(3):248–258. LFT, liver function test.

rifampin monotherapy may inadvertently increase TB resistance in those people.

There is no age restriction for the use of 4R. The adverse effect profile of 4R is excellent, with similar transaminase elevations as with 9 months of isoniazid (see below).[110–112] Hence, 4R is preferred in children without HIV infection of all ages who are not able to undergo DOT, or if there is a concern of an isoniazid-resistant isolate as judged from the exposure history.

3 Months of Daily Therapy With Isoniazid and Rifampin (3HR) (90 Doses)

This regimen consists of 3 months of daily isoniazid and rifampin (3HR), using the same doses as when each drug is used alone. There is no age restriction for the use of 3HR. In combining isoniazid and rifampin, this regimen is similar in principle to 3HP; however, the medications are given daily because of the relatively short half-life of rifampin compared with rifapentine. Efficacy and rates of completion of 3HR are comparable or better when compared with isoniazid monotherapy.[113]

6 or 9 Months of Isoniazid (6H) (9H)

Isoniazid monotherapy has been the most widely recommended and used treatment of pediatric TBI. Isoniazid is bactericidal against *M tuberculosis*. Isoniazid may be given daily by SAT (10–15 mg/kg per dose, maximum 300 mg per dose) or twice weekly via DOT (20–30 mg/kg per dose, maximum 900 mg per dose).[96] Therapy with 6 months of isoniazid (6H) is complete if the child has received 180 doses (if given daily via SAT) or 52 doses (if given twice weekly under DOT) within 9 months. If using a 9-month regimen, therapy is complete if the child has received 270 doses (if given daily via SAT) or

TABLE 6 Regimens Used in Pediatric Patients With TBI

Regimen	Agent(s)	Dose and Age Group	Administration	Duration, mo	No. Doses Needed for Completion	Rates of Completion, %	Age Restriction	Comments
3HP	Isoniazid + Rifapentine	Age ≥12 y Isoniazid: 15 mg/kg rounded up: nearest 50 or 100 mg (max 900 mg) Rifapentine (by wt): 10–14 kg: 300 mg 14.1–25 kg: 450 mg 25.1–32 kg: 600 mg 32.1–49.9 kg: 750 mg ≥50.0 kg: 900 mg Age 2–11 y Isoniazid: 25 mg/kg rounded up: nearest 50 or 100 mg (max 900 mg) Rifapentine: see above	Weekly (SAT or DOT)	3	12	63–97	Not for children <2 y	Take with food, containing fat if possible; pyridoxine for selected patients[a]
4R	Rifampin	Adult: 10 mg/kg (max 600 mg) Child: 15–20 mg/kg (max 600 mg)	Daily (SAT)	4	120	72–96	None	Drug–drug interactions
3HR	Isoniazid + rifampin	Same doses as when drugs are used individually	Daily (SAT)	3	90	82	None	Not considered unless 3HP or 4R are not feasible
6H	Isoniazid	Adult: 5 mg/kg (max dose 300 mg) Child: 10–15 mg/kg (max 300 mg)	Daily (SAT)	6	180	20–93	None	Seizures with overdose; pyridoxine for selected patients[a]
		Adult: 15 mg/kg (max dose 900 mg) Child: 20–30 mg/kg (max 900 mg)	Twice weekly (DOT)		52			
9H	Isoniazid	Adult: 5 mg/kg (max dose 300 mg) Child: 10–15 mg/kg (max 300 mg)	Daily (SAT)	9[a]	270	20–93	None	Seizures with overdose; pyridoxine for selected patients[a]
		Adult: 15 mg/kg (max dose 900 mg) Child: 20–30 mg/kg (max 900 mg)	Twice weekly (DOT)		76			

Table adapted from Cruz AT, Ahmed A, Mandalakas AM, Starke JR. Treatment of latent tuberculosis infection in children. *J Pediatr Infect Dis*. 2013;2(3):248–258. 6H, 6 months of isoniazid; 9H, 9 months of isoniazid; —, not applicable.

[a] Exclusively breastfed infants and for children and adolescents on meat- and milk-deficient diets; children with nutritional deficiencies, including all symptomatic children living with HIV; pregnant adolescents and women.

76 doses (if given twice weekly under DOT) within 12 months.

The efficacy of isoniazid monotherapy reaches 98% against development of TB disease.[106] The World Health Organization recommends a treatment duration of 6 months[114] to provide high coverage of the population in countries with a high disease burden. A 9-month regimen gives an additional 20% to 30% increase in efficacy.[97] The CDC and National TB Controllers Association recommends 6-month or 9-month durations of isoniazid monotherapy, if shorter-course rifamycin-based regimens cannot be used.[108]

Although isoniazid is readily available, the long duration of isoniazid monotherapy results in poor adherence and low completion rates. This option may be unattractive to patients and families. Many TB care providers and clinics use this regimen only when a rifamycin-containing regimen cannot be used because of drug interactions.

Administration of Antituberculosis Medication to Children

Given the common inability of young children to swallow pills and to mitigate the common adverse effect of gastrointestinal tract upset right after taking the medication, guidance for administering medication (particularly isoniazid) is warranted. Commercially available isoniazid suspension contains large amounts of sorbitol and often causes nausea and diarrhea if the volume exceeds 5 mL and/or if it is taken when the child has fasted. If the child is unable to swallow pills, the pills can be crushed and mixed into syrup or other palatable liquid to appeal to the young child, and in the smallest volume possible to ensure the entire dose is taken (ie, not in a full bottle of milk). Rifampin should be given on an empty stomach or with a small amount of food. Rifapentine should be administered with food, particularly with a high fat content, to enhance absorption.

For mothers receiving treatment for TBI or TB disease who are also breastfeeding, their infants may be indirectly receiving TB medications. The amount being received is miniscule and is the basis for recommendations for mothers to continue breastfeeding even while receiving TB treatment with first-line agents.[115]

Evaluation and Management of Adverse Reactions

Regardless of the treatment regimen selected, all children should be clinically monitored on a regular basis. This allows the medical provider to assess for medication adverse effects, determine if there is advancement of the TBI to disease, and continue to educate patients and families on the importance of treatment and adherence. Monthly clinical evaluation (at a minimum) to observe for signs or symptoms of hepatitis and other adverse effects of drug therapy is appropriate and can be done without routine laboratory monitoring of serum transaminase concentrations. Children receiving other known potentially hepatotoxic medications or who have known or suspected liver dysfunction (including obese children at risk for nonalcoholic steatohepatitis) should have baseline transaminase levels determined and followed closely for clinical signs or symptoms of hepatitis. The increasing use of telehealth visits in ambulatory care settings may allow increased access for monitoring but has the disadvantage of not allowing a thorough physical examination in a child who is taking hepatotoxic drugs.

End-of-Therapy Assessment

Families should be advised that either test of infection (TST or IGRA) will remain positive after treatment completion because of immunologic memory and is not a sign of treatment failure. Patients and their parents also should be aware that the child should not receive a TST in the future, because there may be an accelerated reaction that can result in a blister or even a scar at the site of the injection. Repeat chest radiography after treatment completion is not necessary. If there is a clinical change or a new risk factor has emerged, then a complete physical examination and chest radiography should be performed for assessment of TB disease.

Common Drug-Related Adverse Reactions

Hepatotoxicity

I f any patient, while on treatment, exhibits clinical signs and symptoms concerning for a significant adverse reaction from the medication (including but not limited to abdominal pain, anorexia, jaundice, dark-colored urine, pale stools), the medication should be stopped immediately while the clinician is contacted and directs evaluation. Many patients who eventually suffer severe hepatotoxicity had continued to take the medications even after clinical signs or symptoms became apparent. Transaminases should be assessed and, if elevated, measured weekly until either resolution or concern prompting gastroenterology consultation. Resolution of clinical symptoms and/or laboratory abnormalities may allow rechallenge with the same regimen. In situations in which resolution does not occur after medication discontinuation, or previously resolved abnormalities resurface at the time of rechallenge, a different regimen not containing the suspected offending drug should be started. This decision to use drugs other than isoniazid or a

rifamycin should be made in consultation with an expert in treatment of pediatric TB.

Respiratory Issues

It is exceedingly rare to develop pulmonary TB disease while on therapy for TBI, unless adherence is poor. The anti-TB medications have a low rate of adverse respiratory effects, and respiratory illnesses occurring while on therapy are usually intercurrent infections or asthma exacerbations. Evaluation and management usually should target acute community-acquired viral or bacterial pathogens, rather than emergent TB disease, and transmission-based precautions should be followed (ie, droplet and/or contact precautions with eye protection) when examining patients with respiratory symptoms.

Gastrointestinal Tract Upset

Gastrointestinal tract upset (nausea, vomiting, anorexia, abdominal pain) may occur, particularly in the first few weeks of therapy. Symptoms occurring shortly after administration of the drugs are rarely a sign of hepatitis but, more often, are attributable to irritation of the stomach mucosa. Having a small amount of food or milk in the stomach may alleviate these symptoms. However, isoniazid and rifampin should not be taken with large amounts of food, because this will affect absorption. If treatment is by SAT, dyspepsia may be minimized by taking medications at bedtime. If medications are not able to be taken at night, taking antacids concurrently may alleviate symptoms without compromising absorption,[116] although pharmacokinetic studies regarding this issue did not include children. By contrast, rifapentine always should be taken with food, preferably with an appreciable fat content, to enhance absorption. It is incumbent on the clinician to ensure that gastrointestinal tract upset, if not easily relieved with above measures, is not secondary to medication-induced hepatotoxicity.

Interruptions in Therapy

Questions may arise regarding how to manage patients who experience interruptions in therapy because of poor adherence, assessment of possible drug-related toxicity, or temporary lack of available medications. No formal trials of interrupted treatment courses and efficacy have been conducted. Published guidance and medical expert opinion have put forth acceptable options for completion of certain regimens (see specifics in drug regimens above).

Interruptions in treatment regimens with already short duration of the rifamycin-based regimens likely have more detrimental impact on effectiveness. The clinician needs to determine if to restart the regimen or extend the date of completion. If the interruption occurred early or over an extended time (over a month), it may be prudent to restart courses of rifamycin-based regimens.

Special Considerations

Treatment of Multidrug-Resistant TBI

Multidrug-resistant TB is defined as infection or disease caused by a strain of *M tuberculosis* that is resistant to at least isoniazid and rifampin, the 2 first-line drugs with greatest efficacy. Optimal therapy for multidrug-resistant TBI has not been established and needs to be individualized on the basis of the exact drug resistance pattern of the isolate. Although there have been no randomized controlled trials, many experts recommend that a fluoroquinolone antibiotic, either levofloxacin or moxifloxacin, alone or in combination with a second drug to which the isolate is susceptible, is the best currently available regimen.[117] The optimal length of therapy is unknown, with most experts recommending treatment duration between 6 and 12 months. These cases should be managed in consultation with a specialist with expertise in managing pediatric TB.

Children Living With HIV Infection

The CDC and National TB Controllers Association prefer short-course rifamycin-based regimens for TBI if there are no prohibitive drug-drug interactions with antiretroviral medications.[108] Specifically, 3HP is recommended for children 2 years and older in this situation, followed by 3HR in children of all ages. The combination of isoniazid and rifapentine has been given successfully to adults living with HIV infection,[118,119] and some data are available for children.[107,109] Treatment of coinfected individuals should be guided by clinicians experienced in the management of both conditions.

SUMMARY OF RECOMMENDATIONS REGARDING TREATMENT REGIMENS

- The risk of a child progressing from having TBI to TB disease depends on the child's age and immune status. Young children (younger than 4 years), adolescents, and immunocompromised individuals are at higher relative risk to progress from infection to disease.
- Short-course rifamycin-based regimens are preferred for treatment of TBI. On the basis of safety, adherence and completion, and effectiveness, many experts prefer 3HP, by DOT, in patients 2 years or older. When DOT is not available or the child cannot handle the pill burden of 3HP, 4R or 3HR may be the best regimen.
- Patient monitoring for adherence (DOT or SAT-hybrid) should be

strongly considered for patients at high risk for progression to TB disease.
- Routine laboratory monitoring is not needed for healthy patients but should be considered for patients with immune compromise, those with existing liver disease, or those who are taking other potentially hepatotoxic medications.
- Respiratory illnesses are rarely a harbinger of progression to disease but likely represent intercurrent community-acquired infections.

LEAD AUTHORS

Dawn Nolt, MD, MPH, FAAP
Jeffrey R. Starke, MD, FAAP

COMMITTEE ON INFECTIOUS DISEASES, 2020–2021

Yvonne A. Maldonado, MD, FAAP, Chairperson
Sean T. O'Leary, MD, MPH, FAAP, Vice Chairperson
Ritu Banerjee, MD, PhD, FAAP
James D. Campbell, MD, MS, FAAP
Mary T. Caserta, MD, FAAP
Jeffrey S. Gerber, MD, PhD, FAAP
Athena P. Kourtis, MD, PhD, MPH, FAAP
Ruth Lynfield, MD, FAAP
Flor M. Munoz, MD, MSc, FAAP
Dawn Nolt, MD, MPH, FAAP
Adam J. Ratner, MD, MPH, FAAP
Samir S. Shah, MD, MSCE, FAAP
William J. Steinbach, MD, FAAP
Kenneth M. Zangwill, MD, FAAP
Theoklis E. Zaoutis, MD, MSCE, FAAP

FORMER COMMITTEE MEMBER

Ann-Christine Nyquist, MD, MSPH, FAAP

EX OFFICIO

David W. Kimberlin, MD, FAAP – *Red Book* Editor
Elizabeth D. Barnett MD, FAAP– *Red Book Associate* Editor
Mark H. Sawyer, MD, FAAP – *Red Book Associate* Editor
Henry H. Bernstein, DO, MHCM, FAAP – *Red Book* Online Associate Editor
H. Cody Meissner, MD, FAAP – Visual *Red Book* Associate Editor

CONTRIBUTORS

Juan D. Chaparro, MD, FAAP – *Partnership for Policy Implementation*
Stuart T. Weinberg, MD, FAAP, FAMIA – *Partnership for Policy Implementation*

LIAISONS

Amanda C. Cohn, MD, FAAP – *Centers for Disease Control and Prevention*
Karen M. Farizo, MD – *US Food and Drug Administration*
Natasha B. Halasa, MD, MPH, FAAP – *Pediatric Infectious Diseases Society*
David Kim, MD – *HHS Office of Infectious Disease and HIV/AIDS Policy*
Eduardo López Medina, MD, MSc – *Sociedad Latinoamericana de Infectologia Pediatrica*
Denee Moore, MD, FAAFP – *American Academy of Family Physicians*
Scot B. Moore, MD, FAAP – *Committee on Practice Ambulatory Medicine*
Lakshmi Panagiotakopoulos, MD, MPH, FAAP – *Centers for Disease Control and Prevention*
Laura Sauvé, MD, MPH, FAAP, FCPS – *Canadian Pediatric Society*
Neil S. Silverman, MD – *American College of Obstetricians and Gynecologists*
Jeffrey R. Starke, MD, FAAP – *American Thoracic Society*
Kay M. Tomashek, MD, MPH, DTM – *National Institutes of Health*

STAFF

Jennifer M. Frantz, MPH

ABBREVIATIONS

3HP: once-weekly dosing of isoniazid and rifapentine
3HR: 3 months of daily isoniazid and rifampin
4R: 4-month regimen of daily rifampin
BCG: bacille Calmette-Guérin
CDC: Centers for Disease Control and Prevention
CFP-10: culture filter protein 10
DOT: directly observed therapy
ELISA: enzyme-linked immunosorbent assay
ELISPOT: enzyme-linked immunosorbent spot
ESAT-6: early secreted antigenic target 6
IFN-γ: interferon-γ
IGRA: interferon-γ release assay
NTM: nontuberculous Mycobacterium
PPD: purified protein derivative
QFT: QuantiFERON-TB Gold In-Tube assay
RD1: region of difference 1
SAT: self-administered therapy
TB: tuberculosis
TB1: tuberculosis antigen tube 1
TB2: tuberculosis antigen tube 2
TBI: tuberculosis infection
TNF-α: tumor necrosis factor-α
T-SPOT: T-SPOT.TB assay
TST: tuberculin skin test

REFERENCES

1. Schwartz NG, Price SF, Pratt RH, Langer AJ. Tuberculosis - United States, 2019. *MMWR Morb Mortal Wkly Rep.* 2020;69(11):286–289
2. Cowger TL, Wortham JM, Burton DC. Epidemiology of tuberculosis among children and adolescents in the USA, 2007-17: an analysis of national surveillance data. *Lancet Public Health.* 2019;4(10):e506–e516
3. Pai M, Denkinger CM, Kik SV, et al. Gamma interferon release assays for detection of Mycobacterium tuberculosis infection. *Clin Microbiol Rev.* 2014;27(1):3–20
4. Leung CC, Yam WC, Ho PL, et al. T-Spot.TB outperforms tuberculin skin test in predicting development of active tuberculosis among household contacts. *Respirology.* 2015;20(3): 496–503
5. Abubakar I, Drobniewski F, Southern J, et al; PREDICT Study Team. Prognostic value of interferon-γ release assays and tuberculin skin test in predicting the development of active tuberculosis (UK PREDICT TB): a prospective cohort study. *Lancet Infect Dis.* 2018;18(10): 1077–1087
6. Sohn H, Kim HY, Lee SH. Cost-effectiveness of contact screening strategies for tuberculosis among high-school adolescents in South Korea. *Int J Tuberc Lung Dis.* 2018;22(5):496–503
7. Cruz AT, Starke JR. Relationship between tuberculin skin test (TST) size and interferon gamma release assay (IGRA) result: when should clinicians obtain IGRAs in children with positive TSTs? *Clin Pediatr (Phila).* 2014;53(12): 1196–1199
8. American Academy of Pediatrics, Committee on Practice and Ambulatory Medicine, Bright Futures Periodicity Schedule Working Group. 2020 Recommendations for preventive pediatric health care. *Pediatrics.* 2020;145(3): e2020200013
9. Lewinsohn DM, Leonard MK, LoBue PA, et al. Official American Thoracic Society/Infectious Diseases Society of America/Centers for Disease Control and Prevention Clinical Practice Guidelines: Diagnosis of tuberculosis in adults and children. *Clin Infect Dis.* 2017;64(2):e1–e33
10. Ahmed A, Feng PI, Gaensbauer JT, et al; Tuberculosis Epidemiologic Studies Consortium. Interferon-γ release assays in children $<$15 years of age. *Pediatrics.* 2020;145(1):e20191930
11. Nguyen DT, Phan H, Trinh T, et al. Sensitivity and characteristics associated with positive QuantiFERON-TB Gold-Plus assay in children with confirmed tuberculosis. *PLoS One.* 2019;14(3): e0213304
12. Sun L, Tian JL, Yin QQ, et al. Performance of the interferon gamma release assays in tuberculosis disease in children five years old or less. *PLoS One.* 2015;10(12):e0143820
13. Huebner RE, Schein MF, Bass JB Jr. The tuberculin skin test. *Clin Infect Dis.* 1993;17(6):968–975
14. American Academy of Pediatrics. Tuberculosis. In: Kimberlin DW, Brady MT, Jackson MA, Long SS, eds. *Red Book: 2018 Report of the Committee on Infectious Diseases.* Elk Grove Village, IL: American Academy of Pediatrics; 2018:829–853
15. Mangtani P, Abubakar I, Ariti C, et al. Protection by BCG vaccine against tuberculosis: a systematic review of randomized controlled trials. *Clin Infect Dis.* 2014;58(4):470–480
16. Horwitz O, Bunch-Christensen K. Correlation between tuberculin sensitivity after 2 months and 5 years among BCG vaccinated subjects. *Bull World Health Organ.* 1972;47(1):49–58
17. Kemp EB, Belshe RB, Hoft DF. Immune responses stimulated by percutaneous and intradermal bacille Calmette-Guérin. *J Infect Dis.* 1996;174(1): 113–119
18. Lifschitz M. The value of the tuberculin skin test as a screening test for tuberculosis among BCG-vaccinated children. *Pediatrics.* 1965;36(4):624–627
19. Joncas JH, Robitaille R, Gauthier T. Interpretation of the PPD skin test in BCG-vaccinated children. *Can Med Assoc J.* 1975;113(2):127–128
20. Seddon JA, Paton J, Nademi Z, et al. The impact of BCG vaccination on tuberculin skin test responses in children is age dependent: evidence to be considered when screening children for tuberculosis infection. *Thorax.* 2016;71(10):932–939
21. Menzies D. Interpretation of repeated tuberculin tests. Boosting, conversion, and reversion. *Am J Respir Crit Care Med.* 1999;159(1):15–21
22. Sepulveda RL, Burr C, Ferrer X, Sorensen RU. Booster effect of tuberculin testing in healthy 6-year-old school children vaccinated with Bacillus Calmette-Guérin at birth in Santiago, Chile. *Pediatr Infect Dis J.* 1988;7(8):578–581
23. Stout JE, Wu Y, Ho CS, et al; Tuberculosis Epidemiologic Studies Consortium. Evaluating latent tuberculosis infection diagnostics using latent class analysis. *Thorax.* 2018;73(11):1062–1070
24. Cruz AT, Reichman LB. The case for retiring the tuberculin skin test. *Pediatrics.* 2019;143(6):e20183327
25. Lombardi G, Petrucci R, Corsini I, et al. Quantitative analysis of gamma interferon release assay response in children with latent and active tuberculosis. *J Clin Microbiol.* 2018;56(2):e01360-17
26. Hangai S, Yoshimi A, Hosoi A, et al. An indeterminate result of QuantiFERON-TB Gold In-Tube for miliary tuberculosis due to a high level of IFN-γ production. *Int J Hematol.* 2014;99(4):523–526
27. Mazurek GH, Jereb J, Vernon A, LoBue P, Goldberg S, Castro K; IGRA Expert Committee; Centers for Disease Control and Prevention (CDC). Updated guidelines for using interferon gamma release assays to detect Mycobacterium tuberculosis infection - United States, 2010. *MMWR Recomm Rep.* 2010;59(RR-5):1–25
28. Gandra S, Scott WS, Somaraju V, Wang H, Wilton S, Feigenbaum M. Questionable effectiveness of the QuantiFERON-TB Gold Test (Cellestis) as a screening tool in healthcare workers. *Infect Control Hosp Epidemiol.* 2010;31(12): 1279–1285
29. Nkurunungi G, Lutangira JE, Lule SA, et al. Determining Mycobacterium tuberculosis infection among BCG-immunised Ugandan children by T-SPOT.TB and tuberculin skin testing. *PLoS One.* 2012;7(10):e47340
30. Nemes E, Rozot V, Geldenhuys H, et al; C-040-404 Study Team and the

Adolescent Cohort Study Team. Optimization and interpretation of serial QuantiFERON testing to measure acquisition of Mycobacterium tuberculosis infection. *Am J Respir Crit Care Med.* 2017;196(5):638–648

31. Andrews JR, Nemes E, Tameris M, et al. Serial QuantiFERON testing and tuberculosis disease risk among young children: an observational cohort study. *Lancet Respir Med.* 2017;5(4): 282–290
32. Tebruegge M, Curtis N, Clifford V, et al. Seasonal variation in the performance of QuantiFERON-TB Gold In-Tube assays used for the diagnosis of tuberculosis infection. *Tuberculosis (Edinb).* 2018;110:26–29
33. Stout JE, Belknap R, Wu YJ, Ho CS. Paradox of serial interferon-gamma release assays: variability width more important than specificity size. *Int J Tuberc Lung Dis.* 2018;22(5):518–523
34. Kordy F, Waters V, Den-Hollander C, Read S, Lam R, Kitai I. Optimizing blood collection and processing for Quantiferon-TB Gold in-Tube testing gives low rates of indeterminate results: clinical implications. *Pediatr Infect Dis J.* 2018;37(1):e22–e24
35. Machingaidze S, Wiysonge CS, Gonzalez-Angulo Y, et al. The utility of an interferon gamma release assay for diagnosis of latent tuberculosis infection and disease in children: a systematic review and meta-analysis. *Pediatr Infect Dis J.* 2011;30(8):694–700
36. Mandalakas AM, Detjen AK, Hesseling AC, Benedetti A, Menzies D. Interferon-gamma release assays and childhood tuberculosis: systematic review and meta-analysis. *Int J Tuberc Lung Dis.* 2011;15(8):1018–1032
37. Sun L, Xiao J, Miao Q, et al. Interferon gamma release assay in diagnosis of pediatric tuberculosis: a meta-analysis. *FEMS Immunol Med Microbiol.* 2011;63(2):165–173
38. Chiappini E, Accetta G, Bonsignori F, et al. Interferon-γ release assays for the diagnosis of Mycobacterium tuberculosis infection in children: a systematic review and meta-analysis. *Int J Immunopathol Pharmacol.* 2012;25(3): 557–564
39. Muñoz L, Santin M, Alcaide F, et al; OPTIMIST Study Team. QuantiFERON-TB Gold In-Tube as a confirmatory test for tuberculin skin test in tuberculosis contact tracing: a noninferiority clinical trial. *Clin Infect Dis.* 2018;66(3): 396–403
40. Beshir MR, Zidan AE, El-Saadny HF, et al. Evaluation of the immune response to interferon gamma release assay and tuberculin skin test among BCG vaccinated children in east of Egypt: a cross-sectional study. *Medicine (Baltimore).* 2016;95(17):e3470
41. Mastrolia MV, Sollai S, Totaro C, et al. Utility of tuberculin skin test and IGRA for tuberculosis screening in internationally adopted children: retrospective analysis from a single center in Florence, Italy. *Travel Med Infect Dis.* 2019;28:64–67
42. Elliot C, Marais B, Williams P, et al. Tuberculin skin test versus interferon-gamma release assay in refugee children: a retrospective cohort study. *J Paediatr Child Health.* 2018;54(8): 834–839
43. Spicer KB, Turner J, Wang SH, Koranyi K, Powell DA. Tuberculin skin testing and T-SPOT.TB in internationally adopted children. *Pediatr Infect Dis J.* 2015;34(6):599–603
44. Lighter J, Rigaud M, Eduardo R, Peng CH, Pollack H. Latent tuberculosis diagnosis in children by using the QuantiFERON-TB Gold In-Tube test. *Pediatrics.* 2009;123(1):30–37
45. Rose W, Read SE, Bitnun A, et al. Relating tuberculosis (TB) contact characteristics to QuantiFERON-TB-Gold and tuberculin skin test results in the Toronto pediatric TB clinic. *J Pediatric Infect Dis Soc.* 2015;4(2):96–103
46. Chun JK, Kim CK, Kim HS, et al. The role of a whole blood interferon-gamma assay for the detection of latent tuberculosis infection in Bacille Calmette-Guérin vaccinated children. *Diagn Microbiol Infect Dis.* 2008;62(4): 389–394
47. Ling DI, Crépeau CA, Dufresne M, et al. Evaluation of the impact of interferon-gamma release assays on the management of childhood tuberculosis. *Pediatr Infect Dis J.* 2012;31(12): 1258–1262
48. Kampmann B, Seddon JA, Paton J, et al. Evaluating UK national guidance for screening of children for tuberculosis. A prospective multicenter study. *Am J Respir Crit Care Med.* 2018; 197(8):1058–1064
49. Lowenthal P, Barry PM, Flood J. High discordance between pre-US and post-US entry tuberculosis test results among immigrant children: is it time to adopt interferon gamma release assay for preentry tuberculosis screening? *Pediatr Infect Dis J.* 2016;35(3):231–236
50. Gudjónsdóttir MJ, Kötz K, Nielsen RS, et al. Relation between BCG vaccine scar and an interferon-gamma release assay in immigrant children with "positive" tuberculin skin test ($\geq$10 mm). *BMC Infect Dis.* 2016;16(1): 540
51. Yun KW, Kim YK, Kim HR, Lee MK, Lim IS. Usefulness of interferon-γ release assay for the diagnosis of latent tuberculosis infection in young children. *Korean J Pediatr.* 2016;59(6):256–261
52. Ling DI, Nicol MP, Pai M, Pienaar S, Dendukuri N, Zar HJ. Incremental value of T-SPOT.TB for diagnosis of active pulmonary tuberculosis in children in a high-burden setting: a multivariable analysis. *Thorax.* 2013;68(9):860–866
53. Schopfer K, Rieder HL, Bodmer T, et al. The sensitivity of an interferon-γ release assay in microbiologically confirmed pediatric tuberculosis. *Eur J Pediatr.* 2014;173(3):331–336
54. Laurenti P, Raponi M, de Waure C, Marino M, Ricciardi W, Damiani G. Performance of interferon-γ release assays in the diagnosis of confirmed active tuberculosis in immunocompetent children: a new systematic review and meta-analysis. *BMC Infect Dis.* 2016;16:131
55. Kay AW, Islam SM, Wendorf K, Westenhouse J, Barry PM. Interferon-γ release assay performance for tuberculosis in childhood. *Pediatrics.* 2018;141(6): e20173918
56. Petrucci R, Lombardi G, Corsini I, et al. Quantiferon-TB Gold In-Tube improves tuberculosis diagnosis in children. *Pediatr Infect Dis J.* 2017;36(1):44–49
57. Hill PC, Brookes RH, Adetifa IM, et al. Comparison of enzyme-linked

immunospot assay and tuberculin skin test in healthy children exposed to Mycobacterium tuberculosis. *Pediatrics.* 2006;117(5):1542–1548

58. Adetifa IM, Ota MO, Jeffries DJ, et al. Commercial interferon gamma release assays compared to the tuberculin skin test for diagnosis of latent Mycobacterium tuberculosis infection in childhood contacts in the Gambia. *Pediatr Infect Dis J.* 2010;29(5):439–443
59. Haustein T, Ridout DA, Hartley JC, et al. The likelihood of an indeterminate test result from a whole-blood interferon-gamma release assay for the diagnosis of Mycobacterium tuberculosis infection in children correlates with age and immune status. *Pediatr Infect Dis J.* 2009;28(8):669–673
60. Bianchi L, Galli L, Moriondo M, et al. Interferon-gamma release assay improves the diagnosis of tuberculosis in children. *Pediatr Infect Dis J.* 2009;28(6):510–514
61. Cruz AT, Geltemeyer AM, Starke JR, Flores JA, Graviss EA, Smith KC. Comparing the tuberculin skin test and T-SPOT.TB blood test in children. *Pediatrics.* 2011;127(1). Available at: www.pediatrics.org/cgi/content/full/127/1/e31
62. Mandalakas AM, Highsmith HY, Harris NM, Pawlicka A, Kirchner HL. T-SPOT.TB performance in routine pediatric practice in a low TB burden setting. *Pediatr Infect Dis J.* 2018;37(4):292–297
63. Gaensbauer J, Gonzales B, Belknap R, Wilson ML, O'Connor ME. Interferon-gamma release assay-based screening for pediatric latent tuberculosis infection in an urban primary care network. *J Pediatr.* 2018;200:202–209
64. Howley MM, Painter JA, Katz DJ, et al; Tuberculosis Epidemiologic Studies Consortium. Evaluation of QuantiFERON-TB gold in-tube and tuberculin skin tests among immigrant children being screened for latent tuberculosis infection. *Pediatr Infect Dis J.* 2015;34(1):35–39
65. Rego K, Pereira K, MacDougall J, Cruikshank W. Utility of the T-SPOT®.TB test's borderline category to increase test resolution for results around the cut-off point. *Tuberculosis (Edinb).* 2018;108:178–185
66. Santin M, Muñoz L, Rigau D. Interferon-γ release assays for the diagnosis of tuberculosis and tuberculosis infection in HIV-infected adults: a systematic review and meta-analysis. *PLoS One.* 2012;7(3):e32482
67. Hradsky O, Ohem J, Zarubova K, et al. Disease activity is an important factor for indeterminate interferon-γ release assay results in children with inflammatory bowel disease. *J Pediatr Gastroenterol Nutr.* 2014;58(3):320–324
68. Lucas M, Nicol P, McKinnon E, et al. A prospective large-scale study of methods for the detection of latent Mycobacterium tuberculosis infection in refugee children. *Thorax.* 2010;65(5):442–448
69. Blandinières A, de Lauzanne A, Guérin-El Khourouj V, et al. QuantiFERON to diagnose infection by Mycobacterium tuberculosis: performance in infants and older children. *J Infect.* 2013;67(5):391–398
70. Kasambira TS, Shah M, Adrian PV, et al. QuantiFERON-TB Gold In-Tube for the detection of Mycobacterium tuberculosis infection in children with household tuberculosis contact. *Int J Tuberc Lung Dis.* 2011;15(5):628–634
71. Bergamini BM, Losi M, Vaienti F, et al. Performance of commercial blood tests for the diagnosis of latent tuberculosis infection in children and adolescents. *Pediatrics.* 2009;123(3). Available at: www.pediatrics.org/cgi/content/full/123/3/e419
72. Critselis E, Amanatidou V, Syridou G, et al. The effect of age on whole blood interferon-gamma release assay response among children investigated for latent tuberculosis infection. *J Pediatr.* 2012;161(4):632–638
73. Meier NR, Volken T, Geiger M, Heininger U, Tebruegge M, Ritz N. Risk factors for indeterminate interferon-gamma release assay for the diagnosis of tuberculosis in children-a systematic review and meta-analysis. *Front Pediatr.* 2019;7:208
74. Cattamanchi A, Smith R, Steingart KR, et al. Interferon-gamma release assays for the diagnosis of latent tuberculosis infection in HIV-infected individuals: a systematic review and meta-analysis. *J Acquir Immune Defic Syndr.* 2011;56(3):230–238
75. Chen J, Zhang R, Wang J, et al. Interferon-gamma release assays for the diagnosis of active tuberculosis in HIV-infected patients: a systematic review and meta-analysis. *PLoS One.* 2011;6(11):e26827
76. Mandalakas AM, Hesseling AC, Chegou NN, et al. High level of discordant IGRA results in HIV-infected adults and children. *Int J Tuberc Lung Dis.* 2008;12(4):417–423
77. Mandalakas AM, van Wyk S, Kirchner HL, et al. Detecting tuberculosis infection in HIV-infected children: a study of diagnostic accuracy, confounding and interaction. *Pediatr Infect Dis J.* 2013;32(3):e111–e118
78. Dehority W, Viani RM, Araneta MRG, Lopez G, Spector SA. Comparison of the QuantiFERON TB Gold In-tube assay with tuberculin skin test for the diagnosis of latent tuberculosis infection among HIV-infected and uninfected children. *Pediatr Infect Dis J.* 2017;36(12):e317–e321
79. AIDSinfo. Mycobacterium tuberculosis infection and disease. 2019. Available at: https://aidsinfo.nih.gov/guidelines/html/4/adult-and-adolescent-opportunistic-infection/325/mycobacterium-tuberculosis. Accessed June 15, 2020
80. Stefan DC, Dippenaar A, Detjen AK, et al. Interferon-gamma release assays for the detection of Mycobacterium tuberculosis infection in children with cancer. *Int J Tuberc Lung Dis.* 2010;14(6):689–694
81. Carvalho AC, Schumacher RF, Bigoni S, et al. Contact investigation based on serial interferon-gamma release assays (IGRA) in children from the hematology-oncology ward after exposure to a patient with pulmonary tuberculosis. *Infection.* 2013;41(4):827–831
82. Smith R, Cattamanchi A, Steingart KR, et al. Interferon-γ release assays for diagnosis of latent tuberculosis infection: evidence in immune-mediated inflammatory disorders. *Curr Opin Rheumatol.* 2011;23(4):377–384
83. Winthrop KL, Weinblatt ME, Daley CL. You can't always get what you want,

but if you try sometimes (with two tests–TST and IGRA–for tuberculosis) you get what you need. *Ann Rheum Dis.* 2012;71(11):1757–1760

84. Gabriele F, Trachana M, Simitsopoulou M, et al. Performance of QuantiFERON®-TB Gold In-Tube assay in children receiving disease modifying anti-rheumatic drugs. *World J Pediatr.* 2017;13(5):472–478
85. Vassilopoulos D, Tsikrika S, Hatzara C, et al. Comparison of two gamma interferon release assays and tuberculin skin testing for tuberculosis screening in a cohort of patients with rheumatic diseases starting anti-tumor necrosis factor therapy. *Clin Vaccine Immunol.* 2011;18(12):2102–2108
86. Saidenberg-Kermanac'h N, Semerano L, Naccache JM, et al. Screening for latent tuberculosis in anti-TNF-α candidate patients in a high tuberculosis incidence setting. *Int J Tuberc Lung Dis.* 2012;16(10):1307–1314
87. Mínguez S, Latorre I, Mateo L, et al. Interferon-gamma release assays in the detection of latent tuberculosis infection in patients with inflammatory arthritis scheduled for anti-tumour necrosis factor treatment. *Clin Rheumatol.* 2012;31(5):785–794
88. Silveira MBV, Ferrarini MAG, Viana PO, et al. Contribution of the interferon-gamma release assay to tuberculosis diagnosis in children and adolescents. *Int J Tuberc Lung Dis.* 2018;22(10):1172–1178
89. Debord C, De Lauzanne A, Gourgouillon N, et al. Interferon-gamma release assay performance for diagnosing tuberculosis disease in 0- to 5-year-old children. *Pediatr Infect Dis J.* 2011;30(11):995–997
90. Moyo S, Isaacs F, Gelderbloem S, et al. Tuberculin skin test and QuantiFERON® assay in young children investigated for tuberculosis in South Africa. *Int J Tuberc Lung Dis.* 2011;15(9):1176–1181
91. Pavić I, Topić RZ, Raos M, Aberle N, Dodig S. Interferon-γ release assay for the diagnosis of latent tuberculosis in children younger than 5 years of age. *Pediatr Infect Dis J.* 2011;30(10):866–870
92. Velasco-Arnaiz E, Soriano-Arandes A, Latorre I, et al. Performance of tuberculin skin tests and interferon-γ release assays in children younger than 5 years. *Pediatr Infect Dis J.* 2018;37(12):1235–1241
93. Grinsdale JA, Islam S, Tran OC, Ho CS, Kawamura LM, Higashi JM. Interferon-gamma release assays and pediatric public health tuberculosis screening: the San Francisco Program Experience 2005 to 2008. *J Pediatric Infect Dis Soc.* 2016;5(2):122–130
94. Deuffic-Burban S, Atsou K, Viget N, Melliez H, Bouvet E, Yazdanpanah Y. Cost-effectiveness of QuantiFERON-TB test vs. tuberculin skin test in the diagnosis of latent tuberculosis infection. *Int J Tuberc Lung Dis.* 2010;14(4):471–481
95. Marais BJ, Gie RP, Schaaf HS, et al. The natural history of childhood intra-thoracic tuberculosis: a critical review of literature from the pre-chemotherapy era. *Int J Tuberc Lung Dis.* 2004;8(4):392–402
96. Cruz AT, Starke JR. Increasing adherence for latent tuberculosis infection therapy with health department-administered therapy. *Pediatr Infect Dis J.* 2012;31(2):193–195
97. Centers for Disease Control and Prevention. Reported tuberculosis in the United States, 2018. 2019. Available at: www.cdc.gov/tb/statistics/reports/2018/. Accessed June 19, 2020
98. Sharling L, Marks SM, Goodman M, Chorba T, Mase S. Rifampin-resistant Tuberculosis in the United States, 1998-2014. *Clin Infect Dis.* 2020;70(8):1596–1605
99. Sterling TR, Villarino ME, Borisov AS, et al; TB Trials Consortium PREVENT TB Study Team. Three months of rifapentine and isoniazid for latent tuberculosis infection. *N Engl J Med.* 2011;365(23):2155–2166
100. Cruz AT, Starke JR. Completion rate and safety of tuberculosis infection treatment with shorter regimens. *Pediatrics.* 2018;141(2):e20172838
101. Horsburgh CR Jr, Goldberg S, Bethel J, et al; Tuberculosis Epidemiologic Studies Consortium. Latent TB infection treatment acceptance and completion in the United States and Canada. *Chest.* 2010;137(2):401–409
102. Centers for Disease Control and Prevention (CDC). Transmission of Mycobacterium tuberculosis in a high school and school-based supervision of an isoniazid-rifapentine regimen for preventing tuberculosis - Colorado, 2011-2012. *MMWR Morb Mortal Wkly Rep.* 2013;62(39):805–809
103. Belknap R, Holland D, Feng PJ, et al; TB Trials Consortium iAdhere Study Team. Self-administered versus directly observed once-weekly isoniazid and rifapentine treatment of latent tuberculosis infection: a randomized trial. *Ann Intern Med.* 2017;167(10):689–697
104. Garfein RS, Liu L, Cuevas-Mota J, et al. Tuberculosis treatment monitoring by video directly observed therapy in 5 health districts, California, USA. *Emerg Infect Dis.* 2018;24(10):1806–1815
105. Story A, Aldridge RW, Smith CM, et al. Smartphone-enabled video-observed versus directly observed treatment for tuberculosis: a multicentre, analyst-blinded, randomised, controlled superiority trial. *Lancet.* 2019;393(10177):1216–1224
106. Cruz AT, Ahmed A, Mandalakas AM, Starke JR. Treatment of latent tuberculosis infection in children. *J Pediatric Infect Dis Soc.* 2013;2(3):248–258
107. Villarino ME, Scott NA, Weis SE, et al; International Maternal Pediatric and Adolescents AIDS Clinical Trials Group; Tuberculosis Trials Consortium. Treatment for preventing tuberculosis in children and adolescents: a randomized clinical trial of a 3-month, 12-dose regimen of a combination of rifapentine and isoniazid. *JAMA Pediatr.* 2015;169(3):247–255
108. Sterling TR, Njie G, Zenner D, et al. Guidelines for the treatment of latent tuberculosis infection: recommendations from the National Tuberculosis Controllers Association and CDC, 2020. *MMWR Recomm Rep.* 2020;69(1):1–11
109. Borisov AS, Bamrah Morris S, Njie GJ, et al. Update of recommendations for use of once-weekly isoniazid-rifapentine regimen to treat latent Mycobacterium tuberculosis infection. *MMWR*

Morb Mortal Wkly Rep. 2018;67(25):723–726

110. Cruz AT, Starke JR. Safety and completion of a 4-month course of rifampicin for latent tuberculous infection in children. *Int J Tuberc Lung Dis*. 2014;18(9):1057–1061
111. Diallo T, Adjobimey M, Ruslami R, et al. Safety and side effects of rifampin versus isoniazid in children. *N Engl J Med*. 2018;379(5):454–463
112. Gaensbauer J, Aiona K, Haas M, Reves R, Young J, Belknap R. Better completion of pediatric latent tuberculosis treatment using 4 months of rifampin in a US-based tuberculosis clinic. *Pediatr Infect Dis J*. 2018;37(3):224–228
113. Gwee A, Coghlan B, Curtis N. Question 1: what are the options for treating latent TB infection in children? *Arch Dis Child*. 2013;98(6):468–474
114. World Health Organization. *Latent tuberculosis infection: updated and consolidated guidelines for programmatic management*. Geneva: World Health Organization; 2018. License: CC BY-NC-SA 3.0 IGO
115. Nahid P, Dorman SE, Alipanah N, et al. Official American Thoracic Society/Centers for Disease Control and Prevention/Infectious Diseases Society of America Clinical Practice Guidelines: treatment of drug-susceptible tuberculosis. *Clin Infect Dis*. 2016;63(7):e147–e195
116. Lin MY, Lin SJ, Chan LC, Lu YC. Impact of food and antacids on the pharmacokinetics of anti-tuberculosis drugs: systematic review and meta-analysis. *Int J Tuberc Lung Dis*. 2010;14(7):806–818
117. Nahid P, Mase SR, Migliori GB, et al. Treatment of drug-resistant tuberculosis. An official ATS/CDC/ERS/IDSA clinical practice guideline. *Am J Respir Crit Care Med*. 2019;200(10):e93–e142
118. Martinson NA, Barnes GL, Moulton LH, et al. New regimens to prevent tuberculosis in adults with HIV infection. *N Engl J Med*. 2011;365(1):11–20
119. Swindells S, Ramchandani R, Gupta A, et al; BRIEF TB/A5279 Study Team. One month of rifapentine plus isoniazid to prevent HIV-related tuberculosis. *N Engl J Med*. 2019;380(11):1001–1011

Use of Probiotics in Preterm Infants

- *Clinical Report*

CLINICAL REPORT Guidance for the Clinician in Rendering Pediatric Care

American Academy of Pediatrics
DEDICATED TO THE HEALTH OF ALL CHILDREN®

Use of Probiotics in Preterm Infants

Brenda Poindexter, MD, MS, FAAP, COMMITTEE ON FETUS AND NEWBORN

Probiotic products in the United States are available for use in the general category of dietary supplements, bypassing the rigor of the US Food and Drug Administration (FDA) approval process in safety, efficacy, and manufacturing standards. As a result, currently available probiotics lack FDA-approved drug labeling and cannot be marketed to treat or prevent disease in preterm infants, including necrotizing enterocolitis and late-onset sepsis. Despite lack of availability of a pharmaceutical-grade product, the number of preterm infants receiving probiotics in the United States and Canada is steadily increasing. According to recent reports from large collaborative databases in the United States, approximately 10% of extremely low gestational age neonates receive a probiotic preparation during their stay in the NICU, with wide variation in practice among units. In sum, more than 10 000 preterm infants have been enrolled in randomized clinical trials of probiotic supplementation worldwide. Methodologic differences among study protocols included different strains and combinations of therapy, masking of trials, and a priori definitions of the primary outcome measure. Large meta-analyses of these trials have demonstrated the efficacy of multiple-strain probiotics in reducing necrotizing enterocolitis and all-cause mortality, whereas the efficacy of single-strain probiotic preparations is less certain. In the absence of an appropriate medical-grade product in the United States, dietary supplement–grade probiotics, some of which have been the subject of recent recalls for contamination, are being prescribed. Given the lack of FDA-regulated pharmaceutical-grade products in the United States, conflicting data on safety and efficacy, and potential for harm in a highly vulnerable population, current evidence does not support the routine, universal administration of probiotics to preterm infants, particularly those with a birth weight of <1000 g.

INTRODUCTION

There is a rapidly growing body of literature related to the developing intestinal microbiome and the use of probiotics and prebiotics in the maintenance of health and in the prevention and treatment of a number of disease states. In preterm infants, probiotics have been evaluated in

abstract

Children's Healthcare of Atlanta and School of Medicine, Emory University, Atlanta, Georgia

Clinical reports from the American Academy of Pediatrics benefit from expertise and resources of liaisons and internal (AAP) and external reviewers. However, clinical reports from the American Academy of Pediatrics may not reflect the views of the liaisons or the organizations or government agencies that they represent.

Dr Poindexter was responsible for conceptualizing, writing, and revising the manuscript and considering input from all reviewers and the board of directors; the author approved of the final manuscript as submitted.

The guidance in this clinical report does not indicate an exclusive course of treatment or serve as a standard of medical care. Variations, taking into account individual circumstances, may be appropriate.

All clinical reports from the American Academy of Pediatrics automatically expire 5 years after publication unless reaffirmed, revised, or retired at or before that time.

The findings and conclusions in this article are those of the authors and do not necessarily represent the official position of the Centers for Disease Control and Prevention.

DOI: https://doi.org/10.1542/peds.2021-051485

Address correspondence to Brenda Poindexter, MD. E-mail: brenda.poindexter@emory.edu

PEDIATRICS (ISSN Numbers: Print, 0031-4005; Online, 1098-4275).

FINANCIAL DISCLOSURE: The author has indicated she has no financial relationships relevant to this article to disclose.

FUNDING: No external funding.

To cite: Poindexter B, AAP COMMITTEE ON FETUS AND NEWBORN. Use of Probiotics in Preterm Infants. *Pediatrics*. 2021;147(6):e2021051485

a number of randomized clinical trials for the prevention of severe necrotizing enterocolitis (NEC), late-onset sepsis, and all-cause mortality.[1] Despite significant differences in the combination of probiotic preparations used in these trials and the lack of availability of a pharmaceutical-grade probiotic product in the United States, the number of preterm infants receiving probiotics is steadily increasing. According to recent reports from large collaborative databases in the United States, approximately 10% of extremely low gestational age neonates receive some type of probiotic during their stay in the NICU, with wide variation in practice among units.[2] Although some infant formulas for term infants available in the United States now contain probiotics, formulas for preterm infants do not.

The purpose of this clinical report is to (1) highlight differences among commercially available probiotic preparations and the current (lack of) regulatory standards in the United States; (2) outline potential risks associated with the use of probiotics, supporting a cautionary approach with their routine use in preterm infants; (3) review the current evidence evaluating the use of probiotics in both prevention and treatment of NEC, late-onset sepsis, and mortality; and (4) highlight the need for pharmaceutical-grade probiotics that have been rigorously evaluated for safety and efficacy.

INTESTINAL MICROBIOME OF THE PRETERM INFANT

Over the past decade, the role of the intestinal microbiome as a marker of health and disease in preterm infants has been increasingly recognized. Differences in the intestinal microbiota among infants born at term and those born preterm have been demonstrated, with fewer bacterial species, less diversity, and increased proportions of potentially pathogenic strains in preterm infants. In addition, a number of factors are known to alter the microbiota in preterm infants, including mode of delivery, exposure to antibiotics, use of histamine antagonists, and diet (especially human milk, promoting prevalence of *Bifidobacterium* species).[3,4] Numerous studies have described intestinal dysbiosis preceding the onset of NEC in preterm infants, most commonly characterized by increased *Proteobacteria* and decreased relative abundancies of *Firmicutes* and *Bacteroidetes* species.[5] Proposed benefits of probiotics include preventing intestinal dysbiosis and assisting in metabolism of dietary nutrients, leading to byproducts essential for intestinal health. For example, *Bifidobacterium longum* subspecies *infantis* consumes human milk oligosaccharides, promoting a healthy intestinal microbiota.[6]

PROBIOTIC PREPARATIONS

An expert panel convened by the International Scientific Association for Probiotics and Prebiotics defined probiotics as "live microorganisms that, when administered in adequate amounts, confer a health benefit to the host."[7] In contrast, a prebiotic is a nutrient (oligosaccharides, for example) that can modify the gut microbiota. Importantly, this consensus panel proposed benchmark standards, recognizing differences in regulatory approaches for probiotics in different countries. Such differences have significant implications for interpretation of studies of probiotic supplementation and for recommendations for clinical use of probiotics in the NICU, including but not limited to the number of colony-forming units (CFUs) in the product, claims of benefit that are not strain specific, and the intent to support a healthy gut microbiota versus to prevent disease. Unlike products used as dietary supplements, probiotics labeled with the intent to treat are required to meet higher regulatory standards. Indeed, the International Scientific Association for Probiotics and Prebiotics expert panel noted distinctive criteria for a "probiotic drug" with a specific indication for treatment or prevention of disease to require a defined strain(s) of live microbe, proof of delivery of viable probiotic at efficacious dose at end of shelf-life, and a risk/benefit assessment to justify use based on appropriate trials to meet regulatory standards for drugs.[8] It is important to note that none of the probiotic trials published to date in preterm infants for the prevention of NEC meet these criteria or level of evidence. In the United States, probiotic products are typically manufactured as a dietary supplement. If a probiotic is going to be marketed as a drug for treatment of a disease or disorder, it has to meet stricter requirements, including proof of safety and efficacy for its intended use through clinical trials and approval by the US Food and Drug Administration before it can be sold.[9,10]

Probiotic preparations may include a single bacterial strain or a combination of multiple strains. In addition to the particular bacterial species on the probiotic product label, the preparations are highly variable in terms of the number of viable microorganisms both at the time of manufacturing and after shelf storage.

Studies evaluating the efficacy of oral probiotics for the prevention of NEC have included single bacterial strains and mixtures of probiotics, often including *Lactobacillus*, *Bifidobacterium*, and/or *Saccharomyces* species. Despite the observation that infants receiving human milk are colonized with *Bifidobacterium breve* and *Bifidobacterium infantis*,[6] not all probiotic preparations contain these bacteria. It is also important to note that the duration of colonization of the gastrointestinal tract after

administration of products containing *Bifidobacterium* organisms is discontinued may only persist for a few months.[11] In a recent study, 16 different commercially available probiotic products were evaluated to determine if the bacteria species listed on the label matched that obtained by culture and polymerase chain reaction in the laboratory. Disturbingly, only 1 of the 16 products containing *Bifidobacterium* organisms matched the label exactly, and there was substantial variability in the composition of probiotics by lot and pill. One of the products tested did not contain any of the species listed.[12]

SAFETY

The potential infectious risk associated with probiotic supplementation may be related to the risk of sepsis associated with the bacterial strain in the probiotic product that colonizes the infant or from contamination of the product with a pathogen during the manufacturing process.

Although there have been a few cases of probiotic-associated sepsis reported in neonates receiving *Lactobacillus rhamnosus GG*,[13] a meta-analysis including more than 5000 infants in randomized trials reported no systemic infection with the supplemental probiotic organism.[14] Although the risk appears to be low, the potential of bacterial cross-colonization among infants within a unit is also a potential risk.[15] In the Probiotics in Very Preterm Infants (PiPS) trial, *B breve* was identified as a cross contaminant in 37% of infants randomly assigned to the placebo control group.[16] However, it may be difficult to distinguish the change in the infant from the change in the resident flora of the NICU.

There have been several recent recalls of dietary supplement–grade probiotics for contamination, including with *Salmonella, Rhizopus,* and *Penicillium* species. Gastrointestinal mucormycosis has been reported in a preterm infant receiving contaminated ABC Dophilus Powder.[17]

The Agency for Healthcare Research and Quality recently issued a report on the safety of probiotics to reduce risk and prevent or treat disease including 622 studies. Unfortunately, one-third of the studies reported only nonspecific safety statements (such as "well-tolerated"), and the authors noted that adverse events were not well documented in the majority of studies. The conclusions of this report were as follows: "There is a lack of assessment and systematic reporting of adverse events in probiotic intervention studies, and interventions are poorly documented. The available evidence in [randomized controlled trials] does not indicate an increased risk; however, rare adverse events are difficult to assess, and despite the substantial number of publications, the current literature is not well equipped to answer questions on the safety of probiotic interventions with confidence."[18] Other systematic reviews have similarly reported inadequate reporting of adverse and serious adverse events in studies evaluating probiotics in high-risk patients.[19,20]

CURRENT EVIDENCE

Probiotics for the Prevention of NEC

Several recent meta-analyses have evaluated the effects of probiotics to prevent NEC (Bell stage 2 or 3), late-onset sepsis, and death in preterm infants (typically very low birth weight infants). In the past 5 years, there have been numerous published systematic reviews.[21,22] Despite great heterogeneity among studies, the cumulative pooled risk ratio (RR) for NEC (including more than 10 000 infants) is strongly in favor of treatment with probiotics for the prevention of NEC.[22]

Three of the earliest randomized trials of probiotics in preterm infants suggesting benefit were conducted outside the United States. Bin-Nun et al[23] (Israel) evaluated the mixture of *B infantis*, *Streptococcus thermophilus*, and *Bifidobacteria bifidus*; Dani et al[24] (Italy) evaluated *L rhamnosus* GG; and Lin et al[25] (Taiwan) evaluated *Lactobacillus acidophilus* and *B infantis*. In each of these early studies, researchers found a reduction in the incidence of NEC in infants who were randomly assigned to receive probiotics when compared with those in the control group. These 3 studies and those that have followed have had wide heterogeneity of subjects and interventions and are also limited by the small number of infants with a birth weight less than 1000 g, the population at highest risk for NEC.

The studies are hindered by methodologic differences among study protocols, including different strains and combinations of therapy, masking of trials, and having an a priori definition of the primary outcome measure. It is not clear whether it is appropriate to pool data from trials by using different strains of probiotics, leading many investigators to urge caution in interpretation of meta-analyses of probiotics for the prevention of morbidity in preterm infants.[26]

The PiPS trial, conducted in the United Kingdom, was a large, multicenter, randomized controlled trial of *B breve* supplementation in 1315 very preterm infants. In contrast to some of the earlier trials conducted in low-resource settings, in the PiPS trial, researchers found no difference in the primary outcomes of NEC (RR, 0.93; 95% confidence interval [CI], 0.68–1.27), sepsis (RR, 0.97; 95% CI, 0.73–1.29), or death (RR, 0.93; 95% CI, 0.67–1.30) before hospital discharge.[16]

The ProPrems trial, conducted in 10 perinatal centers in Australia and New Zealand, evaluated the effect of

a probiotic combination (*B infantis*, *Streptococcus thermophiles*, and *Bifidobacterium lactis*) in 1099 very low birth weight (<1500 g) infants with high exposure to human milk. Although no difference in the primary outcome of late-onset sepsis was found in this trial, the incidence of NEC (Bell stage 2 or greater) was reduced (2.0% vs 4.4%) in infants randomly assigned to receive the probiotic combination (RR, 0.46; 95% CI, 0.23–0.93). However, in a prespecified subgroup analysis of infants born at <28 weeks' gestational age and with a birth weight of <1000 g, there was no difference in the rate of NEC.[27]

Not All Probiotics Are Equal: Single Versus Multiple Strain

Multiple-strain probiotics were associated with a significant reduction in NEC (pooled odds ratio, 0.36; 95% CI, 0.24–0.53) and mortality (pooled odds ratio, 0.58; 95% CI, 0.43–0.79), whereas interventions using single-strain probiotic (usually *Lactobacillus*) had only a borderline effect in reducing NEC and no effect on mortality.[28] The European Society for Paediatric Gastroenterology, Hepatology and Nutrition (ESPGHAN) recently published a strain-specific systematic review of the efficacy of probiotics for prevention of NEC, highlighting important differences among various bacterial strains.[29]

Probiotics for the Prevention of Culture-Proven Sepsis in Preterm Infants

In a 2014 Cochrane review that included 19 randomized or quasi-randomized trials of probiotic supplementation in 5338 preterm infants, there was no evidence of significant reduction of nosocomial sepsis (RR, 0.91; 95% CI, 0.80–1.03).[14]

CURRENT PRACTICE GUIDELINES

The American Academy of Pediatrics, Canadian Pediatric Society, and ESPGHAN have all issued statements advocating for caution with regard to routine use of probiotics in preterm infants. In 2010, an American Academy of Pediatrics clinical report cautioned that "the combinations of probiotics most convincing for NEC prevention are not available in the United States… not all probiotics have been studied; therefore, all probiotics cannot be generally recommended."[30] In 2019, the Canadian Pediatric Society reaffirmed the lack of safety and efficacy data for infants with a birth weight of <1000 g as follows: "Probiotics may help to prevent NEC. Administering live microorganisms to preterm newborns should be approached with caution. Along with breastfeeding promotion, probiotics can be considered for the prevention of NEC in preterm infants >1 kg who are at risk for NEC. There is currently no data for infants weighing <1000 g."[31] The ESPGHAN recently published consensus-based guidance for the potential use of probiotics in preterm infants.[32] With regard to the safety of administration of probiotics to preterm infants, the panel stipulated that local laboratories should have the ability to detect probiotic bacteremia, that only products manufactured according to current good manufacturing practices should be used, and that the potential risks and benefits are provided to parents of preterm infants. The panel conditionally recommended use of *L rhamnosus GG* (dose from 1×10^9 CFUs to 6×10^9 CFUs) or a combination of *B infantis*, *B lactis*, and *S thermophilus* (dose of 3.0 to 3.5 $\times$ 10^8 CFUs of each strain) for the reduction of stage 2 or 3 NEC but noted low certainty of evidence. In addition, the panel recommended against the use of certain probiotic preparations on the basis of safety concerns and uncertainty of evidence. Finally, the panel noted the lack of evidence related to the optimal start and length of treatment. Most recently, the American Gastroenterological Association published recommendations using the Grading of Recommendations Assessment, Development and Evaluation approach.[33] Similar to the ESPGHAN, the American Gastroenterological Association made a conditional recommendation for use of a certain probiotic strain or strain combination for the prevention of NEC in preterm infants but did not address the lack of a pharmaceutical-grade product for this population.

PROS AND CONS OF ADMINISTRATION OF CURRENTLY AVAILABLE PROBIOTIC PRODUCTS

NEC remains a devastating disease in preterm infants, with high mortality and morbidity.[34] Given the number of publications in favor of using probiotics for the prevention of NEC, it is not at all surprising that the use of probiotics is increasing, even with the inherent limitations of dietary supplement–grade products that are currently available in the United States. A recent series of articles has eloquently outlined the pros and cons of routine usage of currently available probiotic products,[35,36] and other groups have also urged caution before implementation of routine use of probiotics.[37]

Some of the products currently available in the United States include Culturelle (*L rhamnosus GG*), Similac Probiotic Tri-Blend (*B infantis*, *S thermophilus*, and *B lactis*), and Evivo (*B infantis*). Each of these preparations are categorized as dietary supplements and are not labeled with the number of CFUs for the probiotic strain(s).

LONG-TERM CONSIDERATIONS

The long-term implications of giving probiotics to preterm infants and how administration of microorganisms may permanently alter the microbiome is currently unknown. Jacobs et al[38] found comparable rates of survival without major neurodevelopmental impairment among subjects enrolled in the ProPrems trial. Although reassuring that administration of the probiotic preparation was not associated with adverse neurodevelopmental

outcomes, future studies are needed to more rigorously assess the effects of probiotics on longer-term outcomes.

ONGOING CLINICAL TRIALS

Although many trials involving probiotics use of a dietary supplement–grade product, a phase Ib study evaluating the safety and tolerability of 2 doses of a pharmaceutical-grade probiotic (STP206; NCT01954017) in preterm infants was recently completed. In addition, a phase III randomized clinical trial to evaluate the safety and efficacy of *Lactobacillus reuteri* (IBP-9414; NCT03978000) to prevent NEC in preterm infants is currently ongoing. Proponents for routine administration of probiotics for NEC prevention agree that future research should compare high-quality probiotic products (both purity and viability of microbes) and doses.[36]

SUMMARY

- In studies supporting the use of probiotics to decrease the risk of NEC and late-onset infection, researchers have used multiple different products in diverse settings and in diverse preterm target populations. The most recent modern trials have not demonstrated a reduction in NEC in infants at the highest risk for this morbidity. A pharmaceutical-grade probiotic product is not currently available in the United States. Long-term safety remains unknown. For these reasons, current evidence does not support the routine, universal administration of probiotics to preterm infants, particularly those with a birth weight of <1000 g.
- Centers making the decision to administer probiotics to select preterm infants should discuss the potential risks and benefits of this therapy with parents and should strongly consider a formalized informed consent process. Such centers should develop local guidelines addressing probiotic use and conduct surveillance to assess local impacts because the introduction of probiotics has been shown to alter the center's flora and potentially affect all infants cared for in the center.
- Clinicians must be aware of the lack of regulatory standards for commercially available probiotic preparations manufactured as dietary supplements and the potential for contamination with pathogenic species.
- Centers choosing to administer probiotics should carefully document outcomes, adverse events, and safety.

LEAD AUTHOR

Brenda Poindexter, MD, MS, FAAP

COMMITTEE ON FETUS AND NEWBORN, 2019–2020

James Cummings, MD, Chairperson
Ivan Hand, MD
Ira Adams-Chapman, MD, MD
Susan W. Aucott, MD
Karen M. Puopolo, MD
Jay P. Goldsmith, MD
David Kaufman, MD
Camilia Martin, MD
Meredith Mowitz, MD

FORMER COMMITTEE MEMBER

Brenda Poindexter, MD, MS, FAAP

LIAISONS

Timothy Jancelewicz, MD – *American Academy of Pediatrics Section on Surgery*
Michael Narvey, MD – *Canadian Paediatric Society*
Russell Miller, MD – *American College of Obstetricians and Gynecologists*
RADM Wanda Barfield, MD, MPH – *Centers for Disease Control and Prevention*
Lisa Grisham, APRN, NNP-BC – *National Association of Neonatal Nurses*

STAFF

Jim Couto, MA

ABBREVIATIONS

CFU: colony-forming unit
CI: confidence interval
ESPGHAN: European Society for Paediatric Gastroenterology, Hepatology and Nutrition
NEC: necrotizing enterocolitis
PiPS: Probiotics in Very Preterm Infants
RR: risk ratio

POTENTIAL CONFLICT OF INTEREST: The author has indicated she has no potential conflicts of interest to disclose.

REFERENCES

1. Dermyshi E, Wang Y, Yan C, et al. The "golden age" of probiotics: a systematic review and meta-analysis of randomized and observational studies in preterm infants. *Neonatology*. 2017;112(1):9–23
2. Viswanathan S, Lau C, Akbari H, Hoyen C, Walsh MC. Survey and evidence based review of probiotics used in very low birth weight preterm infants within the United States. *J Perinatol*. 2016; 36(12):1106–1111
3. Neu J. The developing intestinal microbiome: probiotics and prebiotics. *World Rev Nutr Diet*. 2014;110:167–176
4. Lenfestey MW, Neu J. Probiotics in newborns and children. *Pediatr Clin North Am*. 2017;64(6):1271–1289
5. Pammi M, Cope J, Tarr PI, et al. Intestinal dysbiosis in preterm infants preceding necrotizing enterocolitis: a systematic review and meta-analysis. *Microbiome*. 2017;5(1):31

6. Underwood MA, German JB, Lebrilla CB, Mills DA. Bifidobacterium longum subspecies infantis: champion colonizer of the infant gut. *Pediatr Res*. 2015; 77(1–2):229–235
7. Hill C, Guarner F, Reid G, et al. Expert consensus document. The International Scientific Association for Probiotics and Prebiotics consensus statement on the scope and appropriate use of the term probiotic. *Nat Rev Gastroenterol Hepatol*. 2014;11(8):506–514
8. National Institutes of Health, Office of Dietary Supplements. Frequently asked questions. Regulatory information. Available at: https://ods.od.nih.gov/Health_Information/ODS_Frequently_Asked_Questions.aspx#Regulatory. Accessed October 13, 2020
9. Fenster K, Freeburg B, Hollard C, Wong C, Rønhave Laursen R, Ouwehand AC. The production and delivery of probiotics: a review of a practical approach. *Microorganisms*. 2019;7(3): 83
10. Drago L, Rodighiero V, Celeste T, Rovetto L, De Vecchi E. Microbiological evaluation of commercial probiotic products available in the USA in 2009. *J Chemother*. 2010;22(6):373–377
11. Frese SA, Hutton AA, Contreras LN, et al. Persistence of supplemented *Bifidobacterium longum* subsp. *infantis* EVC001 in breastfed infants. *mSphere*. 2017;2(6):e00501–e00517
12. Lewis ZT, Shani G, Masarweh CF, et al. Validating bifidobacterial species and subspecies identity in commercial probiotic products. *Pediatr Res*. 2016; 79(3):445–452
13. Dani C, Coviello C C, Corsini I I, Arena F, Antonelli A, Rossolini GM. Lactobacillus sepsis and probiotic therapy in newborns: two new cases and literature review. *AJP Rep*. 2016;6(1): e25–e29
14. AlFaleh K, Anabrees J. Probiotics for prevention of necrotizing enterocolitis in preterm infants. *Cochrane Database Syst Rev*. 2014;(4):CD005496
15. Hickey L, Garland SM, Jacobs SE, O'Donnell CPF, Tabrizi SN; ProPrems Study Group. Cross-colonization of infants with probiotic organisms in a neonatal unit. *J Hosp Infect*. 2014; 88(4):226–229
16. Costeloe K, Hardy P, Juszczak E, Wilks M, Millar MR; Probiotics in Preterm Infants Study Collaborative Group. Bifidobacterium breve BBG-001 in very preterm infants: a randomised controlled phase 3 trial. *Lancet*. 2016; 387(10019):649–660
17. Vallabhaneni S, Walker TA, Lockhart SR, et al.; Centers for Disease Control and Prevention (CDC). Notes from the field: fatal gastrointestinal mucormycosis in a premature infant associated with a contaminated dietary supplement–Connecticut, 2014. *MMWR Morb Mortal Wkly Rep*. 2015;64(6): 155–156
18. Hempel S, Newberry S, Ruelaz A, et al. Safety of probiotics used to reduce risk and prevent or treat disease. *Evid Rep Technol Assess (Full Rep)*. 2011;(200): 1–645
19. Abbasi J. Are probiotics money down the toilet? Or worse? *JAMA*. 2019;321(7): 633–635
20. Bafeta A, Koh M, Riveros C, Ravaud P. Harms reporting in randomized controlled trials of interventions aimed at modifying microbiota: a systematic review. *Ann Intern Med*. 2018;169(4): 240–247
21. Sawh SC, Deshpande S, Jansen S, Reynaert CJ, Jones PM. Prevention of necrotizing enterocolitis with probiotics: a systematic review and meta-analysis. *PeerJ*. 2016;4:e2429
22. Patel RM, Underwood MA. Probiotics and necrotizing enterocolitis. *Semin Pediatr Surg*. 2018;27(1):39–46
23. Bin-Nun A, Bromiker R, Wilschanski M, et al. Oral probiotics prevent necrotizing enterocolitis in very low birth weight neonates. *J Pediatr*. 2005; 147(2):192–196
24. Dani C, Biadaioli R, Bertini G, Martelli E, Rubaltelli FF. Probiotics feeding in prevention of urinary tract infection, bacterial sepsis and necrotizing enterocolitis in preterm infants. A prospective double-blind study. *Biol Neonate*. 2002;82(2):103–108
25. Lin HC, Su BH, Chen AC, et al. Oral probiotics reduce the incidence and severity of necrotizing enterocolitis in very low birth weight infants. *Pediatrics*. 2005;115(1):1–4
26. Szajewska H, van Goudoever JB. To give or not to give probiotics to preterm infants. *Am J Clin Nutr*. 2014;100(6): 1411–1412
27. Jacobs SE, Tobin JM, Opie GF, et al.; ProPrems Study Group. Probiotic effects on late-onset sepsis in very preterm infants: a randomized controlled trial. *Pediatrics*. 2013;132(6): 1055–1062
28. Chang HY, Chen JH, Chang JH, Lin HC, Lin CY, Peng CC. Multiple strains probiotics appear to be the most effective probiotics in the prevention of necrotizing enterocolitis and mortality: an updated meta-analysis. *PLoS One*. 2017;12(2):e0171579
29. van den Akker CHP, van Goudoever JB, Szajewska H, et al.; ESPGHAN Working Group for Probiotics, Prebiotics & Committee on Nutrition. Probiotics for preterm infants: a strain-specific systematic review and network meta-analysis. *J Pediatr Gastroenterol Nutr*. 2018;67(1):103–122
30. Thomas DW, Greer FR; American Academy of Pediatrics Committee on Nutrition; American Academy of Pediatrics Section on Gastroenterology, Hepatology, and Nutrition. Probiotics and prebiotics in pediatrics. *Pediatrics*. 2010;126(6):1217–1231
31. Marchand V. Using probiotics in the paediatric population. *Paediatr Child Health*. 2012;17(10):575–576
32. van den Akker CHP, van Goudoever JB, Shamir R, et al. Probiotics and preterm infants: a position paper by the European Society for Paediatric Gastroenterology Hepatology and Nutrition Committee on Nutrition and the European Society for Paediatric Gastroenterology Hepatology and Nutrition Working Group for Probiotics and Prebiotics. *J Pediatr Gastroenterol Nutr*. 2020; 70(5):664–680
33. Su GL, Ko CW, Bercik P, et al. AGA clinical practice guidelines on the role of probiotics in the management of gastrointestinal disorders. *Gastroenterology*. 2020;159(2):697–705
34. Patel RM, Kandefer S, Walsh MC, et al.; Eunice Kennedy Shriver National Institute of Child Health and Human Development Neonatal Research Network. Causes and timing of death in

extremely premature infants from 2000 through 2011. *N Engl J Med*. 2015; 372(4):331–340

35. Pell LG, Loutet MG, Roth DE, Sherman PM. Arguments against routine administration of probiotics for NEC prevention. *Curr Opin Pediatr*. 2019; 31(2):195–201
36. Underwood MA. Arguments for routine administration of probiotics for NEC prevention. *Curr Opin Pediatr*. 2019; 31(2):188–194
37. Garland SM, Jacobs SE, Tobin JM, Opie GF, Donath S; ProPrems study group. A cautionary note on instituting probiotics into routine clinical care for premature infants. *Pediatrics*. 2010;126(3):e741-NaN–e745
38. Jacobs SE, Hickey L, Donath S, et al.; ProPremsStudy Groups. Probiotics, prematurity and neurodevelopment: follow-up of a randomised trial. *BMJ Paediatr Open*. 2017;1(1):e000176

Web Services and Cloud Computing in Pediatric Care

- *Technical Report*

TECHNICAL REPORT

American Academy of Pediatrics
DEDICATED TO THE HEALTH OF ALL CHILDREN™

Web Services and Cloud Computing in Pediatric Care

Michael G. Leu, MD, MS, MHS, FAAP, FAMIA,[a] Stuart T. Weinberg, MD, FAAP, FAMIA,[b] Craig Monsen, MD, MS,[c] Christoph U. Lehmann, MD, FAAP, FACMI, FIAHSI,[d] COUNCIL ON CLINICAL INFORMATION TECHNOLOGY

Electronic health record (EHR) systems do not uniformly implement pediatric-supportive functionalities. One method of adding these capabilities across EHR platforms is to integrate Web services and Web applications that may perform decision support and store data in the cloud when the EHR platform is able to integrate Web services. Specific examples of these services are described, such as immunization clinical decision support services, consumer health resources, and bilirubin nomograms. Health care providers, EHR vendors, and developers share responsibilities in the appropriate development, integration, and use of Web services and Web applications as they relate to best practices in the areas of data security and confidentiality, technical availability, audit trails, terminology and messaging standards, compliance with the Health Insurance Portability and Accountability Act, testing, usability, and other considerations. It is desirable for health care providers to have knowledge of Web services and Web applications that can improve pediatric capabilities in their own EHRs because this will naturally inform discussions concerning EHR features and facilitate implementation and subsequent use of these capabilities by clinicians caring for children.

INTRODUCTION

The Health Information Technology for Economic and Clinical Health Act, part of the 2009 American Recovery and Reinvestment Act, helped to drive adoption of electronic health records (EHRs). This act paid incentives to eligible health care providers meeting meaningful use requirements.[1] Per the Office of the National Coordinator for Health Information Technology, 96% of hospitals and 78% of physician offices use certified EHR technology.[2,3]

Unfortunately, some EHRs used by pediatricians are still not supportive of pediatric functionalities, such as plotting growth charts or computing anthropometric percentiles, tracking adherence to well-child visits and

abstract

[a]*Departments of Pediatrics and Biomedical Informatics and Medical Education, University of Washington and Seattle Children's Hospital, Seattle, Washington;* [b]*Departments of Biomedical Informatics and Pediatrics, Vanderbilt University, Nashville, Tennessee;* [c]*Center for Informatics, Atrius Health, Auburndale, Massachusetts; and* [d]*Departments of Pediatrics, Bioinformatics, and Population and Data Sciences, University of Texas Southwestern Medical Center, Dallas, Texas*

DOI: https://doi.org/10.1542/peds.2021-052048

Address correspondence to Michael G. Leu, MD, MS, MHS.
E-mail: michael.leu@seattlechildrens.org

PEDIATRICS (ISSN Numbers: Print, 0031-4005; Online, 1098-4275).

FINANCIAL DISCLOSURE: The authors have indicated they have no financial relationships relevant to this article to disclose.

To cite: Leu MG, Weinberg ST, Monsen C, et al. Web Services and Cloud Computing in Pediatric Care. *Pediatrics.* 2021;148(1):e2021052048

immunizations, supporting weight-based dosing, or determining catch-up immunizations.[4,5] Safe pediatric medication prescribing, in particular, has been noted as an area where meaningful use has fallen short.[6,7] In addition to these fundamental pediatric EHR capabilities, additional pediatric EHR requirements that have been previously described for outpatient[8] and inpatient[9] systems have not routinely been available in the systems adopted.[10]

Web services and applications often require local customization, either by the practice or by the EHR vendor (with corresponding time lag). This report explores the technical and legal foundations when creating and integrating clinical Web services and applications for use in pediatric health care.

WEB SERVICES AND CLOUD COMPUTING: DEFINITIONS

A software service is code that can be executed within the context of another process or application.[11] The earliest software services were based on technologies such as remote procedure calls, whereby an application could communicate with another application on the same computer to process information using the other application's processing or memory space.[12]

The ability to encapsulate computer logic to be run between computer processes and applications gains a lot of power when expanded to the Internet. Web services are software services in which the calling application uses Internet protocols to access services on a different machine (or cloud of machines). Logic encapsulated in a service can be called from applications anywhere on the World Wide Web and processed by the service using the Web service's processor or memory, with results returned to the calling applications. Web services typically use standard communications protocols for information transport and structure. Some services, such as Simple Object Access Protocol (SOAP), use data exchange with Hypertext Transport Protocol, unsecured or secured (HTTP versus HTTPS), with information these days often encoded in extensible markup language (XML).[11,13,14,15]

Some Web services support the sharing of resources within the Web services using representational state transfer (REST), in which resources are accessed via uniform resource identifiers (URIs). These resources are accessed by using standard interfaces and protocols such, as GET, PUT, POST, and DELETE. When representational state transfer is used, interactions with resources require that the resources be passed explicitly through the interfaces.[16]

It is fairly common for applications to use Web services provided by a vendor (eg, Amazon Web Services, Microsoft Azure, Salesforce Customer Relationship Management) to allow the application writer to focus on the more novel parts of their application, letting the Web service platform handle the minutiae of straightforward operations (eg, data storage, databases), authentication, networking, messaging and/or e-mail, cross-platform functionality, and updating, or to encapsulate the complex processing of "big" clinical data. The concept of Web service requests that can be processed by multiple different processors and by different vendors is known more broadly as "cloud computing." Cloud computing places the maintenance and expertise related to maintaining hardware and software in the hands of the Web service vendor, reducing the customer's needs to supply the computing power.[17]

More recently, SMART (Substitutable Medical Applications, Reusable Technologies) application programming interface (API) has been defined to allow applications built atop EHRs to access EHR data in a way that is more independent of EHRs.[18] The SMART API is used to access information in the EHR, such as medications, and the resulting data, such as a decision support solution, come back in a SMART data format. EHR vendors implement the SMART API on their EHRs by mapping their internal data structures to the normalized clinical data structures that SMART is expecting. SMART applications also support an authentication standard and selected terminology standards, such as RxNorm, Logical Observation Identifiers Names and Codes (LOINC), and Systematized Nomenclature of Medicine–Clinical Terms (SNOMED CT) . SMART applications are HTML5 applications that can run within Web browsers and frames. The SMART standards include open-source libraries, a "sandbox" for application testing, and an app gallery for users.[18]

More recently, Health Level Seven defined standards for Fast Healthcare Interoperability Resources (FHIR), with implementers using this standard to support laboratory result exchanges.[19] FHIR represents clinical resource profiles as intuitive interoperable concepts, such as MedicationPrescription, which may refer to a prescriber, patient, and drug prescribed. The SMART group took these FHIR specifications (which included FHIR descriptions of about 50 clinical resource profiles with APIs for data access) and added the SMART concepts of authorization, authentication, additional SMART resource profiles, and user interface

integration, which they call SMART on FHIR.[20]

SMART resource definitions require EHR vendors to normalize their data, and early developer experiences with SMART on FHIR suggest that vendors are reluctant to adopt this technology.[20] Although FHIR does not require the data normalization, the combination of SMART on FHIR typically requires some adjustments to run on each individual vendor platform.

WHY DEVELOP WEB SERVICES AND APPLICATIONS?

Web-based services and applications are desirable because they allow for clinical logic to be developed and programmed once and then shared across many different applications and/or EHRs. The ability of developing a shareable resource only once is the major benefit of "modular programming," in which logic is encapsulated in a module instead of being repeatedly redeveloped with the potential for errors. Established technical protocols like SMART on FHIR allow for Web services to be accessed from multiple platforms.

Encapsulate Expertise

Web-based services and applications hold the promise that they may speed the implementation of computable pediatric clinical functions in EHRs. Instead of focusing resources on understanding and correctly interpreting clinical algorithms or logic, the vendors need to focus only on how to call the Web service and correctly integrate and display its results. For the vendor, the underlying logic and operation of the Web service may remain a black box. For simple Web services, such as some that provide content for discharge instructions, vendors simply call the Web service to retrieve the discharge instruction information then customize format and display for printing.[21] The encapsulation of expertise may allow medical specialty societies and organizations to serve as the clinical experts if they can provide Web services and applications that permit integration with EHRs.[22]

Ease of Maintenance

In addition to encapsulating expertise, Web services and applications simplify the maintenance of clinical logic. Web services can, for example, provide immunization forecasting based on the immunizations already given to the patient.[23] When EHR vendors integrate such a service, any Web service logic update that reflects updatd immunization recommendations from the American Academy of Pediatrics or from the Centers for Disease Control and Prevention Advisory Committee on Immunization Practices would immediately be available to users of different EHRs without any required changes to the EHR software, assuming that the interface remains preserved.

Testing Can Be Shared and Automated

Another advantage of creating Web services and applications relates to testing. Because the logic is encapsulated in one place, the Web service can be called by a small test application to ensure that it is working correctly before integrating the service with the more complex environment of EHRs. Calls to the Web service can be automated so that regression testing scenarios (eg, in the immunization example, ensuring that immunization logic for parts of the immunization schedule that were not updated still works correctly). And because the Web service is ubiquitously available on the Internet, testing efforts can be shared among multiple stakeholders in different locations instead of reliance on vendor internal testing and discovery of errors by end-user clinicians.[24]

EXAMPLES OF WEB SERVICES AND APPLICATIONS

There are abundant examples of nonmedical Web services that are used by Web sites people visit every day. Maps that are integrated into hotel or restaurant Web sites are usually externally generated and then incorporated into the site through a Web service. Calculations of latitude and longitude are externally determined to measure distances between addresses when searching for the shortest route. Centralized data from real estate listings are accessed and integrated into individual realtor Web sites. There are also Web services that support data storage and cloud computing, although these services may or may not always be secure enough in managing protected health information to comply with the Health Insurance Portability and Accountability Act (HIPAA).[25]

Clinical Web services and applications are more limited at this time. Initial experiments with encapsulated logic included independently developed solutions to improve EHR safety.[26] For example, a calculator for continuously infused medication was integrated with a vendor EHR. Web services and applications offer opportunities to catalyze the integration of pediatric-specific functionalities into EHRs. Immunization decision support could be accomplished by sending immunization data and relevant demographic and clinical data to a resource that performs an assessment and returns forecasted results. A multitude of pediatric-specific calculations, such as percentiles for pediatric hypertension assessment, could also be readily available through Web services.[27]

WHAT KINDS OF WEB SERVICES AND APPLICATIONS EXIST TODAY?

Infobuttons: Hypertext Markup Language and XML Handout Generators

One of the simplest types of Web services takes a term and uses a Web service to find out more information about that term. This type of functionality is called "Infobutton" technology because it is based on the user interface concept of being able to highlight a term then click on an "info button" or menu selection to learn more about what has been highlighted.[28]

One example of this technology is when users can send the Web service a diagnosis code in SNOMED, *International Classification of Diseases, Ninth Revision*, or *International Classification of Diseases, 10th Revision*, and an XML (or JavaScript Object Notation [JSON] or JSON with Padding [JSONP]) construct will be returned that contains patient education information for that medical condition. Services are also provided to support pharmacy and/or medication lookup by RXCUI (RxNorm concept unique identifer for the clinical drug or substance)/ NDC and laboratory test lookup by LOINC. In addition to being accessible by EHR programs.[29]

Clinical Calculators

Clinical calculators take selected patient information and use it to provide a customized report or calculation. Calculation Web services are best if they not only provide good calculations and can handle erroneous or missing inputs gracefully but also provide references and explanations for their calculation results.[30] Some examples amenable to being provided as Web services to support pediatrics may include the following:

- Fahrenheit (English) to Celsius (metric) conversion;
- length or height, weight, weight for height, and BMI percentiles, including condition-specific growth charts, such as for cerebral palsy[31] or Down syndrome[32];
- blood pressure percentiles;
- neonatal morbidity and mortality calculations for preterm infants;
- medical translation services; and
- services that take input and use natural language processing to spell check, grammar check, or correct text.

One published example of a simple pediatric Web service that can be easily integrated into an EHR relates to plotting values on a bilirubin nomogram. Such a Web service can take 3 arguments (hour of life, bilirubin level, and units) as part of a URL and return a Web page that describes the infant's risk for developing severe hyperbilirubinemia based the American Academy of Pediatrics bilirubin nomogram.[33–35]

Clinical Decision Support for Immunizations

Several Web services exist to provide clinical decision support for immunizations.[36–38] These services can be integrated into EHRs, allowing for both the forecasting of future vaccine doses and the validation of existing documented doses. The different services may have different business models and methods of integration.

SMART Applications

The SMART App Gallery lists applications for bilirubin level charting, blood pressure percentiles, rheumatology summaries (including joint homunculi), and growth charts.[39] Although these apps are likely in use at the institutions that developed them, it is unclear whether these apps are in use at other institutions.

Considerations for Web Services and Applications

The factors that both vendors and users need to consider when Web services and applications are used are similar to those to assess when practices are considering purchasing an EHR: application availability, downtime procedures, data ownership, interoperability and vocabularies, and workflow analysis and simulation. In addition, there are 2 new underappreciated areas to consider: transparency of the logic of the Web service and concerns about the ability to identify individuals from their data.[40,41]

Service and Application Availability and Downtime Procedures

Performance and uptime characteristics are critical. Delays in results from the Web service will often be perceived by end users as failures in the EHR itself. If the EHR fails or generates cryptic error messages because of a Web service failure, health care providers may become disgruntled, and it may be difficult for the practice and for the vendor to address the problem in real time because the Web service is controlled by a third party. Health care providers have the expectation that their EHRs will be available when they are needed, and some health care providers may require that these systems be available 24/7 (eg, for emergency and/or inpatient care).

Acceptable downtime for Web services is driven by the agreements between the end users (physicians or EHR vendors) and by the type of services. If the Web service provides a low risk service which can easily be done manually (eg, plotting a point on a growth chart), downtime may be more tolerable than if it performs a more mission critical operation (eg, dose range checking). It will be up to the health care

provider and his or her EHR vendor to negotiate response time to unforeseen problems with Web service providers.

Data and Storage

Clinical calculators may take a fixed set of inputs and return a fixed output. For example, a Web service can convert from English to metric units (eg, Fahrenheit to Celsius, pounds to kilograms, inches to centimeters). Although such a Web service would, in theory, not need to store any data, it could (eg, it could store what it was called with and/or administrative data included in the Web request, such as the IP address of where the request originated). Web service developers have used information passed to them to try to improve their services and to attempt to generate revenue (eg, targeted advertising through Google AdSense).

Web services and applications may save data so that in the event of interruption, they can continue from where they left off. The information may be stored in the client (EHR) application or in the application's storage. To keep track of stored information, apps may use identifiers. If identifiers use protected health information, either individually or in aggregate (eg, Social Security numbers), HIPAA may apply. Web services and applications need to validate sent data in a way that does not compromise the security of the calling application or computing environment. Hackers may attempt to exploit Web services to gain control over the process and/or memory to which Web services have access (as seen with recent events related to ransomware) or to access health information, which is of increasing value on the black market.[42] Ideally, Web services will execute within a protected address space where any failures cannot compromise the processor or memory running the Web service.

Just as a Web service must maintain integrity with inputs, EHR applications that call Web services must process returns from the Web service in a safe manner. EHR data sent to a Web service that would contain protected health information should be (1) securely transmitted between the application and the Web service; (2) managed per HIPAA rules by the Web service (as described in business associate agreements between EHR vendors, Web service or application vendors, and the clinical practice); and (3) controlled by an agreement that describes any storing of information sent to the Web service and its ownership and use.[43]

A potential additional risk of Web services using the Internet and storing data are that these separate data repositories can become compromised. If the application vendor stores data using Web services, and authentication is insufficient (as reported with the initial version of Apple iCloud, which allowed celebrity passwords to be guessed by brute force without lockouts after a certain number of failed password attempts), the data stores may be hacked, allowing access to data backed up from phones.[44]

Interoperability and Vocabularies

It is desirable to use existing data and vocabulary standards when developing Web services. Using existing standards, such as RxNorm, LOINC, SNOMED, and *International Classification of Diseases*, will allow data to be exchanged with other clinical systems, will capitalize on vendor support for these standards, and will reduce the effort required to connect to and integrate Web services.[40]

Workflow Analysis and Simulation

Consumers of different Web services and applications may vary significantly. Ideally, Web services for clinicians will be integrated in the regular workflow; for example, the Web service is available through the clinician's EHR, which autopopulates data sent to the service with the appropriate patient information. Some Web services or applications can be accessed via links to Web pages.

Transparency: "Show Your Work"

From a technical standpoint, Web services and applications constitute software code that can be used ubiquitously. End users may, by default, assume that applications have been tested and are safe. They may not have a clear understanding of how results, such as recommendations or calculated values, are achieved. All clinical software should be transparent as to the evidence applied and calculations made. Making the work transparent allows stakeholders (such as informaticians and clinician end users) to be informed when determining whether the software supports organizational goals when deciding whether to integrate the software.

Web services and applications, especially those that perform calculations, should cite references and provide transparency to algorithms used so that any recommendation can be validated and verified. Transparency will aid both users and developers. Users who disagree with the Web service's recommendation can review the underlying assumptions and rules and may be able to contact the developer and suggest changes and corrections. If improvements or corrections are needed in a Web service or application, the Web service should be reconfigured rapidly, with the anticipated time

frame communicated, to maintain clinician cooperation and engagement.[30]

Identifiability of Individuals

Health care identities are considered more valuable than simple credit card numbers and achieve higher prices on the black market. Health care identities may be used to apply for credit, to file fraudulent tax returns, or to commit Medicare and/or Medicaid fraud. Measures to protect identities are only as good as the most insecure step. Data passed to Web services should be limited to the minimum needed for execution, especially if protected health information is requested. Use of heuristics to allow patient record deduplication is recommended when possible.[45]

A simple way to determine the correct amount of information to pass to a Web service involves simulation in which the developer team examines the data being requested or sent to the Web service and reviews them in aggregate and in the context of the mission and functionality of the Web service. A Web service designed to perform Fahrenheit to Celsius conversion that is requesting patient identifiers would raise concerns and be flagged as requesting more data than required. Such analysis is critically important, especially in the case of identified data, because data in transit or stored outside of the system may potentially be more vulnerable to compromise.

Aggregating data from one source with other sources allows previously anonymous data to be identified. Even if identifying information has not been provided, an unintended consequence of sharing data with Web services and applications is the discerning of identities, especially if the data are combined with the increasing amount of public data on individuals. For example, when AOL released a list of searches that were grouped by anonymous search identifiers, the identity of one searcher was revealed just from queries.[46] When similar events occur in a health context, patients could be vulnerable not only to a lack of privacy but also to blackmail, discrimination, or other threats.

APPROPRIATE USE OF WEB SERVICES AND APPLICATIONS

To support successful implementation, the Web service interface and outputs should be clearly specified. The application must respect the data requirements of the Web service (eg, if a Web service is passing a length or height of a patient and the Web service requires that the length or height be specified in centimeters, then the calling application needs to provide the length or height in the appropriate units). The application is responsible for converting data into the format required by the Web service.

Secure Connections

The EHR application calling the Web service should transmit information via a secure, encrypted channel, especially if protected health information is involved. The EHR vendor must ensure that the Web service will handle data securely. This can be achieved by either an agreement, such as a business associates agreement, or, in exceptional cases, by reviewing source code to ensure that (1) the Web service does not store data or (2) the Web service stores data in a secure manner and in a secure location not vulnerable to compromise. Ideally, the business associates agreement will also describe what data the Web service is collecting, the ownership of data, and the permissible data uses.

Protected Environment

Currently, many EHR systems authenticate users using a username, password, and location-based authentication. EHR vendors are to determine when a Web service is accessing user data, how the Web service will be authenticated, and what access and permissions are allowed. Ideally, when Web services are authenticated, they would not authenticate through an existing user profile with potentially broad permissions, but instead, in a way that the service would have limited or no access to protected health information. This would force the Web service to work with information explicitly supplied to the service.

Web services may represent a security risk in the event that (1) the EHR application is redirected to a different Web service with ill intent or (2) the Web service itself is not robust and/or mishandles data. Therefore, the calling application must be able to manage situations in which (1) the Web service tries to perform actions within the calling application that it should not, (2) the Web service corrupts data sent to it, or (3) the Web service returns results that are not valid. EHR applications should provide a limited and protected environment in which they execute Web service code (eg, a sandbox) and the service cannot cause harm resulting in data breaches, impermissible access, or data corruption.

Performance

Applications may manage performance of Web services by multitasking when Web services are in use (running them in separate threads or processes), allowing the user to continue with his or her work while awaiting results. Alternately, the Web service could

be timed and stopped if it is taking too long.

Needs for Authentication and Auditing

Health care applications such as EHRs are held to a higher standard than consumer applications. EHRs ensure that the chain of data from entry to storage and retrieval is secure, auditable, and restricted to individuals with appropriate authorization.[43] These requirements of ensuring adequate privacy and security protections for protected health information are reinforced by meaningful use criteria.[1]

Access to and editing of patient information are often restricted by role. Inappropriate chart access may be a terminable offense. Records are to be accessed only by individuals who are authorized by policy, and access to patient charts should be audited. Web services and applications need to preserve these safeguards, including user authentication and authorization, and are not allowed to take shortcuts, such as permitting Web services or applications to use a higher level of privileges than the user.

Audits of who accessed data to determine if access was proper and legal are important. When Web services that access and/or store data are implemented, this access must be recognizably recorded for auditing purposes so that practices can determine if data compromise is a result of data stored by Web services or a breach of security at the practice.

Testing

Web services will generate clinical recommendations to clinicians. It is imperative that a Web service delivers what is advertised and expected by the user. Preferable testing approaches would include automatic testing and logging of returned results compared with the expected results for all possible inputs to the Web service. For example, if a Web service input is three-dimensional (age, sex, laboratory value), testing scripts should cover every possible combination of each input parameter or, at a minimum, the most common use cases. Direct usability testing with users, ideally before roll out to inform training efforts, is desirable before any software releases.

Versions and Maintenance

As clinical knowledge grows, Web services will require updates and modifications. Other reasons to update a Web service include functionality enhancements, bug fixes, and safety and security enhancements.

Versioning (keeping track of modifications and their implementation) that includes the output created by the Web service is critical. Health care providers are required to practice the standard of care, which develops and changes over time. For medical-legal reasons, it is critical to be able to have a discovery process recreate the output of a Web service at a previous date to demonstrate the adherence to the standards of care at that time. Web services and applications should provide version information, and client software, such as EHRs, should capture this information so that practices can audit and reconstruct which data and rules were being used at different points in time.

With any Web service update, developers are required to provide documentation to prepare users for functionality or output modifications. Web service and application vendors will supply predocumentation of upcoming releases to allow end users to learn about future anticipated behavior of the Web service or application. Ideally, practices and EHR vendors will be allowed to accept or decline the updates. Release dates (and, if applicable, anticipated expiration dates) are obtained to support communication to users.

If an owner of a Web service or application is not willing or able to maintain and update his or her software in response to new knowledge or technology or security issues, the Web service should be explicit about this or should be retired for use.

FUTURE WEB SERVICES

More sophisticated Web services may return XML outputs that the invoking application can then interpret and/or display. For example, a Google Web service takes a text string representing a location and returns XML that represents that location on a map. A Web service that takes information such as sex, age, and weight could plot those weights and return a personalized growth chart[43,47] that would include likely interpretations for the growth chart (eg, consistent with failure to thrive versus consistent with hypothyroidism). A Web service could take a collection of addresses in a neighborhood of patients exposed to a toxin or infectious disease and return a geographical map with the specified locations highlighted.[48]

CONCLUSIONS

Web services and cloud computing in health care are near the “peak of inflated expectations” on the hype cycle,[49] in which many small prototype applications exist that have not been broadly adopted because of underlying infrastructure issues, lack of integration with clinical workflows, and/or lack of perceived impact for cost to integrate. Given the rapid speed at which this field is developing, more Web-based services than are referenced in this document will be

developed and marketed to clinicians in practice; thus, this report constitutes some illustrative examples only. It will be important to identify and prioritize needed Web services for the support of pediatrics to facilitate the development of these Web services, to help disseminate these services through either endorsement or integration with implementation tool kits, and to keep these concepts in mind when pediatricians and pediatric practices decide whether to put new Web services into practice.

LEAD AUTHORS

Michael G. Leu, MD, MS, MHS, FAAP, FAMIA
Stuart T. Weinberg, MD, FAAP, FAMIA
Craig Monsen, MD, MS
Christoph U. Lehmann, MD, FAAP, FACMI, FIAHSI

COUNCIL ON CLINICAL INFORMATION TECHNOLOGY EXECUTIVE COMMITTEE, 2018–2020

Emily Chui Webber, MD, FAAP, Chairperson
Gregg M. Alexander, DO
Eric L. Beyer, MD, FAAP
Sandy Lee Chung, MD, FAAP
Kevin Dufendach, MD, MS, FAAP
Alexander M. Hamling, MD, MBA, FAAP
Marvin B. Harper, MD, FAAP
Eric S. Kirkendall, MD, MBI, FAAP
Eli M. Lourie, MD, MBI, FAAP, FAMIA Ann M. Mann, MD, FAAP
Stephen J. Morgan, MD, FAAP
Heather C. O'Donnell, MD, FAAP Reza Sadeghian, MD, MBA, MSc, FAAP
Eric Shelov, MD, MBI, FAAP

Srinivasan Suresh, MD, MBA, FAAP
Andrew M. Wiesenthal, MD, SM, FAAP
Jeffrey A. Wright, MD, FAAP
Stuart T. Weinberg, MD, FAAP, FAMIA – *Immediate Past Chairperson*

LIAISONS

Dale C. Alverson, MD, FAAP – *Section on Telehealth Care*
Francis Dick-Wai Chan, MD, FAAP – *Section on Advances in Therapeutics and Technology*
Han Yu (Stephanie) Liou, MD – *Section on Pediatric Trainees*
Melissa S. Van Cain, MD, FAAP – *Section on Pediatric Trainees*

STAFF

Lisa Krams, MAHS

ACKNOWLEDGMENT

We thank Alan E. Zuckerman, MD, FAAP, for his contributions to the technical report.

ABBREVIATIONS

API: application programming interface
EHR: electronic health record
FHIR: Fast Healthcare Interoperability Resources
HIPAA: Health Insurance Portability and Accountability Act
JSON: JavaScript Object Notation
JSONP: JSON with Padding
LOINC: Logical Observation Identifiers Names and Codes
SMART: Substitutable Medical Applications and Reusable Technologies
SNOMED CT: Systematized Nomenclature of Medicine – Clinical Terms
XML: extensible markup language

FUNDING: No external funding.

POTENTIAL CONFLICT OF INTEREST: Dr Lehmann has a board of directors relationship with the International Medical Informatics Association and an editor-in-chief relationship with *Applied Clinical Informatics*; and Drs Leu, Weinberg, and Monsen have indicated they have no potential conflicts of interest to disclose.

REFERENCES

1. Centers for Medicare and Medicaid Services. Medicare and Medicaid promoting interoperability program basics. Available at: https://www.cms.gov/Regulations-and-Guidance/Legislation/EHRIncentivePrograms/Basics.html. Accessed August 19, 2016
2. Henry J, Pylypchuk Y, Searcy T, Patel V. Adoption of electronic health record systems among U.S. non-federal acute care hospitals: 2008-2015. 2016. Available at: http://dashboard.healthit.gov/evaluations/data-briefs/non-federal-acute-care-hospital-ehr-adoption-2008-2015.php. Accessed August 19, 2016
3. Jamoom E, Yang N. Table of electronic health record adoption and use among office-based physicians in the U.S., by state: 2015 National Electronic Health Records Survey. 2016. Available at: www.cdc.gov/nchs/data/ahcd/nehrs/2015_nehrs_web_table.pdf. Accessed August 19, 2016
4. Lehmann CU, O'Connor KG, Shorte VA, Johnson TD. Use of electronic health record systems by office-based pediatricians. *Pediatrics*. 2015;135(1). Available at: www.pediatrics.org/cgi/content/full/135/1/e7
5. Leu MG, O'Connor KG, Marshall R, Price DT, Klein JD. Pediatricians' use of health information technology: a national survey. *Pediatrics*. 2012;130(6). Available at: www.pediatrics.org/cgi/content/full/130/6/e1441
6. Slight SP, Berner ES, Galanter W, et al. Meaningful use of electronic health records: experiences from the field and future opportunities. [published correction appears in JMIR Med Inform. 2015;3(3):e32].

7. Dufendach KR, Eichenberger JA, McPheeters ML, et al. *Core Functionality in Pediatric Electronic Health Records*. Rockville, MD: Agency for Healthcare Research and Quality; 2015. Available at https://www.ncbi.nlm.nih.gov/books/NBK293626/. Accessed August 19, 2016
8. Spooner SA; Council on Clinical Information Technology, American Academy of Pediatrics. Special requirements of electronic health record systems in pediatrics. *Pediatrics*. 2007;119(3):631–637
9. Lehmann CU; Council on Clinical Information Technology. Pediatric aspects of inpatient health information technology systems. *Pediatrics*. 2015;135(3). Available at: www.pediatrics.org/cgi/content/full/135/3/e756
10. Spooner SA. We are still waiting for fully supportive electronic health records in pediatrics. [published correction appears in Pediatrics. 2013;131(5):1013]. *Pediatrics*. 2012;130(6). Available at: www.pediatrics.org/cgi/content/full/130/6/e1674
11. WROX Press. Programmer to programmer. Available at: p2p.wrox.com. Accessed May 27, 2019
12. Microsoft. Remote Procedure Call. Updated April 8, 2010. Available at: https://docs.microsoft.com/en-us/previous-versions/ms950395 (v=msdn.10). Accessed June 1, 2021
13. Microsoft. Web services specifications index page. Available at: https://msdn.microsoft.com/en-us/library/ms951274.aspx. Accessed August 19, 2016
14. Loya SR, Kawamoto K, Chatwin C, Huser V. Service oriented architecture for clinical decision support: a systematic review and future directions. *J Med Syst*. 2014;38(12):140
15. Rodriguez-Loya S, Aziz A, Chatwin C. A service oriented approach for guidelines-based clinical decision support using BPMN. *Stud Health Technol Inform*. 2014;205:43–47
16. IBM DeveloperWorks. RESTful web services. The basics. Available at: https://developer.ibm.com/technologies/web-development/articles/ws-restful/. Accessed August 19, 2016
17. Amazon Web Services. What is cloud computing? Available at: https://aws.amazon.com/what-is-cloud-computing/. Accessed February 5, 2018
18. Mandl KD, Mandel JC, Murphy SN, et al. The SMART platform: early experience enabling substitutable applications for electronic health records. *J Am Med Inform Assoc*. 2012;19(4):597–603
19. HL7.org. FHIR overview. Available at: https://www.hl7.org/fhir/overview.html. Accessed February 5, 2018
20. Mandel JC, Kreda DA, Mandl KD, Kohane IS, Ramoni RB. SMART on FHIR: a standards-based, interoperable apps platform for electronic health records. *J Am Med Inform Assoc*. 2016;23(5):899–908
21. Burgess S, Dennis S, Lanka S, Miller N, Potvin J. MedlinePlus Connect: linking health IT systems to consumer health information. *IT Prof*. 2012;14(3):22–28
22. Paterno MD, Maviglia SM, Ramelson HZ, et al. Creating shareable decision support services: an interdisciplinary challenge. *AMIA Annu Symp Proc*. 2010;2010:602–606
23. Nakamura MM, Simons WW, Samuels R, Daniel J, Mandl KD. Service-oriented architecture for pediatric immunization decision support. *AMIA Annu Symp Proc*. 2007:1056
24. DZone/Integration Zone. 12 great web service testing tools. Available at: https://dzone.com/articles/12-great-web-service-testing-tools. Accessed August 19, 2016
25. Amazon Web Service. Architecting for HIPAA in the cloud. Available at: https://aws.amazon.com/health/providers-and-insurers/hipaa/. Accessed February 5, 2018
26. Lehmann CU, Kim GR, Gujral R, Veltri MA, Clark JS, Miller MR. Decreasing errors in pediatric continuous intravenous infusions. *Pediatr Crit Care Med*. 2006;7(3):225–230
27. SMART App Gallery. BP centiles v1 (open source). Available at: https://apps.smarthealthit.org/app/bp-centiles-v2. Accessed May 27, 2019
28. HL7 International. HL7 Version 3 Standard: Context Aware Knowledge Retrieval Application ("Infobutton"), Knowledge Request, Release. Available at: www.hl7.org/implement/standards/product_brief.cfm?product_id=208. Accessed February 5, 2018
29. US National Library of Medicine. MedlinePlus Connect Web Application Demonstration. Available at: https://connect.medlineplus.gov/demo/application
30. Leu MG, Holston AM. Online clinical calculators abound, but few useful for pediatrics. *AAP News*. 2010;31(2):30
31. Brooks J, Day S, Shavelle R, Strauss D. Low weight, morbidity, and mortality in children with cerebral palsy: new clinical growth charts. *Pediatrics*. 2011;128(2). Available at: www.pediatrics.org/cgi/content/full/128/2/e299
32. Zemel BS, Pipan M, Stallings VA, et al. Growth charts for children with Down syndrome in the United States. *Pediatrics*. 2015;136(5). Available at: www.pediatrics.org/cgi/content/full/136/5/e1204
33. BiliTool™. BiliTool EMR. Available at: https://bilitool.org/?page_id=10. Accessed August 19, 2016
34. American Academy of Pediatrics Subcommittee on Hyperbilirubinemia. Management of hyperbilirubinemia in the newborn infant 35 or more weeks of gestation. *Pediatrics*. 2004;114(1):297–316
35. Longhurst C, Turner S, Burgos AE. Development of a Web-based decision support tool to increase use of neonatal hyperbilirubinemia guidelines. *Jt Comm J Qual Patient Saf*. 2009;35(5):256–262
36. Scientific Technologies Corporation. ImmuCast - standalone forecaster and reminder/recall modules. Available at: https://stchealth.com/wp-content/uploads/2017/06/ImmuCast-SAF-and-Reminder-Recall_Apr2015.pdf. Accessed May 27, 2019
37. HLN Consulting. ICE. Available at: https://www.hln.com/services/open-source/ice/. Accessed May 27, 2019
38. Software Partners. Decision support (MDS). Available at: www.swpartners.com/products/decision-support-mds. Accessed May 27, 2019
39. SMART App Gallery. Featured apps. Available at: https://apps.smarthealthit.org/. Accessed May 27, 2019
40. Wager KA, Lee FW, Glaser JP. *Health Care Information Systems: A Practical Approach for Health Care Management*.

2nd ed. San Francisco, CA: Jossey-Bass; 2009

41. Metzger J, Fortin J; California Health-Care Foundation; First Consulting Group. Computerized physician order entry in community hospitals: lessons from the field. 2003. Available at: https://www.chcf.org/wp-content/uploads/2017/12/PDF-CPOECommHospCorrected.pdf. Accessed May 27, 2019
42. Yao M. Your electronic medical records could be worth $1000 to hackers. *Forbes*. April 14, 2017. Available at: https://www.forbes.com/sites/mariyayao/2017/04/14/your-electronic-medical-records-can-be-worth-1000-to-hackers/#6951892850cf. Accessed May 27, 2019
43. US Department of Health and Human Services Office for Civil Rights. HIPAA administrative simplification. Available at: https://www.hhs.gov/sites/default/files/hipaa-simplification-201303.pdf?language=es. Accessed May 27, 2019
44. Charlton A. iCloud accounts at risk of brute force attack as hacker exploits 'painfully obvious' password flaw. *International Business Times*. January 2, 2015. Available at: www.ibtimes.co.uk/icloud-accounts-risk-brute-force-attack-hacker-exploits-painfully-obvious-password-flaw-1481623. Accessed August 19, 2016
45. Morris G, Farnum G, Afzal S, Robinson C, Greene J, Coughlin C. Patient identification and matching final report. Available at: https://www.healthit.gov/sites/default/files/patient_identification_matching_final_report.pdf. Accessed May 27, 2019
46. Barbaro M, Zeller T Jr. A face is exposed for AOL searcher no. 4417749. *New York Times*. August 9, 2006. Available at: www.nytimes.com/2006/08/09/technology/09aol.html. Accessed May 27, 2019
47. SOAPware. SOAPware documentation: growth charts interface. Available at: https://soapware.screenstepslive.com/s/archive/m/new_user_manual_2011/l/24634-growth-charts-interface. Accessed May 27, 2019
48. Google Developers. Places API Overview. Available at: https://developers.google.com/places/web-service/place-id. Accessed February 5, 2018
49. Forni AA, van der Meulen R. Gartner's 2016 hype cycle for emerging technologies identifies three key trends that organizations must track to gain competitive advantage. *Gartner Newsroom*. 2016. Available at:https://www.gartner.com/en/newsroom/press-releases/2016-08-16-gartners-2016-hype-cycle-for-emerging-technologies-identifies-three-key-trends-that-organizations-must-track-to-gain-competitive-advantage. Accessed May 27, 2019

SECTION 4

Current Policies

From the American Academy of Pediatrics

(Through December 31, 2021)

- *Policy Statements*
  ORGANIZATIONAL PRINCIPLES TO GUIDE AND DEFINE THE CHILD HEALTH CARE SYSTEM AND TO IMPROVE THE HEALTH OF ALL CHILDREN

- *Clinical Reports*
  GUIDANCE FOR THE CLINICIAN IN RENDERING PEDIATRIC CARE

- *Technical Reports*
  BACKGROUND INFORMATION TO SUPPORT AMERICAN ACADEMY OF PEDIATRICS POLICY

American Academy of Pediatrics

Policy Statements, Clinical Reports, Technical Reports

Current through December 31, 2021
The companion *Pediatric Clinical Practice Guidelines & Policies* eBook
points to the full text of all titles listed herein.

2021 RECOMMENDATIONS FOR PREVENTIVE PEDIATRIC HEALTH CARE

Committee on Practice and Ambulatory Medicine and Bright Futures Periodicity Schedule Workgroup

ABSTRACT. The 2021 Recommendations for Preventive Pediatric Health Care (Periodicity Schedule) has been approved by the American Academy of Pediatrics (AAP) and represents a consensus of the AAP and the Bright Futures Periodicity Schedule Workgroup. Each child and family is unique; therefore, these recommendations are designed for the care of children who are receiving competent parenting, have no manifestations of any important health problems, and are growing and developing in a satisfactory fashion. Developmental, psychosocial, and chronic disease issues for children and adolescents may require frequent counseling and treatment visits separate from preventive care visits. Additional visits also may become necessary if circumstances suggest variations from normal. (2/21)

See full text on page 561.

https://doi.org/10.1542/peds.2020-049776

AAP DIVERSITY AND INCLUSION STATEMENT

American Academy of Pediatrics

ABSTRACT. The vision of the American Academy of Pediatrics (AAP) is that all children have optimal health and well-being and are valued by society and that AAP members practice the highest quality health care and experience professional satisfaction and personal well-being. From the founding of the AAP, pursuing this vision has included treasuring the uniqueness of each child and fostering a profession, health care system, and communities that celebrate all aspects of the diversity of each child and family. (3/18)

https://doi.org/10.1542/peds.2018-0193

ABUSIVE HEAD TRAUMA IN INFANTS AND CHILDREN

Sandeep K. Narang, MD, JD, FAAP; Amanda Fingarson, DO, FAAP; James Lukefahr, MD, FAAP; and Council on Child Abuse and Neglect

ABSTRACT. Abusive head trauma (AHT) remains a significant cause of morbidity and mortality in the pediatric population, especially in young infants. In the past decade, advancements in research have refined medical understanding of the epidemiological, clinical, biomechanical, and pathologic factors comprising the diagnosis, thereby enhancing clinical detection of a challenging diagnostic entity. Failure to recognize AHT and respond appropriately at any step in the process, from medical diagnosis to child protection and legal decision-making, can place children at risk. The American Academy of Pediatrics revises the 2009 policy statement on AHT to incorporate the growing body of knowledge on the topic. Although this statement incorporates some of that growing body of knowledge, it is not a comprehensive exposition of the science. This statement aims to provide pediatric practitioners with general guidance on a complex subject. The Academy recommends that pediatric practitioners remain vigilant for the signs and symptoms of AHT, conduct thorough medical evaluations, consult with pediatric medical subspecialists when necessary, and embrace the challenges and need for strong advocacy on the subject. (3/20)

https://doi.org/10.1542/peds.2020-0203

ACCESS TO OPTIMAL EMERGENCY CARE FOR CHILDREN

Kathleen M. Brown, MD, FAAP, FACEP; Alice D. Ackerman, MD, MBA, FAAP; Timothy K. Ruttan, MD, FACEP, FAAP; Sally K. Snow, RN, BSN, CPEN, FAEN; Committee on Pediatric Emergency Medicine (joint with American College of Emergency Physicians Pediatric Emergency Medicine Committee and Emergency Nurses Association Pediatric Committee, 2018–2019)

ABSTRACT. Every year, millions of pediatric patients seek emergency care. Significant barriers limit access to optimal emergency services for large numbers of children. The American Academy of Pediatrics, American College of Emergency Physicians, and Emergency Nurses Association have a strong commitment to identifying these barriers, working to overcome them, and encouraging, through education and system changes, improved access to emergency care for all children. (4/21)

See full text on page 565.

https://doi.org/10.1542/peds.2021-050787

ACHIEVING QUALITY HEALTH SERVICES FOR ADOLESCENTS

Committee on Adolescence

ABSTRACT. This update of the 2008 statement from the American Academy of Pediatrics redirects the discussion of quality health care from the theoretical to the practical within the medical home. This statement reviews the evolution of the medical home concept and challenges the provision of quality adolescent health care within the patient-centered medical home. Areas of attention for quality adolescent health care are reviewed, including developmentally appropriate care, confidentiality, location of adolescent care, providers who offer such care, the role of research in advancing care, and the transition to adult care. (7/16)

https://doi.org/10.1542/peds.2016-1347

ACHIEVING THE PEDIATRIC MENTAL HEALTH COMPETENCIES (TECHNICAL REPORT)

Cori M. Green, MD, MS, FAAP; Jane Meschan Foy, MD, FAAP; Marian F. Earls, MD, FAAP; Committee on Psychosocial Aspects of Child and Family Health; and Mental Health Leadership Work Group

ABSTRACT. Mental health disorders affect 1 in 5 children; however, the majority of affected children do not receive appropriate services, leading to adverse adult outcomes. To meet the needs of children, pediatricians need to take on a larger role in addressing mental health problems. The accompanying policy statement, "Mental Health Competencies for Pediatric Practice," articulates mental health competencies pediatricians could achieve to improve the mental health care of children; yet, the majority of pediatricians do not feel prepared to do so. In this technical report, we summarize current initiatives and resources that exist for trainees and practicing pediatricians across the training continuum. We also identify gaps in mental

health clinical experience and training and suggest areas in which education can be strengthened. With this report, we aim to stimulate efforts to address gaps by summarizing educational strategies that have been applied and could be applied to undergraduate medical education, residency and fellowship training, continuing medical education, maintenance of certification, and practice quality improvement activities to achieve the pediatric mental health competencies. In this report, we also articulate the research questions important to the future of pediatric mental health training and practice. (10/19)
https://doi.org/10.1542/peds.2019-2758

ADDRESSING EARLY CHILDHOOD EMOTIONAL AND BEHAVIORAL PROBLEMS

Council on Early Childhood, Committee on Psychosocial Aspects of Child and Family Health, and Section on Developmental and Behavioral Pediatrics

ABSTRACT. Emotional, behavioral, and relationship problems can develop in very young children, especially those living in high-risk families or communities. These early problems interfere with the normative activities of young children and their families and predict long-lasting problems across multiple domains. A growing evidence base demonstrates the efficacy of specific family-focused therapies in reducing the symptoms of emotional, behavioral, and relationship symptoms, with effects lasting years after the therapy has ended. Pediatricians are usually the primary health care providers for children with emotional or behavioral difficulties, and awareness of emerging research about evidence-based treatments will enhance this care. In most communities, access to these interventions is insufficient. Pediatricians can improve the care of young children with emotional, behavioral, and relationship problems by calling for the following: increased access to care; increased research identifying alternative approaches, including primary care delivery of treatments; adequate payment for pediatric providers who serve these young children; and improved education for pediatric providers about the principles of evidence-based interventions. (11/16)
https://doi.org/10.1542/peds.2016-3023

ADDRESSING EARLY CHILDHOOD EMOTIONAL AND BEHAVIORAL PROBLEMS (TECHNICAL REPORT)

Mary Margaret Gleason, MD, FAAP; Edward Goldson, MD, FAAP; Michael W. Yogman, MD, FAAP; Council on Early Childhood; Committee on Psychosocial Aspects of Child and Family Health; and Section on Developmental and Behavioral Pediatrics

ABSTRACT. More than 10% of young children experience clinically significant mental health problems, with rates of impairment and persistence comparable to those seen in older children. For many of these clinical disorders, effective treatments supported by rigorous data are available. On the other hand, rigorous support for psychopharmacologic interventions is limited to 2 large randomized controlled trials. Access to psychotherapeutic interventions is limited. The pediatrician has a critical role as the leader of the medical home to promote well-being that includes emotional, behavioral, and relationship health. To be effective in this role, pediatricians promote the use of safe and effective treatments and recognize the limitations of psychopharmacologic interventions. This technical report reviews the data supporting treatments for young children with emotional, behavioral, and relationship problems and supports the policy statement of the same name. (11/16)
https://doi.org/10.1542/peds.2016-3025

ADMISSION AND DISCHARGE GUIDELINES FOR THE PEDIATRIC PATIENT REQUIRING INTERMEDIATE CARE (CLINICAL REPORT)

Committee on Hospital Care and Section on Critical Care (joint with Society of Critical Care Medicine)

ABSTRACT. During the past 3 decades, the specialty of pediatric critical care medicine has grown rapidly, leading to a number of pediatric intensive care units opening across the country. Many patients who are admitted to the hospital require a higher level of care than routine inpatient general pediatric care, yet not to the degree of intensity of pediatric critical care; therefore, an intermediate care level has been developed in institutions providing multidisciplinary subspecialty pediatric care. These patients may require frequent monitoring of vital signs and nursing interventions, but usually they do not require invasive monitoring. The admission of the pediatric intermediate care patient is guided by physiologic parameters depending on the respective organ system involved relative to an institution's resources and capacity to care for a patient in a general care environment. This report provides admission and discharge guidelines for intermediate pediatric care. Intermediate care promotes greater flexibility in patient triage and provides a cost-effective alternative to admission to a pediatric intensive care unit. This level of care may enhance the efficiency of care and make health care more affordable for patients receiving intermediate care. (5/04, reaffirmed 2/08, 5/17, 2/20)
https://doi.org/10.1542/peds.113.5.1430

ADOLESCENT AND YOUNG ADULT TATTOOING, PIERCING, AND SCARIFICATION (CLINICAL REPORT)

Cora C. Breuner, MD, MPH; David A. Levine, MD; and Committee on Adolescence

ABSTRACT. Tattoos, piercing, and scarification are now commonplace among adolescents and young adults. This first clinical report from the American Academy of Pediatrics on voluntary body modification will review the methods used to perform the modifications. Complications resulting from body modification methods, although not common, are discussed to provide the pediatrician with management information. Body modification will be contrasted with nonsuicidal self-injury. When available, information also is presented on societal perceptions of body modification. (9/17)
https://doi.org/10.1542/peds.2017-1962

ADOLESCENT DRUG TESTING POLICIES IN SCHOOLS

Sharon Levy, MD, MPH, FAAP; Miriam Schizer, MD, MPH, FAAP; and Committee on Substance Abuse

ABSTRACT. School-based drug testing is a controversial approach to preventing substance use by students. Although school drug testing has hypothetical benefits, and studies have noted modest reductions in self-reported student drug use, the American Academy of Pediatrics opposes widespread implementation of these programs because of the lack of solid evidence for their effectiveness. (3/15)
https://doi.org/10.1542/peds.2015-0054

ADOLESCENT DRUG TESTING POLICIES IN SCHOOLS (TECHNICAL REPORT)

Sharon Levy, MD, MPH, FAAP; Miriam Schizer, MD, MPH, FAAP; and Committee on Substance Abuse

ABSTRACT. More than a decade after the US Supreme Court established the legality of school-based drug testing, these programs remain controversial, and the evidence evaluating efficacy and risks is inconclusive. The objective of this technical report is to review the relevant literature that explores the benefits, risks, and costs of these programs. (3/15)
https://doi.org/10.1542/peds.2015-0055

ADOLESCENT PREGNANCY: CURRENT TRENDS AND ISSUES (CLINICAL REPORT)

Jonathan D. Klein, MD, MPH, and Committee on Adolescence

ABSTRACT. The prevention of unintended adolescent pregnancy is an important goal of the American Academy of Pediatrics and our society. Although adolescent pregnancy and birth rates have been steadily decreasing, many adolescents still become pregnant. Since the last statement on adolescent pregnancy was issued by the Academy in 1998, efforts to prevent adolescent pregnancy have increased, and new observations, technologies, and prevention effectiveness data have emerged. The purpose of this clinical report is to review current trends and issues related to adolescent pregnancy, update practitioners on this topic, and review legal and policy implications of concern to pediatricians. (7/05)

https://doi.org/10.1542/peds.2005-0999

ADOLESCENT PREGNANCY: CURRENT TRENDS AND ISSUES—ADDENDUM

Committee on Adolescence

INTRODUCTION. The purpose of this addendum is to update pediatricians and other professionals on recent research and data regarding adolescent sexuality, contraceptive use, and childbearing since publication of the original 2005 clinical report, "Adolescent Pregnancy: Current Trends and Issues." There has been a trend of decreasing sexual activity and teen births and pregnancies since 1991, except between the years of 2005 and 2007, when there was a 5% increase in birth rates. Currently, teen birth rates in the United States are at a record low secondary to increased use of contraception at first intercourse and use of dual methods of condoms and hormonal contraception among sexually active teenagers. Despite these data, the United States continues to lead other industrialized countries in having unacceptably high rates of adolescent pregnancy, with over 700 000 pregnancies per year, the direct health consequence of unprotected intercourse. Importantly, the 2006–2010 National Survey of Family Growth (NSFG) revealed that less than one-third of 15- to 19-year-old female subjects consistently used contraceptive methods at last intercourse. (4/14)

https://doi.org/10.1542/peds.2014-0450

ADOLESCENTS AND HIV INFECTION: THE PEDIATRICIAN'S ROLE IN PROMOTING ROUTINE TESTING

Committee on Pediatric AIDS

ABSTRACT. Pediatricians can play a key role in preventing and controlling HIV infection by promoting risk-reduction counseling and offering routine HIV testing to adolescent and young adult patients. Most sexually active youth do not feel that they are at risk of contracting HIV and have never been tested. Obtaining a sexual history and creating an atmosphere that promotes nonjudgmental risk counseling is a key component of the adolescent visit. In light of increasing numbers of people with HIV/AIDS and missed opportunities for HIV testing, the Centers for Disease Control and Prevention recommends universal and routine HIV testing for all patients seen in health care settings who are 13 to 64 years of age. There are advances in diagnostics and treatment that help support this recommendation. This policy statement reviews the epidemiologic data and recommends that routine screening be offered to all adolescents at least once by 16 to 18 years of age in health care settings when the prevalence of HIV in the patient population is more than 0.1%. In areas of lower community HIV prevalence, routine HIV testing is encouraged for all sexually active adolescents and those with other risk factors for HIV. This statement addresses many of the real and perceived barriers that pediatricians face in promoting routine HIV testing for their patients. (10/11, reaffirmed 9/15)

https://doi.org/10.1542/peds.2011-1761

THE ADOLESCENT'S RIGHT TO CONFIDENTIAL CARE WHEN CONSIDERING ABORTION

Committee on Adolescence

ABSTRACT. In this statement, the American Academy of Pediatrics reaffirms its position that the rights of adolescents to confidential care when considering abortion should be protected. Adolescents should be encouraged to involve their parents and other trusted adults in decisions regarding pregnancy termination, and most do so voluntarily. The majority of states require that minors have parental consent for an abortion. However, legislation mandating parental involvement does not achieve the intended benefit of promoting family communication, and it increases the risk of harm to the adolescent by delaying access to appropriate medical care. This statement presents a summary of pertinent current information related to the benefits and risks of legislation requiring mandatory parental involvement in an adolescent's decision to obtain an abortion. (1/17)

https://doi.org/10.1542/peds.2016-3861

ADVANCED PRACTICE IN NEONATAL NURSING

Committee on Fetus and Newborn

ABSTRACT. The participation of advanced practice registered nurses in neonatal care continues to be accepted and supported by the American Academy of Pediatrics. Recognized categories of advanced practice neonatal nursing are the neonatal clinical nurse specialist and the neonatal nurse practitioner. (5/09, reaffirmed 1/14)

https://doi.org/10.1542/peds.2009-0867

ADVOCACY AND COLLABORATIVE HEALTH CARE FOR JUSTICE-INVOLVED YOUTH

Mikah C. Owen, MD, MPH, FAAP; Stephenie B. Wallace, MD, MSPH, FAAP; and Committee on Adolescence

ABSTRACT. Children and adolescents who become involved with the justice system often do so with complex medical, mental health, developmental, social, and legal needs. Most have been exposed to childhood trauma or adversity, which both contribute to their involvement with the justice system and negatively impact their health and well-being. Whether youth are held in confinement or in their home communities, pediatricians play a critical role in promoting the health and well-being of justice-involved youth. Having a working knowledge of the juvenile justice system and common issues facing justice-involved youth may help pediatricians enhance their clinical care and advocacy efforts. This policy statement is a revision of the 2011 policy "Health Care for Youth in the Juvenile Justice System." It provides an overview of the juvenile justice system, describes racial bias and overrepresentation of youth of color in the justice system, reviews the health and mental health status of justice-involved youth, and identifies advocacy opportunities for juvenile justice reform. (6/20)

https://doi.org/10.1542/peds.2020-1755

ADVOCACY FOR IMPROVING NUTRITION IN THE FIRST 1000 DAYS TO SUPPORT CHILDHOOD DEVELOPMENT AND ADULT HEALTH

Sarah Jane Schwarzenberg, MD, FAAP; Michael K. Georgieff, MD, FAAP; and Committee on Nutrition

ABSTRACT. Maternal prenatal nutrition and the child's nutrition in the first 2 years of life (1000 days) are crucial factors in a child's neurodevelopment and lifelong mental health. Child and adult health risks, including obesity, hypertension, and diabetes, may be programmed by nutritional status during this period. Calories are essential for growth of both fetus and child but are not sufficient for normal brain development. Although all nutrients are necessary for brain growth, key nutrients that support neurodevelopment include protein; zinc; iron; choline; folate; iodine; vitamins A, D, B_6, and B_{12}; and long-chain poly-

unsaturated fatty acids. Failure to provide key nutrients during this critical period of brain development may result in lifelong deficits in brain function despite subsequent nutrient repletion. Understanding the complex interplay of micro- and macronutrients and neurodevelopment is key to moving beyond simply recommending a "good diet" to optimizing nutrient delivery for the developing child. Leaders in pediatric health and policy makers must be aware of this research given its implications for public policy at the federal and state level. Pediatricians should refer to existing services for nutrition support for pregnant and breastfeeding women, infants, and toddlers. Finally, all providers caring for children can advocate for healthy diets for mothers, infants, and young children in the first 1000 days. Prioritizing public policies that ensure the provision of adequate nutrients and healthy eating during this crucial time would ensure that all children have an early foundation for optimal neurodevelopment, a key factor in long-term health. (1/18)
https://doi.org/10.1542/peds.2017-3716

ADVOCATING FOR LIFE SUPPORT TRAINING OF CHILDREN, PARENTS, CAREGIVERS, SCHOOL PERSONNEL, AND THE PUBLIC

James M. Callahan, MD, FAAP; Susan M. Fuchs, MD, FAAP; and Committee on Pediatric Emergency Medicine

ABSTRACT. Out-of-hospital cardiac arrest occurs frequently among people of all ages, including more than 6000 children annually. Pediatric cardiac arrest in the out-of-hospital setting is a stressful event for family, friends, caregivers, classmates, school personnel, and witnesses. Immediate bystander cardiopulmonary resuscitation and the use of automated external defibrillators are associated with improved survival in adults. There is some evidence in which improved survival in children who receive immediate bystander cardiopulmonary resuscitation is shown. Pediatricians, in their role as advocates to improve the health of all children, are uniquely positioned to strongly encourage the training of children, parents, caregivers, school personnel, and the lay public in the provision of basic life support, including pediatric basic life support, as well as the appropriate use of automated external defibrillators. (5/18)
https://doi.org/10.1542/peds.2018-0704

ADVOCATING FOR LIFE SUPPORT TRAINING OF CHILDREN, PARENTS, CAREGIVERS, SCHOOL PERSONNEL, AND THE PUBLIC (TECHNICAL REPORT)

Susan M. Fuchs, MD, FAAP, and Committee on Pediatric Emergency Medicine

ABSTRACT. Pediatric cardiac arrest in the out-of-hospital setting is a traumatic event for family, friends, caregivers, classmates, and school personnel. Immediate bystander cardiopulmonary resuscitation and the use of automatic external defibrillators have been shown to improve survival in adults. There is some evidence to show improved survival in children who receive immediate bystander cardiopulmonary resuscitation. Pediatricians, in their role as advocates to improve the health of all children, are uniquely positioned to strongly encourage the training of children, parents, caregivers, school personnel, and the lay public in the provision of basic life support, including pediatric basic life support, as well as the appropriate use of automated external defibrillators. (5/18)
https://doi.org/10.1542/peds.2018-0705

AGE LIMIT OF PEDIATRICS

Amy Peykoff Hardin, MD, FAAP; Jesse M. Hackell, MD, FAAP; and Committee on Practice and Ambulatory Medicine

ABSTRACT. Pediatrics is a multifaceted specialty that encompasses children's physical, psychosocial, developmental, and mental health. Pediatric care may begin periconceptionally and continues through gestation, infancy, childhood, adolescence, and young adulthood. Although adolescence and young adulthood are recognizable phases of life, an upper age limit is not easily demarcated and varies depending on the individual patient. The establishment of arbitrary age limits on pediatric care by health care providers should be discouraged. The decision to continue care with a pediatrician or pediatric medical or surgical subspecialist should be made solely by the patient (and family, when appropriate) and the physician and must take into account the physical and psychosocial needs of the patient and the abilities of the pediatric provider to meet these needs. (8/17)
https://doi.org/10.1542/peds.2017-2151

AGE TERMINOLOGY DURING THE PERINATAL PERIOD

Committee on Fetus and Newborn

ABSTRACT. Consistent definitions to describe the length of gestation and age in neonates are needed to compare neurodevelopmental, medical, and growth outcomes. The purposes of this policy statement are to review conventional definitions of age during the perinatal period and to recommend use of standard terminology including gestational age, postmenstrual age, chronological age, corrected age, adjusted age, and estimated date of delivery. (11/04, reaffirmed 10/07, 11/08, 7/14)
https://doi.org/10.1542/peds.2004-1915

ALCOHOL USE BY YOUTH

Joanna Quigley, MD, FAAP, and Committee on Substance Use and Prevention

ABSTRACT. Alcohol use continues to be problematic for youth and young adults in the United States. Understanding of neurobiology and neuroplasticity continues to highlight the potential adverse impact of underage drinking on the developing brain. This policy statement provides the position of the American Academy of Pediatrics on the issue of alcohol and is supported by an accompanying technical report. (6/19)
https://doi.org/10.1542/peds.2019-1356

ALCOHOL USE BY YOUTH (TECHNICAL REPORT)

Sheryl A. Ryan, MD, FAAP; Patricia Kokotailo, MD, MPH, FAAP; and Committee on Substance Use and Prevention

ABSTRACT. Alcohol use continues to be a major concern from preadolescence through young adulthood in the United States. Results of recent neuroscience research have helped to elucidate neurobiological models of addiction, substantiated the deleterious effects of alcohol on adolescent brain development, and added additional evidence to support the call to prevent and reduce underage drinking. This technical report reviews the relevant literature and supports the accompanying policy statement in this issue of *Pediatrics.* (6/19)
https://doi.org/10.1542/peds.2019-1357

ALLERGY TESTING IN CHILDHOOD: USING ALLERGEN-SPECIFIC IGE TESTS (CLINICAL REPORT)

Scott H. Sicherer, MD; Robert A. Wood, MD; and Section on Allergy and Immunology

ABSTRACT. A variety of triggers can induce common pediatric allergic diseases which include asthma, allergic rhinitis, atopic dermatitis, food allergy, and anaphylaxis. Allergy testing serves to confirm an allergic trigger suspected on the basis of history. Tests for allergen-specific immunoglobulin E (IgE) are performed by in vitro assays or skin tests. The tests are excellent for identifying a sensitized state in which allergen-specific IgE is present, and may identify triggers to be eliminated and help guide immunotherapy treatment. However, a positive test result does not always equate with clinical allergy. Newer enzymatic assays based on anti-IgE antibodies have supplanted the radioallergosorbent test (RAST). This clinical report focuses on allergen-specific IgE testing, emphasizing that the medical history and

knowledge of disease characteristics are crucial for rational test selection and interpretation. (12/11)
https://doi.org/10.1542/peds.2011-2382

ALL-TERRAIN VEHICLE INJURY PREVENTION: TWO-, THREE-, AND FOUR-WHEELED UNLICENSED MOTOR VEHICLES

Committee on Injury and Poison Prevention

ABSTRACT. Since 1987, the American Academy of Pediatrics (AAP) has had a policy about the use of motorized cycles and all-terrain vehicles (ATVs) by children. The purpose of this policy statement is to update and strengthen previous policy. This statement describes the various kinds of motorized cycles and ATVs and outlines the epidemiologic characteristics of deaths and injuries related to their use by children in light of the 1987 consent decrees entered into by the US Consumer Product Safety Commission and the manufacturers of ATVs. Recommendations are made for public, patient, and parent education by pediatricians; equipment modifications; the use of safety equipment; and the development and improvement of safer off-road trails and responsive emergency medical systems. In addition, the AAP strengthens its recommendation for passage of legislation in all states prohibiting the use of 2- and 4-wheeled off-road vehicles by children younger than 16 years, as well as a ban on the sale of new and used 3-wheeled ATVs, with a recall of all used 3-wheeled ATVs. (6/00, reaffirmed 5/04, 1/07, 5/13, 11/19)
https://doi.org/10.1542/peds.105.6.1352

ALUMINUM EFFECTS IN INFANTS AND CHILDREN (TECHNICAL REPORT)

Mark R. Corkins, MD, FAAP, and Committee on Nutrition

ABSTRACT. Aluminum has no known biological function; however, it is a contaminant present in most foods and medications. Aluminum is excreted by the renal system, and patients with renal diseases should avoid aluminum-containing medications. Studies demonstrating long-term toxicity from the aluminum content in parenteral nutrition components led the US Food and Drug Administration to implement rules for these solutions. Large-volume ingredients were required to reduce the aluminum concentration, and small-volume components were required to be labeled with the aluminum concentration. Despite these rules, the total aluminum concentration from some components continues to be above the recommended final concentration. The concerns about toxicity from the aluminum present in infant formulas and antiperspirants have not been substantiated but require more research. Aluminum is one of the most effective adjuvants used in vaccines, and a large number of studies have documented minimal adverse effects from this use. Long-term, high-concentration exposure to aluminum has been linked in meta-analyses with the development of Alzheimer disease. (11/19)
https://doi.org/10.1542/peds.2019-3148

AMBIENT AIR POLLUTION: HEALTH HAZARDS TO CHILDREN

Heather L. Brumberg, MD, MPH, FAAP; Catherine J. Karr, MD, PhD, FAAP; and Council on Environmental Health

ABSTRACT. Ambient air pollution is produced by sources including vehicular traffic, coal-fired power plants, hydraulic fracturing, agricultural production, and forest fires. It consists of primary pollutants generated by combustion and secondary pollutants formed in the atmosphere from precursor gases. Air pollution causes and exacerbates climate change, and climate change worsens health effects of air pollution. Infants and children are uniquely sensitive to air pollution, because their organs are developing and they have higher air per body weight intake. Health effects linked to air pollution include not only exacerbations of respiratory diseases but also reduced lung function development and increased asthma incidence. Additional outcomes of concern include preterm birth, low birth weight, neurodevelopmental disorders, IQ loss, pediatric cancers, and increased risks for adult chronic diseases. These effects are mediated by oxidative stress, chronic inflammation, endocrine disruption, and genetic and epigenetic mechanisms across the life span. Natural experiments demonstrate that with initiatives such as increased use of public transportation, both air quality and community health improve. Similarly, the Clean Air Act has improved air quality, although exposure inequities persist. Other effective strategies for reducing air pollution include ending reliance on coal, oil, and gas; regulating industrial emissions; reducing exposure with attention to proximity of residences, schools, and child care facilities to traffic; and a greater awareness of the Air Quality Index. This policy reviews both short- and long-term health consequences of ambient air pollution, especially in relation to developmental exposures. It examines individual, community, and legislative strategies to mitigate air pollution. (5/21)
See full text on page 577.
https://doi.org/10.1542/peds.2021-051484

ANTENATAL COUNSELING REGARDING RESUSCITATION AND INTENSIVE CARE BEFORE 25 WEEKS OF GESTATION (CLINICAL REPORT)

James Cummings, MD, FAAP, and Committee on Fetus and Newborn

ABSTRACT. The anticipated birth of an extremely low gestational age (<25 weeks) infant presents many difficult questions, and variations in practice continue to exist. Decisions regarding care of periviable infants should ideally be well informed, ethically sound, consistent within medical teams, and consonant with the parents' wishes. Each health care institution should consider having policies and procedures for antenatal counseling in these situations. Family counseling may be aided by the use of visual materials, which should take into consideration the intellectual, cultural, and other characteristics of the family members. Although general recommendations can guide practice, each situation is unique; thus, decision-making should be individualized. In most cases, the approach should be shared decision-making with the family, guided by considering both the likelihood of death or morbidity and the parents' desires for their unborn child. If a decision is made not to resuscitate, providing comfort care, encouraging family bonding, and palliative care support are appropriate. (8/15)
https://doi.org/10.1542/peds.2015-2336

ANTERIOR CRUCIATE LIGAMENT INJURIES: DIAGNOSIS, TREATMENT, AND PREVENTION (CLINICAL REPORT)

Cynthia R. LaBella, MD, FAAP; William Hennrikus, MD, FAAP; Timothy E. Hewett, PhD, FACSM; Council on Sports Medicine and Fitness; and Section on Orthopaedics

ABSTRACT. The number of anterior cruciate ligament (ACL) injuries reported in athletes younger than 18 years has increased over the past 2 decades. Reasons for the increasing ACL injury rate include the growing number of children and adolescents participating in organized sports, intensive sports training at an earlier age, and greater rate of diagnosis because of increased awareness and greater use of advanced medical imaging. ACL injury rates are low in young children and increase sharply during puberty, especially for girls, who have higher rates of noncontact ACL injuries than boys do in similar sports. Intrinsic risk factors for ACL injury include higher BMI, subtalar joint overpronation, generalized ligamentous laxity, and decreased neuromuscular control of knee motion. ACL injuries often require surgery and/or many months of rehabilitation and substantial time lost from school and sports participation. Unfortunately, regardless of treatment, athletes with ACL injuries are up to 10 times more likely to develop degenerative arthritis of the knee. Safe and effective surgical techniques for children and adoles-

cents continue to evolve. Neuromuscular training can reduce risk of ACL injury in adolescent girls. This report outlines the current state of knowledge on epidemiology, diagnosis, treatment, and prevention of ACL injuries in children and adolescents. (4/14, reaffirmed 7/18)
https://doi.org/10.1542/peds.2014-0623

ANTIBIOTIC STEWARDSHIP IN PEDIATRICS

Jeffrey S. Gerber, MD, PhD, FAAP; Mary Anne Jackson, MD, FAAP; Pranita D. Tamma, MD, MHS; Theoklis E. Zaoutis, MD, FAAP; Committee on Infectious Diseases (joint with Pediatric Infectious Diseases Society)

ABSTRACT. Antibiotic overuse contributes to antibiotic resistance, which is a threat to public health. Antibiotic stewardship is a practice dedicated to prescribing antibiotics only when necessary and, when antibiotics are considered necessary, promoting use of the appropriate agent(s), dose, duration, and route of therapy to optimize clinical outcomes while minimizing the unintended consequences of antibiotic use. Because there are differences in common infectious conditions, drug-specific considerations, and the evidence surrounding treatment recommendations (eg, first-line therapy, duration of therapy) between children and adults, this statement provides specific guidance for the pediatric population. This policy statement discusses the rationale for inpatient and outpatient antibiotic stewardship programs; essential personnel, infrastructure, and activities required; approaches to evaluating their effectiveness; and gaps in knowledge that require further investigation. Key guidance for both inpatient and outpatient antibiotic stewardship programs are provided. (12/20)
See full text on page 593.
https://doi.org/10.1542/peds.2020-040295

THE APGAR SCORE

Committee on Fetus and Newborn (joint with American College of Obstetricians and Gynecologists Committee on Obstetric Practice)

ABSTRACT. The Apgar score provides an accepted and convenient method for reporting the status of the newborn infant immediately after birth and the response to resuscitation if needed. The Apgar score alone cannot be considered as evidence of, or a consequence of, asphyxia; does not predict individual neonatal mortality or neurologic outcome; and should not be used for that purpose. An Apgar score assigned during resuscitation is not equivalent to a score assigned to a spontaneously breathing infant. The American Academy of Pediatrics and the American College of Obstetricians and Gynecologists encourage use of an expanded Apgar score reporting form that accounts for concurrent resuscitative interventions. (9/15)
https://doi.org/10.1542/peds.2015-2651

APNEA OF PREMATURITY (CLINICAL REPORT)

Eric C. Eichenwald, MD, FAAP, and Committee on Fetus and Newborn

ABSTRACT. Apnea of prematurity is one of the most common diagnoses in the NICU. Despite the frequency of apnea of prematurity, it is unknown whether recurrent apnea, bradycardia, and hypoxemia in preterm infants are harmful. Research into the development of respiratory control in immature animals and preterm infants has facilitated our understanding of the pathogenesis and treatment of apnea of prematurity. However, the lack of consistent definitions, monitoring practices, and consensus about clinical significance leads to significant variation in practice. The purpose of this clinical report is to review the evidence basis for the definition, epidemiology, and treatment of apnea of prematurity as well as discharge recommendations for preterm infants diagnosed with recurrent apneic events. (12/15)
https://doi.org/10.1542/peds.2015-3757

ASSESSMENT AND MANAGEMENT OF INGUINAL HERNIA IN INFANTS (CLINICAL REPORT)

Kasper S. Wang, MD; Committee on Fetus and Newborn; and Section on Surgery

ABSTRACT. Inguinal hernia repair in infants is a routine surgical procedure. However, numerous issues, including timing of the repair, the need to explore the contralateral groin, use of laparoscopy, and anesthetic approach, remain unsettled. Given the lack of compelling data, consideration should be given to large, prospective, randomized controlled trials to determine best practices for the management of inguinal hernias in infants. (9/12, reaffirmed 5/21)
https://doi.org/10.1542/peds.2012-2008

ATOPIC DERMATITIS: SKIN-DIRECTED MANAGEMENT (CLINICAL REPORT)

Megha M. Tollefson, MD; Anna L. Bruckner, MD, FAAP; and Section on Dermatology

ABSTRACT. Atopic dermatitis is a common inflammatory skin condition characterized by relapsing eczematous lesions in a typical distribution. It can be frustrating for pediatric patients, parents, and health care providers alike. The pediatrician will treat the majority of children with atopic dermatitis as many patients will not have access to a pediatric medical subspecialist, such as a pediatric dermatologist or pediatric allergist. This report provides up-to-date information regarding the disease and its impact, pathogenesis, treatment options, and potential complications. The goal of this report is to assist pediatricians with accurate and useful information that will improve the care of patients with atopic dermatitis. (11/14)
https://doi.org/10.1542/peds.2014-2812

ATTENTION-DEFICIT/HYPERACTIVITY DISORDER AND SUBSTANCE ABUSE (CLINICAL REPORT)

Elizabeth Harstad, MD, MPH, FAAP; Sharon Levy, MD, MPH, FAAP; and Committee on Substance Abuse

ABSTRACT. Attention-deficit/hyperactivity disorder (ADHD) and substance use disorders are inextricably intertwined. Children with ADHD are more likely than peers to develop substance use disorders. Treatment with stimulants may reduce the risk of substance use disorders, but stimulants are a class of medication with significant abuse and diversion potential. The objectives of this clinical report were to present practical strategies for reducing the risk of substance use disorders in patients with ADHD and suggestions for safe stimulant prescribing. (6/14, reaffirmed 10/20)
https://doi.org/10.1542/peds.2014-0992

BARRIER PROTECTION USE BY ADOLESCENTS DURING SEXUAL ACTIVITY

Laura K. Grubb, MD, MPH, FAAP, and Committee on Adolescence

ABSTRACT. Rates of sexual activity, pregnancies, and births among adolescents have continued to decline during the past decade to historic lows. Despite these positive trends, many adolescents remain at risk for unintended pregnancy and sexually transmitted infections (STIs). When used consistently and correctly, latex and synthetic barrier methods reduce the risk of many STIs, including HIV, and pregnancy. This update of the 2013 policy statement is intended to assist pediatricians in understanding and supporting the use of barrier methods by their patients to prevent unintended pregnancies and STIs and address obstacles to their use. (7/20)
https://doi.org/10.1542/peds.2020-007237

BARRIER PROTECTION USE BY ADOLESCENTS DURING SEXUAL ACTIVITY (TECHNICAL REPORT)

Laura K. Grubb, MD, MPH, FAAP, and Committee on Adolescence

ABSTRACT. Rates of sexual activity, pregnancies, and births among adolescents have continued to decline during the past decade to historic lows. Despite these positive trends, many adolescents remain at risk for unintended pregnancy and sexually transmitted infections (STIs). This technical report discusses the new data and trends in adolescent sexual behavior and barrier protection use. Since 2017, STI rates have increased and use of barrier methods, specifically external condom use, has declined among adolescents and young adults. Interventions that increase availability of or accessibility to barrier methods are most efficacious when combined with additional individual, small-group, or community-level activities that include messages about safer sex. Continued research informs public health interventions for adolescents that increase the consistent and correct use of barrier methods and promote dual protection of barrier methods for STI prevention together with other effective methods of contraception. (7/20)

https://doi.org/10.1542/peds.2020-007245

BEST PRACTICES FOR IMPROVING FLOW AND CARE OF PEDIATRIC PATIENTS IN THE EMERGENCY DEPARTMENT (TECHNICAL REPORT)

Isabel A. Barata, MD, FACEP; Kathleen M. Brown, MD, FACEP; Laura Fitzmaurice, MD, FACEP, FAAP; Elizabeth Stone Griffin, RN; Sally K. Snow, BSN, RN; and Committee on Pediatric Emergency Medicine (joint with American College of Emergency Physicians Pediatric Emergency Medicine Committee and Emergency Nurses Association Pediatric Committee)

ABSTRACT. This report provides a summary of best practices for improving flow, reducing waiting times, and improving the quality of care of pediatric patients in the emergency department. (12/14, reaffirmed 7/20)

https://doi.org/10.1542/peds.2014-3425

BICYCLE HELMETS

Committee on Injury and Poison Prevention

ABSTRACT. Bicycling remains one of the most popular recreational sports among children in America and is the leading cause of recreational sports injuries treated in emergency departments. An estimated 23 000 children younger than 21 years sustained head injuries (excluding the face) while bicycling in 1998. The bicycle helmet is a very effective device that can prevent the occurrence of up to 88% of serious brain injuries. Despite this, most children do not wear a helmet each time they ride a bicycle, and adolescents are particularly resistant to helmet use. Recently, a group of national experts and government agencies renewed the call for all bicyclists to wear helmets. This policy statement describes the role of the pediatrician in helping attain universal helmet use among children and teens for each bicycle ride. (10/01, reaffirmed 1/05, 2/08, 11/11)

https://doi.org/10.1542/peds.108.4.1030

BINGE DRINKING (CLINICAL REPORT)

Lorena Siqueira, MD, MSPH, FAAP; Vincent C. Smith, MD, MPH, FAAP; and Committee on Substance Abuse

ABSTRACT. Alcohol is the substance most frequently abused by children and adolescents in the United States, and its use is associated with the leading causes of death and serious injury at this age (ie, motor vehicle accidents, homicides, and suicides). Among youth who drink, the proportion who drink heavily is higher than among adult drinkers, increasing from approximately 50% in those 12 to 14 years of age to 72% among those 18 to 20 years of age. In this clinical report, the definition, epidemiology, and risk factors for binge drinking; the neurobiology of intoxication, blackouts, and hangovers; genetic considerations; and adverse outcomes are discussed. The report offers guidance for the pediatrician. As with any high-risk behavior, prevention plays a more important role than later intervention and has been shown to be more effective. In the pediatric office setting, it is important to ask every adolescent about alcohol use. (8/15)

https://doi.org/10.1542/peds.2015-2337

BIOLOGICS FOR ASTHMA AND ALLERGIC SKIN DISEASES IN CHILDREN (CLINICAL REPORT)

Heather Hoch De Keyser, MD, MSCS, FAAP; Bradley Chipps, MD, FAAP; Chitra Dinakar, MD, FAAP; Section on Allergy and Immunology; and Section on Pediatric Pulmonology and Sleep Medicine

ABSTRACT. An estimated 7 million children in the United States have asthma, which causes a significant health care burden and affects quality of life. The minority of these children have asthma that does not respond to Global Initiative for Asthma steps 4 and 5 care, and biological medications are recommended at this level in the 2019 Global Initiative for Asthma recommendations. In addition, biologics have been introduced into the care of children with allergic skin diseases. Omalizumab and mepolizumab are approved for children as young as 6 years, and benralizumab and dupilumab are approved for people aged ≥12 years. Reslizumab is approved only for people aged ≥18 years. These monoclonal antibodies may be added for appropriate patients when asthma or allergic skin diseases are not well controlled. Pediatricians and pediatric subspecialists should work together and be aware of the benefits and risks of these medications for their patients, as well as the practical implications of providing these options for their patients. This clinical report serves as an evaluation of the current literature on these types of medications in the treatment of children with asthma and allergic skin disease. (10/21)

See full text on page 607.

https://doi.org/10.1542/peds.2021-054270

BONE DENSITOMETRY IN CHILDREN AND ADOLESCENTS (CLINICAL REPORT)

Laura K. Bachrach, MD; Catherine M. Gordon, MD, MS; and Section on Endocrinology

ABSTRACT. Concerns about bone health and potential fragility in children and adolescents have led to a high interest in bone densitometry. Pediatric patients with genetic and acquired chronic diseases, immobility, and inadequate nutrition may fail to achieve expected gains in bone size, mass, and strength, leaving them vulnerable to fracture. In older adults, bone densitometry has been shown to predict fracture risk and reflect response to therapy. The role of densitometry in the management of children at risk of bone fragility is less clear. This clinical report summarizes current knowledge about bone densitometry in the pediatric population, including indications for its use, interpretation of results, and risks and costs. The report emphasizes updated consensus statements generated at the 2013 Pediatric Position Development Conference of the International Society of Clinical Densitometry by an international panel of bone experts. Some of these recommendations are evidence-based, whereas others reflect expert opinion, because data are sparse on many topics. The statements from this and other expert panels provide general guidance to the pediatrician, but decisions about ordering and interpreting bone densitometry still require clinical judgment. The interpretation of bone densitometry results in children differs from that in older adults. The terms "osteopenia" and "osteoporosis" based on bone densitometry findings alone should not be used in younger patients; instead, bone mineral content or density that falls >2 SDs below expected is labeled "low for age." Pediatric osteoporosis is defined by the Pediatric Position Development Conference by using 1 of the following

criteria: ≥1 vertebral fractures occurring in the absence of local disease or high-energy trauma (without or with densitometry measurements) or low bone density for age and a significant fracture history (defined as ≥2 long bone fractures before 10 years of age or ≥3 long bone fractures before 19 years of age). Ongoing research will help define the indications and best methods for assessing bone strength in children and the clinical factors that contribute to fracture risk. The Pediatric Endocrine Society affirms the educational value of this publication. (9/16)
https://doi.org/10.1542/peds.2016-2398

BOXING PARTICIPATION BY CHILDREN AND ADOLESCENTS

Council on Sports Medicine and Fitness (joint with Canadian Paediatric Society Healthy Active Living and Sports Medicine Committee)

ABSTRACT. Thousands of boys and girls younger than 19 years participate in boxing in North America. Although boxing provides benefits for participants, including exercise, self-discipline, and self-confidence, the sport of boxing encourages and rewards deliberate blows to the head and face. Participants in boxing are at risk of head, face, and neck injuries, including chronic and even fatal neurologic injuries. Concussions are one of the most common injuries that occur with boxing. Because of the risk of head and facial injuries, the American Academy of Pediatrics and the Canadian Paediatric Society oppose boxing as a sport for children and adolescents. These organizations recommend that physicians vigorously oppose boxing in youth and encourage patients to participate in alternative sports in which intentional head blows are not central to the sport. (8/11, reaffirmed 2/15, 3/20)
https://doi.org/10.1542/peds.2011-1165

BREASTFEEDING AND THE USE OF HUMAN MILK

Section on Breastfeeding

ABSTRACT. Breastfeeding and human milk are the normative standards for infant feeding and nutrition. Given the documented short- and long-term medical and neurodevelopmental advantages of breastfeeding, infant nutrition should be considered a public health issue and not only a lifestyle choice. The American Academy of Pediatrics reaffirms its recommendation of exclusive breastfeeding for about 6 months, followed by continued breastfeeding as complementary foods are introduced, with continuation of breastfeeding for 1 year or longer as mutually desired by mother and infant. Medical contraindications to breastfeeding are rare. Infant growth should be monitored with the World Health Organization (WHO) Growth Curve Standards to avoid mislabeling infants as underweight or failing to thrive. Hospital routines to encourage and support the initiation and sustaining of exclusive breastfeeding should be based on the American Academy of Pediatrics-endorsed WHO/UNICEF "Ten Steps to Successful Breastfeeding." National strategies supported by the US Surgeon General's Call to Action, the Centers for Disease Control and Prevention, and The Joint Commission are involved to facilitate breastfeeding practices in US hospitals and communities. Pediatricians play a critical role in their practices and communities as advocates of breastfeeding and thus should be knowledgeable about the health risks of not breastfeeding, the economic benefits to society of breastfeeding, and the techniques for managing and supporting the breastfeeding dyad. The "Business Case for Breastfeeding" details how mothers can maintain lactation in the workplace and the benefits to employers who facilitate this practice. (2/12)
https://doi.org/10.1542/peds.2011-3552

THE BREASTFEEDING-FRIENDLY PEDIATRIC OFFICE PRACTICE (CLINICAL REPORT)

Joan Younger Meek, MD, MS, RD, FAAP, IBCLC; Amy J. Hatcher, MD, FAAP; and Section on Breastfeeding

ABSTRACT. The landscape of breastfeeding has changed over the past several decades as more women initiate breastfeeding in the postpartum period and more hospitals are designated as Baby-Friendly Hospitals by following the evidence-based Ten Steps to Successful Breastfeeding. The number of births in such facilities has increased more than sixfold over the past decade. With more women breastfeeding and stays in the maternity facilities lasting only a few days, the vast majority of continued breastfeeding support occurs in the community. Pediatric care providers evaluate breastfeeding infants and their mothers in the office setting frequently during the first year of life. The office setting should be conducive to providing ongoing breastfeeding support. Likewise, the office practice should avoid creating barriers for breastfeeding mothers and families or unduly promoting infant formula. This clinical report aims to review practices shown to support breastfeeding that can be implemented in the outpatient setting, with the ultimate goal of increasing the duration of exclusive breastfeeding and the continuation of any breastfeeding. (4/17)
https://doi.org/10.1542/peds.2017-0647

THE BUILT ENVIRONMENT: DESIGNING COMMUNITIES TO PROMOTE PHYSICAL ACTIVITY IN CHILDREN

Committee on Environmental Health

ABSTRACT. An estimated 32% of American children are overweight, and physical inactivity contributes to this high prevalence of overweight. This policy statement highlights how the built environment of a community affects children's opportunities for physical activity. Neighborhoods and communities can provide opportunities for recreational physical activity with parks and open spaces, and policies must support this capacity. Children can engage in physical activity as a part of their daily lives, such as on their travel to school. Factors such as school location have played a significant role in the decreased rates of walking to school, and changes in policy may help to increase the number of children who are able to walk to school. Environment modification that addresses risks associated with automobile traffic is likely to be conducive to more walking and biking among children. Actions that reduce parental perception and fear of crime may promote outdoor physical activity. Policies that promote more active lifestyles among children and adolescents will enable them to achieve the recommended 60 minutes of daily physical activity. By working with community partners, pediatricians can participate in establishing communities designed for activity and health. (5/09, reaffirmed 1/13)
https://doi.org/10.1542/peds.2009-0750

CALCIUM AND VITAMIN D REQUIREMENTS OF ENTERALLY FED PRETERM INFANTS (CLINICAL REPORT)

Steven A. Abrams, MD, and Committee on Nutrition

ABSTRACT. Bone health is a critical concern in managing preterm infants. Key nutrients of importance are calcium, vitamin D, and phosphorus. Although human milk is critical for the health of preterm infants, it is low in these nutrients relative to the needs of the infants during growth. Strategies should be in place to fortify human milk for preterm infants with birth weight <1800 to 2000 g and to ensure adequate mineral intake during hospitalization and after hospital discharge. Biochemical monitoring of very low birth weight infants should be performed during their hospitalization. Vitamin D should be provided at 200 to 400 IU/day both during hospitalization and after discharge from the hospital. Infants with radiologic evidence of rickets should have efforts made to maximize calcium and phosphorus intake

by using available commercial products and, if needed, direct supplementation with these minerals. (4/13)
https://doi.org/10.1542/peds.2013-0420

CARDIOVASCULAR MONITORING AND STIMULANT DRUGS FOR ATTENTION-DEFICIT/HYPERACTIVITY DISORDER

James M. Perrin, MD; Richard A. Friedman, MD; Timothy K. Knilans, MD; Black Box Working Group; and Section on Cardiology and Cardiac Surgery

ABSTRACT. A recent American Heart Association (AHA) statement recommended electrocardiograms (ECGs) routinely for children before they start medications to treat attention-deficit/hyperactivity disorder (ADHD). The AHA statement reflected the thoughtful work of a group committed to improving the health of children with heart disease. However, the recommendation to obtain an ECG before starting medications for treating ADHD contradicts the carefully considered and evidence-based recommendations of the American Academy of Child and Adolescent Psychiatry and the American Academy of Pediatrics (AAP). These organizations have concluded that sudden cardiac death (SCD) in persons taking medications for ADHD is a very rare event, occurring at rates no higher than those in the general population of children and adolescents. Both of these groups also noted the lack of any evidence that the routine use of ECG screening before beginning medication for ADHD treatment would prevent sudden death. The AHA statement pointed out the importance of detecting silent but clinically important cardiac conditions in children and adolescents, which is a goal that the AAP shares. The primary purpose of the AHA statement is to prevent cases of SCD that may be related to stimulant medications. The recommendations of the AAP and the rationale for these recommendations are the subject of this statement. (8/08)
https://doi.org/10.1542/peds.2008-1573

CARE OF ADOLESCENT PARENTS AND THEIR CHILDREN (CLINICAL REPORT)

Makia E. Powers, MD, MPH, FAAP; Jennifer Takagishi, MD, FAAP; Committee on Adolescence; and Council on Early Childhood

ABSTRACT. Teen pregnancy and parenting remain important public health issues in the United States and around the world. A significant proportion of teen parents reside with their families of origin, which may positively or negatively affect the family structure. Teen parents, defined as those 15 to 19 years of age, are at high risk for repeat births. Pediatricians can play an important role in the care of adolescent parents and their children. This clinical report updates a previous report on the care of adolescent parents and their children and addresses clinical management specific to this population, including updates on breastfeeding, prenatal management, and adjustments to parenthood. Challenges unique to teen parents and their children are reviewed, along with suggestions for the pediatrician on models for intervention and care. (4/21)
See full text on page 621.
https://doi.org/10.1542/peds.2021-050919

THE CARE OF CHILDREN WITH CONGENITAL HEART DISEASE IN THEIR PRIMARY MEDICAL HOME

M. Regina Lantin-Hermoso, MD, FAAP, FACC; Stuart Berger, MD, FAAP; Ami B. Bhatt, MD, FACC; Julia E. Richerson, MD, FAAP; Robert Morrow, MD, FAAP; Michael D. Freed, MD, FAAP, FACC; Robert H. Beekman III, MD, FAAP, FACC; and Section on Cardiology and Cardiac Surgery

ABSTRACT. Congenital heart disease (CHD) is the most common birth anomaly. With advances in repair and palliation of these complex lesions, more and more patients are surviving and are discharged from the hospital to return to their families. Patients with CHD have complex health care needs that often must be provided for or coordinated for by the primary care provider (PCP) and medical home. This policy statement aims to provide the PCP with general guidelines for the care of the child with congenital heart defects and outlines anticipated problems, serving as a repository of current knowledge in a practical, readily accessible format. A timeline approach is used, emphasizing the role of the PCP and medical home in the management of patients with CHD in their various life stages. (10/17)
https://doi.org/10.1542/peds.2017-2607

CARE OF THE ADOLESCENT AFTER AN ACUTE SEXUAL ASSAULT (CLINICAL REPORT)

James E. Crawford-Jakubiak, MD, FAAP; Elizabeth M. Alderman, MD, FAAP, SAHM; John M. Leventhal, MD, FAAP; Committee on Child Abuse and Neglect; and Committee on Adolescence

ABSTRACT. Sexual violence is a broad term that encompasses a wide range of sexual victimizations. Since the American Academy of Pediatrics published its last policy statement on sexual assault in 2008, additional information and data have emerged about sexual violence affecting adolescents and the treatment and management of the adolescent who has been a victim of sexual assault. This report provides new information to update physicians and focuses on the acute assessment and care of adolescent victims who have experienced a recent sexual assault. Follow-up of the acute assault, as well as prevention of sexual assault, are also discussed. (2/17)
https://doi.org/10.1542/peds.2016-4243

CAREGIVER-FABRICATED ILLNESS IN A CHILD: A MANIFESTATION OF CHILD MALTREATMENT (CLINICAL REPORT)

Emalee G. Flaherty, MD, FAAP; Harriet L. MacMillan, MD; and Committee on Child Abuse and Neglect

ABSTRACT. Caregiver-fabricated illness in a child is a form of child maltreatment caused by a caregiver who falsifies and/or induces a child's illness, leading to unnecessary and potentially harmful medical investigations and/or treatment. This condition can result in significant morbidity and mortality. Although caregiver-fabricated illness in a child has been widely known as Munchausen syndrome by proxy, there is ongoing discussion about alternative names, including pediatric condition falsification, factitious disorder (illness) by proxy, child abuse in the medical setting, and medical child abuse. Because it is a relatively uncommon form of maltreatment, pediatricians need to have a high index of suspicion when faced with a persistent or recurrent illness that cannot be explained and that results in multiple medical procedures or when there are discrepancies between the history, physical examination, and health of a child. This report updates the previous clinical report "Beyond Munchausen Syndrome by Proxy: Identification and Treatment of Child Abuse in the Medical Setting." The authors discuss the need to agree on appropriate terminology, provide an update on published reports of new manifestations of fabricated medical conditions, and discuss approaches to assessment, diagnosis, and management, including how best to protect the child from further harm. (8/13, reaffirmed 8/18)
https://doi.org/10.1542/peds.2013-2045

CARING FOR AMERICAN INDIAN AND ALASKA NATIVE CHILDREN AND ADOLESCENTS

Shaquita Bell, MD, FAAP; Jason F. Deen, MD, FAAP; Molly Fuentes, MD, MS; Kelly Moore, MD, FAAP; and Committee on Native American Child Health

ABSTRACT. American Indian and Alaska Native (AI/AN) populations have substantial health inequities, and most of their disease entities begin in childhood. In addition, AI/AN

children and adolescents have excessive disease rates compared with the general pediatric population. Because of this, providers of pediatric care are in a unique position not only to attenuate disease incidence during childhood but also to improve the health status of this special population as a whole. This policy statement examines the inequitable disease burden observed in AI/AN youth, with a focus on toxic stress, mental health, and issues related to suicide and substance use disorder, risk of and exposure to injury and violence in childhood, obesity and obesity-related cardiovascular risk factors and disease, foster care, and the intersection of lesbian, gay, bisexual, transgender, queer, and Two-Spirit and AI/AN youth. Opportunities for advocacy in policy making also are presented. (3/21)

See full text on page 639.

https://doi.org/10.1542/peds.2021-050498

CHEERLEADING INJURIES: EPIDEMIOLOGY AND RECOMMENDATIONS FOR PREVENTION

Council on Sports Medicine and Fitness

ABSTRACT. Over the last 30 years, cheerleading has increased dramatically in popularity and has evolved from leading the crowd in cheers at sporting events into a competitive, year-round sport involving complex acrobatic stunts and tumbling. Consequently, cheerleading injuries have steadily increased over the years in both number and severity. Sprains and strains to the lower extremities are the most common injuries. Although the overall injury rate remains relatively low, cheerleading has accounted for approximately 66% of all catastrophic injuries in high school girl athletes over the past 25 years. Risk factors for injuries in cheerleading include higher BMI, previous injury, cheering on harder surfaces, performing stunts, and supervision by a coach with low level of training and experience. This policy statement describes the epidemiology of cheerleading injuries and provides recommendations for injury prevention. (10/12, reaffirmed 7/15, 3/21)

https://doi.org/10.1542/peds.2012-2480

CHEMICAL-BIOLOGICAL TERRORISM AND ITS IMPACT ON CHILDREN

Sarita Chung, MD, FAAP; Carl R. Baum, MD, FACMT, FAAP; Ann-Christine Nyquist, MD, MSPH, FAAP; Disaster Preparedness Advisory Council; Council on Environmental Health; and Committee on Infectious Diseases

ABSTRACT. Chemical and biological events (including infectious disease outbreaks) may affect children disproportionately, and the threat of a chemical or biological attack remains in the United States and worldwide. Although federal programs and funding support a broad range of federal initiatives for public health preparedness and response, funding at the state and local levels has been flat or is decreasing, potentially leaving communities vulnerable. Consequently, pediatricians need to prepare and be ready to care for children in their communities before, during, and after a chemical or biological event, including during long-term recovery. Some medical countermeasures for particular chemical and biological agents have not been adequately studied or approved for children. The American Academy of Pediatrics provides resources and education on disaster preparedness and response, including information on the pediatrician's role in disasters, pediatric medical countermeasures, and mental health after an event as well as individual and family preparedness. This policy statement addresses the steps that clinicians and policy makers can take to protect children and mitigate the effects of a chemical or biological attack. (1/20)

https://doi.org/10.1542/peds.2019-3749

CHEMICAL-BIOLOGICAL TERRORISM AND ITS IMPACT ON CHILDREN (TECHNICAL REPORT)

Sarita Chung, MD, FAAP; Carl R. Baum, MD, FACMT, FAAP; Ann-Christine Nyquist, MD, MSPH, FAAP; Disaster Preparedness Advisory Council; Council on Environmental Health; and Committee on Infectious Diseases

ABSTRACT. Children are potential victims of chemical or biological terrorism. In recent years, children have been victims of terrorist acts such as the chemical attacks (2017–2018) in Syria. Consequently, it is necessary to prepare for and respond to the needs of children after a chemical or biological attack. A broad range of public health initiatives have occurred since the terrorist attacks of September 11, 2001. However, in many cases, these initiatives have not ensured the protection of children. Since 2001, public health preparedness has broadened to an all-hazards approach, in which response plans for terrorism are blended with those for unintentional disasters or outbreaks (eg, natural events such as earthquakes or pandemic influenza or man-made catastrophes such as a hazardous-materials spill). In response to new principles and programs that have evolved over the last decade, this technical report supports the accompanying update of the American Academy of Pediatrics 2006 policy statement "Chemical-Biological Terrorism and its Impact on Children." The roles of the pediatrician and public health agencies continue to evolve, and only their coordinated readiness and response efforts will ensure that the medical and mental health needs of children will be met successfully. In this document, we will address chemical and biological incidents. Radiation disasters are addressed separately. (1/20)

https://doi.org/10.1542/peds.2019-3750

CHEMICAL-MANAGEMENT POLICY: PRIORITIZING CHILDREN'S HEALTH

Council on Environmental Health

ABSTRACT. The American Academy of Pediatrics recommends that chemical-management policy in the United States be revised to protect children and pregnant women and to better protect other populations. The Toxic Substance Control Act (TSCA) was passed in 1976. It is widely recognized to have been ineffective in protecting children, pregnant women, and the general population from hazardous chemicals in the marketplace. It does not take into account the special vulnerabilities of children in attempting to protect the population from chemical hazards. Its processes are so cumbersome that in its more than 30 years of existence, the TSCA has been used to regulate only 5 chemicals or chemical classes of the tens of thousands of chemicals that are in commerce. Under the TSCA, chemical companies have no responsibility to perform premarket testing or postmarket follow-up of the products that they produce; in fact, the TSCA contains disincentives for the companies to produce such data. Voluntary programs have been inadequate in resolving problems. Therefore, chemical-management policy needs to be rewritten in the United States. Manufacturers must be responsible for developing information about chemicals before marketing. The US Environmental Protection Agency must have the authority to demand additional safety data about a chemical and to limit or stop the marketing of a chemical when there is a high degree of suspicion that the chemical might be harmful to children, pregnant women, or other populations. (4/11, reaffirmed 9/16)

https://doi.org/10.1542/peds.2011-0523

CHILD ABUSE, CONFIDENTIALITY, AND THE HEALTH INSURANCE PORTABILITY AND ACCOUNTABILITY ACT

Committee on Child Abuse and Neglect

ABSTRACT. The federal Health Insurance Portability and Accountability Act (HIPAA) of 1996 has significantly affected clinical practice, particularly with regard to how patient infor-

mation is shared. HIPAA addresses the security and privacy of patient health data, ensuring that information is released appropriately with patient or guardian consent and knowledge. However, when child abuse or neglect is suspected in a clinical setting, the physician may determine that release of information without consent is necessary to ensure the health and safety of the child. This policy statement provides an overview of HIPAA regulations with regard to the role of the pediatrician in releasing or reviewing patient health information when the patient is a child who is a suspected victim of abuse or neglect. This statement is based on the most current regulations provided by the US Department of Health and Human Services and is subject to future changes and clarifications as updates are provided. (12/09, reaffirmed 1/14)
https://doi.org/10.1542/peds.2009-2864

CHILD FATALITY REVIEW

Cindy W. Christian, MD; Robert D. Sege, MD, PhD; Committee on Child Abuse and Neglect; Committee on Injury, Violence, and Poison Prevention; and Council on Community Pediatrics

ABSTRACT. Injury remains the leading cause of pediatric mortality and requires public health approaches to reduce preventable deaths. Child fatality review teams, first established to review suspicious child deaths involving abuse or neglect, have expanded toward a public health model of prevention of child fatality through systematic review of child deaths from birth through adolescence. Approximately half of all states report reviewing child deaths from all causes, and the process of fatality review has identified effective local and state prevention strategies for reducing child deaths. This expanded approach can be a powerful tool in understanding the epidemiology and preventability of child death locally, regionally, and nationally; improving accuracy of vital statistics data; and identifying public health and legislative strategies for reducing preventable child fatalities. The American Academy of Pediatrics supports the development of federal and state legislation to enhance the child fatality review process and recommends that pediatricians become involved in local and state child death reviews. (8/10, reaffirmed 5/14, 12/19)
https://doi.org/10.1542/peds.2010-2006

CHILD LIFE SERVICES

Barbara Romito, MA, CCLS; Jennifer Jewell, MD, FAAP; Meredith Jackson, MD, FAAP; Committee on Adolescence; and Association of Child Life Professionals

ABSTRACT. Child life programs are an important component of pediatric hospital-based care; they address the psychosocial concerns that accompany hospitalization and other health care experiences. Child life specialists focus on the optimal development and well-being of infants, children, adolescents, and young adults while promoting coping skills and minimizing the adverse effects of hospitalization, health care encounters, and/or other potentially stressful experiences. In collaboration with the entire health care team and family, child life specialists provide interventions that include therapeutic play, expressive modalities, and psychological preparation to facilitate coping and normalization at times and under circumstances that might otherwise prove overwhelming for the child. Play and developmentally appropriate communication are used to (1) promote optimal development, (2) educate children and families about health conditions, (3) prepare children and partner with families for medical events or procedures, (4) plan and rehearse useful coping and pain-management strategies with patients and families, (5) help children work through feelings about past or impending experiences, and (6) partner with families to establish therapeutic relationships between patients, siblings, and caregivers. Child life specialists collaborate with the entire interdisciplinary team to promote coping and enhance the overall health care experience for patients and families. (12/20)
See full text on page 653.
https://doi.org/10.1542/peds.2020-040261

CHILD PASSENGER SAFETY

Dennis R. Durbin, MD, MSCE, FAAP; Benjamin D. Hoffman, MD, FAAP; and Council on Injury, Violence, and Poison Prevention

ABSTRACT. Child passenger safety has dramatically evolved over the past decade; however, motor vehicle crashes continue to be the leading cause of death for children 4 years and older. This policy statement provides 4 evidence-based recommendations for best practices in the choice of a child restraint system to optimize safety in passenger vehicles for children from birth through adolescence: (1) rear-facing car safety seats as long as possible; (2) forward-facing car safety seats from the time they outgrow rear-facing seats for most children through at least 4 years of age; (3) belt-positioning booster seats from the time they outgrow forward-facing seats for most children through at least 8 years of age; and (4) lap and shoulder seat belts for all who have outgrown booster seats. In addition, a fifth evidence-based recommendation is for all children younger than 13 years to ride in the rear seats of vehicles. It is important to note that every transition is associated with some decrease in protection; therefore, parents should be encouraged to delay these transitions for as long as possible. These recommendations are presented in the form of an algorithm that is intended to facilitate implementation of the recommendations by pediatricians to their patients and families and should cover most situations that pediatricians will encounter in practice. The American Academy of Pediatrics urges all pediatricians to know and promote these recommendations as part of child passenger safety anticipatory guidance at every health supervision visit. (10/18)
https://doi.org/10.1542/peds.2018-2460

CHILD PASSENGER SAFETY (TECHNICAL REPORT)

Dennis R. Durbin, MD, MSCE, FAAP; Benjamin D. Hoffman, MD, FAAP; and Council on Injury, Violence, and Poison Prevention

ABSTRACT. Despite significant reductions in the number of children killed in motor vehicle crashes over the past decade, crashes continue to be the leading cause of death to children 4 years and older. Therefore, the American Academy of Pediatrics continues to recommend the inclusion of child passenger safety anticipatory guidance at every health supervision visit. This technical report provides a summary of the evidence in support of 5 recommendations for best practices to optimize safety in passenger vehicles for children from birth through adolescence that all pediatricians should know and promote in their routine practice. These recommendations are presented in the revised policy statement on child passenger safety in the form of an algorithm that is intended to facilitate their implementation by pediatricians with their patients and families. The algorithm is designed to cover the majority of situations that pediatricians will encounter in practice. In addition, a summary of evidence on a number of additional issues affecting the safety of children in motor vehicles, including the proper use and installation of child restraints, exposure to air bags, travel in pickup trucks, children left in or around vehicles, and the importance of restraint laws, is provided. Finally, this technical report provides pediatricians with a number of resources for additional information to use when providing anticipatory guidance to families. (10/18)
https://doi.org/10.1542/peds.2018-2461

CHILD SEX TRAFFICKING AND COMMERCIAL SEXUAL EXPLOITATION: HEALTH CARE NEEDS OF VICTIMS (CLINICAL REPORT)

Jordan Greenbaum, MD; James E. Crawford-Jakubiak, MD, FAAP; and Committee on Child Abuse and Neglect

ABSTRACT. Child sex trafficking and commercial sexual exploitation of children (CSEC) are major public health problems in the United States and throughout the world. Despite large numbers of American and foreign youth affected and a plethora of serious physical and mental health problems associated with CSEC, there is limited information available to pediatricians regarding the nature and scope of human trafficking and how pediatricians and other health care providers may help protect children. Knowledge of risk factors, recruitment practices, possible indicators of CSEC, and common medical and behavioral health problems experienced by victims will help pediatricians recognize potential victims and respond appropriately. As health care providers, educators, and leaders in child advocacy, pediatricians play an essential role in addressing the public health issues faced by child victims of CSEC. Their roles can include working to increase recognition of CSEC, providing direct care and anticipatory guidance related to CSEC, engaging in collaborative efforts with medical and nonmedical colleagues to provide for the complex needs of youth, and educating child-serving professionals and the public. (2/15, reaffirmed 10/20)

https://doi.org/10.1542/peds.2014-4138

THE CHILD WITNESS IN THE COURTROOM

Robert H. Pantell, MD, FAAP, and Committee on Psychosocial Aspects of Child and Family Health

ABSTRACT. Beginning in the 1980s, children have increasingly served as witnesses in the criminal, civil, and family courts; currently, >100 000 children appear in court each year. This statement updates the 1992 American Academy of Pediatrics (AAP) policy statement "The Child as a Witness" and the subsequent 1999 "The Child in Court: A Subject Review." It also builds on existing AAP policy on adverse life events affecting children and resources developed to understand and address childhood trauma. The purpose of this policy statement is to provide background information on some of the legal issues involving children testifying in court, including the accuracy and psychological impact of child testimony; to provide suggestions for how pediatricians can support patients who will testify in court; and to make recommendations for policy improvements to minimize the adverse psychological consequences for child witnesses. These recommendations are, for the most part, based on studies on the psychological and physiologic consequences of children witnessing and experiencing violence, as well as appearing in court, that have emerged since the previous AAP publications on the subject. The goal is to reduce the secondary traumatization of and long-term consequences for children providing testimony about violence they have experienced or witnessed. This statement primarily addresses children appearing in court as victims of physical or sexual abuse or as witnesses of violent acts; most of the scientific literature addresses these specific situations. It may apply, in certain situations, to children required to provide testimony in custody disputes, child welfare proceedings, or immigration court. It does not address children appearing in court as offenders or as part of juvenile justice proceedings. (2/17)

https://doi.org/10.1542/peds.2016-4008

CHILDREN, ADOLESCENTS, AND THE MEDIA

Council on Communications and Media

ABSTRACT. Media, from television to the "new media" (including cell phones, iPads, and social media), are a dominant force in children's lives. Although television is still the predominant medium for children and adolescents, new technologies are increasingly popular. The American Academy of Pediatrics continues to be concerned by evidence about the potential harmful effects of media messages and images; however, important positive and prosocial effects of media use should also be recognized. Pediatricians are encouraged to take a media history and ask 2 media questions at every well-child visit: How much recreational screen time does your child or teenager consume daily? Is there a television set or Internet-connected device in the child's bedroom? Parents are encouraged to establish a family home use plan for all media. Media influences on children and teenagers should be recognized by schools, policymakers, product advertisers, and entertainment producers. (10/13)

https://doi.org/10.1542/peds.2013-2656

CHILDREN AND ADOLESCENTS AND DIGITAL MEDIA (TECHNICAL REPORT)

Yolanda (Linda) Reid Chassiakos, MD, FAAP; Jenny Radesky, MD, FAAP; Dimitri Christakis, MD, FAAP; Megan A. Moreno, MD, MSEd, MPH, FAAP; Corinn Cross, MD, FAAP; and Council on Communications and Media

ABSTRACT. Today's children and adolescents are immersed in both traditional and new forms of digital media. Research on traditional media, such as television, has identified health concerns and negative outcomes that correlate with the duration and content of viewing. Over the past decade, the use of digital media, including interactive and social media, has grown, and research evidence suggests that these newer media offer both benefits and risks to the health of children and teenagers. Evidence-based benefits identified from the use of digital and social media include early learning, exposure to new ideas and knowledge, increased opportunities for social contact and support, and new opportunities to access health promotion messages and information. Risks of such media include negative health effects on sleep, attention, and learning; a higher incidence of obesity and depression; exposure to inaccurate, inappropriate, or unsafe content and contacts; and compromised privacy and confidentiality. This technical report reviews the literature regarding these opportunities and risks, framed around clinical questions, for children from birth to adulthood. To promote health and wellness in children and adolescents, it is important to maintain adequate physical activity, healthy nutrition, good sleep hygiene, and a nurturing social environment. A healthy Family Media Use Plan (www.healthychildren.org/MediaUsePlan) that is individualized for a specific child, teenager, or family can identify an appropriate balance between screen time/online time and other activities, set boundaries for accessing content, guide displays of personal information, encourage age-appropriate critical thinking and digital literacy, and support open family communication and implementation of consistent rules about media use. (10/16)

https://doi.org/10.1542/peds.2016-2593

CHILDREN EXPOSED TO MALTREATMENT: ASSESSMENT AND THE ROLE OF PSYCHOTROPIC MEDICATION (CLINICAL REPORT)

Brooks Keeshin, MD, FAAP; Heather C. Forkey, MD, FAAP; George Fouras, MD, DFAACAP; Harriet L. MacMillan, CM, MD, MSc, FRCPC; Council on Child Abuse and Neglect; and Council on Foster Care, Adoption, and Kinship Care (joint with American Academy of Child and Adolescent Psychiatry Committee on Child Maltreatment and Violence and Committee on Adoption and Foster Care)

ABSTRACT. Pediatricians regularly care for children who have experienced child maltreatment. Child maltreatment is a risk factor for a broad range of mental health problems. Issues specific to child maltreatment make addressing emotional and behavioral challenges among maltreated children difficult. This clinical report focuses on 2 key issues necessary for the care of maltreated children and adolescents in pediatric settings: trauma-informed

assessments and the role of pharmacotherapy in maltreated children and adolescents. Specific to assessment, current or past involvement of the child in the child welfare system can hinder obtaining necessary information or access to appropriate treatments. Furthermore, trauma-informed assessments can help identify the need for specific interventions. Finally, it is important to take both child welfare system and trauma-informed assessment approaches into account when considering the use of psychotropic agents because there are critical diagnostic and systemic issues that affect the prescribing and discontinuing of psychiatric medications among children with a history of child maltreatment. (1/20)
https://doi.org/10.1542/peds.2019-3751

CHILDREN WITH INTELLECTUAL AND DEVELOPMENTAL DISABILITIES AS ORGAN TRANSPLANTATION RECIPIENTS

Mindy B. Statter, MD, MBE; Garey Noritz, MD; Committee on Bioethics; and Council on Children With Disabilities

ABSTRACT. The demand for transplantable solid organs far exceeds the supply of deceased donor organs. Patient selection criteria are determined by individual transplant programs; given the scarcity of solid organs for transplant, allocation to those most likely to benefit takes into consideration both medical and psychosocial factors. Children with intellectual and developmental disabilities have historically been excluded as potential recipients of organ transplants. When a transplant is likely to provide significant health benefits, denying a transplant to otherwise eligible children with disabilities may constitute illegal and unjustified discrimination. Children with intellectual and developmental disabilities should not be excluded from the potential pool of recipients and should be referred for evaluation as recipients of solid organ transplants. (4/20)
https://doi.org/10.1542/peds.2020-0625

CHILDREN'S HEALTH INSURANCE PROGRAM (CHIP): ACCOMPLISHMENTS, CHALLENGES, AND POLICY RECOMMENDATIONS

Committee on Child Health Financing

ABSTRACT. Sixteen years ago, the 105th Congress, responding to the needs of 10 million children in the United States who lacked health insurance, created the State Children's Health Insurance Program (SCHIP) as part of the Balanced Budget Act of 1997. Enacted as Title XXI of the Social Security Act, the Children's Health Insurance Program (CHIP; or SCHIP as it has been known at some points) provided states with federal assistance to create programs specifically designed for children from families with incomes that exceeded Medicaid thresholds but that were insufficient to enable them to afford private health insurance. Congress provided $40 billion in block grants over 10 years for states to expand their existing Medicaid programs to cover the intended populations, to erect new stand-alone SCHIP programs for these children, or to effect some combination of both options. Congress reauthorized CHIP once in 2009 under the Children's Health Insurance Program Reauthorization Act and extended its life further within provisions of the Patient Protection and Affordable Care Act of 2010. The purpose of this statement is to review the features of CHIP as it has evolved over the 16 years of its existence; to summarize what is known about the effects that the program has had on coverage, access, health status, and disparities among participants; to identify challenges that remain with respect to insuring this group of vulnerable children, including the impact that provisions of the new Affordable Care Act will have on the issue of health insurance coverage for near-poor children after 2015; and to offer recommendations on how to expand and strengthen the national commitment to provide health insurance to all children regardless of means. (2/14, reaffirmed 8/20)
https://doi.org/10.1542/peds.2013-4059

CIRCUMCISION POLICY STATEMENT

Task Force on Circumcision

ABSTRACT. Male circumcision is a common procedure, generally performed during the newborn period in the United States. In 2007, the American Academy of Pediatrics (AAP) formed a multidisciplinary task force of AAP members and other stakeholders to evaluate the recent evidence on male circumcision and update the Academy's 1999 recommendations in this area. Evaluation of current evidence indicates that the health benefits of newborn male circumcision outweigh the risks and that the procedure's benefits justify access to this procedure for families who choose it. Specific benefits identified included prevention of urinary tract infections, penile cancer, and transmission of some sexually transmitted infections, including HIV. The American College of Obstetricians and Gynecologists has endorsed this statement. (8/12)
https://doi.org/10.1542/peds.2012-1989

CLIMATIC HEAT STRESS AND EXERCISING CHILDREN AND ADOLESCENTS

Council on Sports Medicine and Fitness and Council on School Health

ABSTRACT. Results of new research indicate that, contrary to previous thinking, youth do not have less effective thermoregulatory ability, insufficient cardiovascular capacity, or lower physical exertion tolerance compared with adults during exercise in the heat when adequate hydration is maintained. Accordingly, besides poor hydration status, the primary determinants of reduced performance and exertional heat-illness risk in youth during sports and other physical activities in a hot environment include undue physical exertion, insufficient recovery between repeated exercise bouts or closely scheduled same-day training sessions or rounds of sports competition, and inappropriately wearing clothing, uniforms, and protective equipment that play a role in excessive heat retention. Because these known contributing risk factors are modifiable, exertional heat illness is usually preventable. With appropriate preparation, modifications, and monitoring, most healthy children and adolescents can safely participate in outdoor sports and other physical activities through a wide range of challenging warm to hot climatic conditions. (8/11, reaffirmed 2/15, 11/19)
https://doi.org/10.1542/peds.2011-1664

CLINICAL CONSIDERATIONS RELATED TO THE BEHAVIORAL MANIFESTATIONS OF CHILD MALTREATMENT (CLINICAL REPORT)

Robert D. Sege, MD, PhD, FAAP; Lisa Amaya-Jackson, MD, MPH, FAACAP; Committee on Child Abuse and Neglect; and Council on Foster Care, Adoption, and Kinship Care (joint with American Academy of Child and Adolescent Psychiatry Committee on Child Maltreatment and Violence and National Center for Child Traumatic Stress)

ABSTRACT. Children who have suffered early abuse or neglect may later present with significant health and behavior problems that may persist long after the abusive or neglectful environment has been remediated. Neurobiological research suggests that early maltreatment may result in an altered psychological and physiologic response to stressful stimuli, a response that deleteriously affects the child's subsequent development. Pediatricians can assist caregivers by helping them recognize the abused or neglected child's emotional and behavioral responses associated with child maltreatment and guide them in the use of positive parenting strategies, referring the children and families to evidence-based therapeutic treatment and mobilizing available community resources. (3/17)
https://doi.org/10.1542/peds.2017-0100

CLINICAL GENETIC EVALUATION OF THE CHILD WITH MENTAL RETARDATION OR DEVELOPMENTAL DELAYS (CLINICAL REPORT)

John B. Moeschler, MD; Michael Shevell, MD; and Committee on Genetics

ABSTRACT. This clinical report describes the clinical genetic evaluation of the child with developmental delays or mental retardation. The purpose of this report is to describe the optimal clinical genetics diagnostic evaluation to assist pediatricians in providing a medical home for children with developmental delays or mental retardation and their families. The literature supports the benefit of expert clinical judgment by a consulting clinical geneticist in the diagnostic evaluation. However, it is recognized that local factors may preclude this particular option. No single approach to the diagnostic process is supported by the literature. This report addresses the diagnostic importance of clinical history, 3-generation family history, dysmorphologic examination, neurologic examination, chromosome analysis (≥650 bands), fragile X molecular genetic testing, fluorescence in situ hybridization studies for subtelomere chromosome rearrangements, molecular genetic testing for typical and atypical presentations of known syndromes, computed tomography and/or magnetic resonance brain imaging, and targeted studies for metabolic disorders. (6/06, reaffirmed 5/12)

https://doi.org/10.1542/peds.2006-1006

CLINICAL PRACTICE POLICY TO PROTECT CHILDREN FROM TOBACCO, NICOTINE, AND TOBACCO SMOKE

Section on Tobacco Control

ABSTRACT. Tobacco dependence starts in childhood. Tobacco exposure of children is common and causes illness and premature death in children and adults, with adverse effects starting in the womb. There is no safe level of tobacco smoke exposure. Pediatricians should screen for use of tobacco and other nicotine delivery devices and provide anticipatory guidance to prevent smoking initiation and reduce tobacco smoke exposure. Pediatricians need to be aware of the different nicotine delivery systems marketed and available.

Parents and caregivers are important sources of children's tobacco smoke exposure. Because tobacco dependence is a severe addiction, to protect children's health, caregiver tobacco dependence treatment should be offered or referral for treatment should be provided (such as referral to the national smoker's quitline at 1-800-QUIT-NOW). If the source of tobacco exposure cannot be eliminated, counseling about reducing exposure to children should be provided.

Health care delivery systems should facilitate the effective prevention, identification, and treatment of tobacco dependence in children and adolescents, their parents, and other caregivers. Health care facilities should protect children from tobacco smoke exposure and tobacco promotion. Tobacco dependence prevention and treatment should be part of medical education, with knowledge assessed as part of board certification examinations. (10/15, reaffirmed 6/20)

https://doi.org/10.1542/peds.2015-3108

CLINICAL TOOLS TO ASSESS ASTHMA CONTROL IN CHILDREN (CLINICAL REPORT)

Chitra Dinakar, MD, FAAP; Bradley E. Chipps, MD, FAAP; Section on Allergy and Immunology; and Section on Pediatric Pulmonology and Sleep Medicine

ABSTRACT. Asthma affects an estimated 7 million children and causes significant health care and disease burden. The most recent iteration of the National Heart, Lung and Blood Institute asthma guidelines, the Expert Panel Report 3, emphasizes the assessment and monitoring of asthma control in the management of asthma. Asthma control refers to the degree to which the manifestations of asthma are minimized by therapeutic interventions and the goals of therapy are met. Although assessment of asthma severity is used to guide initiation of therapy, monitoring of asthma control helps determine whether therapy should be maintained or adjusted. The nuances of estimation of asthma control include understanding concepts of current impairment and future risk and incorporating their measurement into clinical practice. Impairment is assessed on the basis of frequency and intensity of symptoms, variations in lung function, and limitations of daily activities. "Risk" refers to the likelihood of exacerbations, progressive loss of lung function, or adverse effects from medications. Currently available ambulatory tools to measure asthma control range are subjective measures, such as patient-reported composite asthma control score instruments or objective measures of lung function, airway hyperreactivity, and biomarkers. Because asthma control exhibits short- and long-term variability, health care providers need to be vigilant regarding the fluctuations in the factors that can create discordance between subjective and objective assessment of asthma control. Familiarity with the properties, application, and relative value of these measures will enable health care providers to choose the optimal set of measures that will adhere to national standards of care and ensure delivery of high-quality care customized to their patients. (12/16)

https://doi.org/10.1542/peds.2016-3438

COCHLEAR IMPLANTS IN CHILDREN: SURGICAL SITE INFECTIONS AND PREVENTION AND TREATMENT OF ACUTE OTITIS MEDIA AND MENINGITIS

Lorry G. Rubin, MD; Blake Papsin, MD; Committee on Infectious Diseases; and Section on Otolaryngology—Head and Neck Surgery

ABSTRACT. The use of cochlear implants is increasingly common, particularly in children younger than 3 years. Bacterial meningitis, often with associated acute otitis media, is more common in children with cochlear implants than in groups of control children. Children with profound deafness who are candidates for cochlear implants should receive all age-appropriate doses of pneumococcal conjugate and Haemophilus influenzae type b conjugate vaccines and appropriate annual immunization against influenza. In addition, starting at 24 months of age, a single dose of 23-valent pneumococcal polysaccharide vaccine should be administered. Before implant surgery, primary care providers and cochlear implant teams should ensure that immunizations are up-to-date, preferably with completion of indicated vaccines at least 2 weeks before implant surgery. Imaging of the temporal bone/inner ear should be performed before cochlear implantation in all children with congenital deafness and all patients with profound hearing impairment and a history of bacterial meningitis to identify those with inner-ear malformations/cerebrospinal fluid fistulas or ossification of the cochlea. During the initial months after cochlear implantation, the risk of complications of acute otitis media may be higher than during subsequent time periods. Therefore, it is recommended that acute otitis media diagnosed during the first 2 months after implantation be initially treated with a parenteral antibiotic (eg, ceftriaxone or cefotaxime). Episodes occurring 2 months or longer after implantation can be treated with a trial of an oral antimicrobial agent (eg, amoxicillin or amoxicillin/clavulanate at a dose of approximately 90 mg/kg per day of amoxicillin component), provided the child does not appear toxic and the implant does not have a spacer/positioner, a wedge that rests in the cochlea next to the electrodes present in certain implant models available between 1999 and 2002. "Watchful waiting" without antimicrobial therapy is inappropriate for children with implants with acute otitis media. If feasible, tympanocentesis should be performed for acute otitis media, and the material

should be sent for culture, but performance of this procedure should not result in an undue delay in initiating antimicrobial therapy. For patients with suspected meningitis, cerebrospinal fluid as well as middle-ear fluid, if present, should be sent for culture. Empiric antimicrobial therapy for meningitis occurring within 2 months of implantation should include an agent with broad activity against Gram-negative bacilli (eg, meropenem) plus vancomycin. For meningitis occurring 2 months or longer after implantation, standard empiric antimicrobial therapy for meningitis (eg, ceftriaxone plus vancomycin) is indicated. For patients with meningitis, urgent evaluation by an otolaryngologist is indicated for consideration of imaging and surgical exploration. (7/10, reaffirmed 1/18)
https://doi.org/10.1542/peds.2010-1427

CODEINE: TIME TO SAY "NO" (CLINICAL REPORT)

Joseph D. Tobias, MD, FAAP; Thomas P. Green, MD, FAAP; Charles J. Coté, MD, FAAP; Section on Anesthesiology and Pain Medicine; and Committee on Drugs

ABSTRACT. Codeine has been prescribed to pediatric patients for many decades as both an analgesic and an antitussive agent. Codeine is a prodrug with little inherent pharmacologic activity and must be metabolized in the liver into morphine, which is responsible for codeine's analgesic effects. However, there is substantial genetic variability in the activity of the responsible hepatic enzyme, *CYP2D6,* and, as a consequence, individual patient response to codeine varies from no effect to high sensitivity. Drug surveillance has documented the occurrence of unanticipated respiratory depression and death after receiving codeine in children, many of whom have been shown to be ultrarapid metabolizers. Patients with documented or suspected obstructive sleep apnea appear to be at particular risk because of opioid sensitivity, compounding the danger among rapid metabolizers in this group. Recently, various organizations and regulatory bodies, including the World Health Organization, the US Food and Drug Administration, and the European Medicines Agency, have promulgated stern warnings regarding the occurrence of adverse effects of codeine in children. These and other groups have or are considering a declaration of a contraindication for the use of codeine for children as either an analgesic or an antitussive. Additional clinical research must extend the understanding of the risks and benefits of both opioid and nonopioid alternatives for orally administered, effective agents for acute and chronic pain. (9/16)
https://doi.org/10.1542/peds.2016-2396

COLLABORATIVE CARE IN THE IDENTIFICATION AND MANAGEMENT OF PSYCHOSIS IN ADOLESCENTS AND YOUNG ADULTS (CLINICAL REPORT)

Liwei L. Hua, MD, PhD, and Committee on Adolescence

ABSTRACT. Pediatricians are often the first physicians to encounter adolescents and young adults presenting with psychotic symptoms. Although pediatricians would ideally be able to refer these patients immediately into psychiatric care, the shortage of child and adolescent psychiatry services may sometimes require pediatricians to make an initial assessment or continue care after recommendations are made by a specialist. Knowing how to identify and further evaluate these symptoms in pediatric patients and how to collaborate with and refer to specialty care is critical in helping to minimize the duration of untreated psychosis and to optimize outcomes. Because not all patients presenting with psychotic-like symptoms will convert to a psychotic disorder, pediatricians should avoid prematurely assigning a diagnosis when possible. Other contributing factors, such as co-occurring substance abuse or trauma, should also be considered. This clinical report describes psychotic and psychotic-like symptoms in the pediatric age group as well as etiology, risk factors, and recommendations for pediatricians, who may be among the first health care providers to identify youth at risk. (5/21)
See full text on page 665.
https://doi.org/10.1542/peds.2021-051486

COLLABORATIVE ROLE OF THE PEDIATRICIAN IN THE DIAGNOSIS AND MANAGEMENT OF BIPOLAR DISORDER IN ADOLESCENTS (CLINICAL REPORT)

Benjamin N. Shain, MD, PhD, and Committee on Adolescence

ABSTRACT. Despite the complexity of diagnosis and management, pediatricians have an important collaborative role in referring and partnering in the management of adolescents with bipolar disorder. This report presents the classification of bipolar disorder as well as interviewing and diagnostic guidelines. Treatment options are described, particularly focusing on medication management and rationale for the common practice of multiple, simultaneous medications. Medication adverse effects may be problematic and better managed with collaboration between mental health professionals and pediatricians. Case examples illustrate a number of common diagnostic and management issues. (11/12)
https://doi.org/10.1542/peds.2012-2756

COMMUNICATING WITH CHILDREN AND FAMILIES: FROM EVERYDAY INTERACTIONS TO SKILL IN CONVEYING DISTRESSING INFORMATION (TECHNICAL REPORT)

Marcia Levetown, MD, and Committee on Bioethics

ABSTRACT. Health care communication is a skill that is critical to safe and effective medical practice; it can and must be taught. Communication skill influences patient disclosure, treatment adherence and outcome, adaptation to illness, and bereavement. This article provides a review of the evidence regarding clinical communication in the pediatric setting, covering the spectrum from outpatient primary care consultation to death notification, and provides practical suggestions to improve communication with patients and families, enabling more effective, efficient, and empathic pediatric health care. (5/08, reaffirmed 12/16)
https://doi.org/10.1542/peds.2008-0565

COMMUNITY PEDIATRICS: NAVIGATING THE INTERSECTION OF MEDICINE, PUBLIC HEALTH, AND SOCIAL DETERMINANTS OF CHILDREN'S HEALTH

Council on Community Pediatrics

ABSTRACT. This policy statement provides a framework for the pediatrician's role in promoting the health and well-being of all children in the context of their families and communities. It offers pediatricians a definition of community pediatrics, emphasizes the importance of recognizing social determinants of health, and delineates the need to partner with public health to address population-based child health issues. It also recognizes the importance of pediatric involvement in child advocacy at local, state, and federal levels to ensure all children have access to a high-quality medical home and to eliminate child health disparities. This statement provides a set of specific recommendations that underscore the critical nature of this dimension of pediatric practice, teaching, and research. (2/13, reaffirmed 10/16)
https://doi.org/10.1542/peds.2012-3933

COMPREHENSIVE EVALUATION OF THE CHILD WITH INTELLECTUAL DISABILITY OR GLOBAL DEVELOPMENTAL DELAYS (CLINICAL REPORT)

John B. Moeschler, MD, MS, FAAP, FACMG; Michael Shevell, MDCM, FRCP; and Committee on Genetics

ABSTRACT. Global developmental delay and intellectual disability are relatively common pediatric conditions. This report describes the recommended clinical genetics diagnostic approach. The report is based on a review of published reports, most consisting of medium to large case series of diagnostic tests

used, and the proportion of those that led to a diagnosis in such patients. Chromosome microarray is designated as a first-line test and replaces the standard karyotype and fluorescent in situ hybridization subtelomere tests for the child with intellectual disability of unknown etiology. Fragile X testing remains an important first-line test. The importance of considering testing for inborn errors of metabolism in this population is supported by a recent systematic review of the literature and several case series recently published. The role of brain MRI remains important in certain patients. There is also a discussion of the emerging literature on the use of whole-exome sequencing as a diagnostic test in this population. Finally, the importance of intentional comanagement among families, the medical home, and the clinical genetics specialty clinic is discussed. (8/14, reaffirmed 10/19)
https://doi.org/10.1542/peds.2014-1839

COMPREHENSIVE HEALTH EVALUATION OF THE NEWLY ADOPTED CHILD (CLINICAL REPORT)

Veronnie Faye Jones, MD, PhD, MSPH, FAAP; Elaine E. Schulte, MD, MPH, FAAP; and Council on Foster Care, Adoption, and Kinship Care

ABSTRACT. Children who join families through the process of adoption, whether through a domestic or international route, often have multiple health care needs. Pediatricians and other health care personnel are in a unique position to guide families in achieving optimal health for the adopted children as families establish a medical home. Shortly after placement in an adoptive home, it is recommended that children have a timely comprehensive health evaluation to provide care for known medical needs and identify health issues that are unknown. It is important to begin this evaluation with a review of all available medical records and pertinent verbal history. A complete physical examination then follows. The evaluation should also include diagnostic testing based on findings from the history and physical examination as well as the risks presented by the child's previous living conditions. Age-appropriate screenings may include, but are not limited to, newborn screening panels and hearing, vision, dental, and formal behavioral and/or developmental screenings. The comprehensive assessment may occur at the time of the initial visit to the physician after adoptive placement or can take place over several visits. Adopted children can be referred to other medical specialists as deemed appropriate. The Council on Adoption, Foster Care, and Kinship Care is a resource within the American Academy of Pediatrics for physicians providing care for children who are being adopted. (4/19)
https://doi.org/10.1542/peds.2019-0657

CONFLICTS BETWEEN RELIGIOUS OR SPIRITUAL BELIEFS AND PEDIATRIC CARE: INFORMED REFUSAL, EXEMPTIONS, AND PUBLIC FUNDING

Committee on Bioethics

ABSTRACT. Although respect for parents' decision-making authority is an important principle, pediatricians should report suspected cases of medical neglect, and the state should, at times, intervene to require medical treatment of children. Some parents' reasons for refusing medical treatment are based on their religious or spiritual beliefs. In cases in which treatment is likely to prevent death or serious disability or relieve severe pain, children's health and future autonomy should be protected. Because religious exemptions to child abuse and neglect laws do not equally protect all children and may harm some children by causing confusion about the duty to provide medical treatment, these exemptions should be repealed. Furthermore, public health care funds should not cover alternative unproven religious or spiritual healing practices. Such payments may inappropriately legitimize these practices as appropriate medical treatment. (10/13, reaffirmed 12/16, 11/17)
https://doi.org/10.1542/peds.2013-2716

CONGENITAL BRAIN AND SPINAL CORD MALFORMATIONS AND THEIR ASSOCIATED CUTANEOUS MARKERS (CLINICAL REPORT)

Mark Dias, MD, FAANS, FAAP; Michael Partington, MD, FAANS, FAAP; and Section on Neurologic Surgery

ABSTRACT. The brain, spinal cord, and skin are all derived from the embryonic ectoderm; this common derivation leads to a high association between central nervous system dysraphic malformations and abnormalities of the overlying skin. A myelomeningocele is an obvious open malformation, the identification of which is not usually difficult. However, the relationship between congenital spinal cord malformations and other cutaneous malformations, such as dimples, vascular anomalies (including infantile hemangiomata and other vascular malformations), congenital pigmented nevi or other hamartomata, or midline hairy patches may be less obvious but no less important. Pediatricians should be aware of these associations, recognize the cutaneous markers associated with congenital central nervous system malformations, and refer children with such markers to the appropriate specialist in a timely fashion for further evaluation and treatment. (9/15)
https://doi.org/10.1542/peds.2015-2854

CONSENT BY PROXY FOR NONURGENT PEDIATRIC CARE (CLINICAL REPORT)

Jonathan M. Fanaroff, MD, JD, FAAP, FCLM, and Committee on Medical Liability and Risk Management

ABSTRACT. Minor-aged patients are often brought to the pediatrician for nonurgent acute medical care, physical examinations, or health supervision visits by someone other than their legally authorized representative, which, in most situations, is a parent. These surrogates or proxies can be members of the child's extended family, such as a grandparent, adult sibling, or aunt/uncle; a noncustodial parent or stepparent in cases of divorce and remarriage; an adult who lives in the home but is not biologically or legally related to the child; or even a child care provider (eg, au pair, nanny, private-duty nurse/nurse's aide, group home supervisor). This report identifies common situations in which pediatricians may encounter "consent by proxy" for nonurgent medical care for minors, including physical examinations, and explains the potential for liability exposure associated with these circumstances. The report suggests practical steps that balance the need to minimize the physician's liability exposure with the patient's access to health care. Key issues to be considered when creating or updating office policies for obtaining and documenting consent by proxy are offered. (1/17)
https://doi.org/10.1542/peds.2016-3911

CONSENT FOR EMERGENCY MEDICAL SERVICES FOR CHILDREN AND ADOLESCENTS

Committee on Pediatric Emergency Medicine and Committee on Bioethics

ABSTRACT. Parental consent generally is required for the medical evaluation and treatment of minor children. However, children and adolescents might require evaluation of and treatment for emergency medical conditions in situations in which a parent or legal guardian is not available to provide consent or conditions under which an adolescent patient might possess the legal authority to provide consent. In general, a medical screening examination and any medical care necessary and likely to prevent imminent and significant harm to the pediatric patient with an emergency medical condition should not be withheld or delayed because of problems obtaining consent. The purpose of this policy statement is to provide guidance in those situations in which parental consent is not readily available, in which parental consent is not necessary, or in which parental refusal of consent

places a child at risk of significant harm. (7/11, reaffirmed 9/15, 4/20)
https://doi.org/10.1542/peds.2011-1166

CONSUMPTION OF RAW OR UNPASTEURIZED MILK AND MILK PRODUCTS BY PREGNANT WOMEN AND CHILDREN

Committee on Infectious Diseases and Committee on Nutrition

ABSTRACT. Sales of raw or unpasteurized milk and milk products are still legal in at least 30 states in the United States. Raw milk and milk products from cows, goats, and sheep continue to be a source of bacterial infections attributable to a number of virulent pathogens, including *Listeria monocytogenes, Campylobacter jejuni, Salmonella* species, *Brucella* species, and *Escherichia coli* O157. These infections can occur in both healthy and immunocompromised individuals, including older adults, infants, young children, and pregnant women and their unborn fetuses, in whom life-threatening infections and fetal miscarriage can occur. Efforts to limit the sale of raw milk products have met with opposition from those who are proponents of the purported health benefits of consuming raw milk products, which contain natural or unprocessed factors not inactivated by pasteurization. However, the benefits of these natural factors have not been clearly demonstrated in evidence-based studies and, therefore, do not outweigh the risks of raw milk consumption. Substantial data suggest that pasteurized milk confers equivalent health benefits compared with raw milk, without the additional risk of bacterial infections. The purpose of this policy statement was to review the risks of raw milk consumption in the United States and to provide evidence of the risks of infectious complications associated with consumption of unpasteurized milk and milk products, especially among pregnant women, infants, and children. (12/13, reaffirmed 11/19)
https://doi.org/10.1542/peds.2013-3502

CONTRACEPTION FOR ADOLESCENTS

Committee on Adolescence

ABSTRACT. Contraception is a pillar in reducing adolescent pregnancy rates. The American Academy of Pediatrics recommends that pediatricians develop a working knowledge of contraception to help adolescents reduce risks of and negative health consequences related to unintended pregnancy. Over the past 10 years, a number of new contraceptive methods have become available to adolescents, newer guidance has been issued on existing contraceptive methods, and the evidence base for contraception for special populations (adolescents who have disabilities, are obese, are recipients of solid organ transplants, or are HIV infected) has expanded. The Academy has addressed contraception since 1980, and this policy statement updates the 2007 statement on contraception and adolescents. It provides the pediatrician with a description and rationale for best practices in counseling and prescribing contraception for adolescents. It is supported by an accompanying technical report. (9/14, reaffirmed 3/21)
https://doi.org/10.1542/peds.2014-2299

CONTRACEPTION FOR ADOLESCENTS (TECHNICAL REPORT)

Mary A. Ott, MD, MA, FAAP; Gina S. Sucato, MD, MPH, FAAP; and Committee on Adolescence

ABSTRACT. A working knowledge of contraception will assist the pediatrician in both sexual health promotion as well as treatment of common adolescent gynecologic problems. Best practices in adolescent anticipatory guidance and screening include a sexual health history, screening for pregnancy and sexually transmitted infections, counseling, and if indicated, providing access to contraceptives. Pediatricians' long-term relationships with adolescents and families allow them to help promote healthy sexual decision-making, including abstinence and contraceptive use. Additionally, medical indications for contraception, such as acne, dysmenorrhea, and heavy menstrual bleeding, are frequently uncovered during adolescent visits. This technical report provides an evidence base for the accompanying policy statement and addresses key aspects of adolescent contraceptive use, including the following: (1) sexual history taking, confidentiality, and counseling; (2) adolescent data on the use and side effects of newer contraceptive methods; (3) new data on older contraceptive methods; and (4) evidence supporting the use of contraceptives in adolescent patients with complex medical conditions. (9/14, reaffirmed 3/21)
https://doi.org/10.1542/peds.2014-2300

CONTRACEPTION FOR HIV-INFECTED ADOLESCENTS (CLINICAL REPORT)

Athena P. Kourtis, MD, PhD, MPH, FAAP; Ayesha Mirza, MD, FAAP; and Committee on Pediatric AIDS

ABSTRACT. Access to high-quality reproductive health care is important for adolescents and young adults with HIV infection to prevent unintended pregnancies, sexually transmitted infections, and secondary transmission of HIV to partners and children. As perinatally HIV-infected children mature into adolescence and adulthood and new HIV infections among adolescents and young adults continue to occur in the United States, medical providers taking care of such individuals often face issues related to sexual and reproductive health. Challenges including drug interactions between several hormonal methods and antiretroviral agents make decisions regarding contraceptive options more complex for these adolescents. Dual protection, defined as the use of an effective contraceptive along with condoms, should be central to ongoing discussions with HIV-infected young women and couples wishing to avoid pregnancy. Last, reproductive health discussions need to be integrated with discussions on HIV care, because a reduction in plasma HIV viral load below the level of detection (an "undetectable viral load") is essential for the individual's health as well as for a reduction in HIV transmission to partners and children. (8/16)
https://doi.org/10.1542/peds.2016-1892

CONTROVERSIES CONCERNING VITAMIN K AND THE NEWBORN

Committee on Fetus and Newborn

ABSTRACT. Prevention of early vitamin K deficiency bleeding (VKDB) of the newborn, with onset at birth to 2 weeks of age (formerly known as classic hemorrhagic disease of the newborn), by oral or parenteral administration of vitamin K is accepted practice. In contrast, late VKDB, with onset from 2 to 12 weeks of age, is most effectively prevented by parenteral administration of vitamin K. Earlier concern regarding a possible causal association between parenteral vitamin K and childhood cancer has not been substantiated. This revised statement presents updated recommendations for the use of vitamin K in the prevention of early and late VKDB. (7/03, reaffirmed 5/06, 5/09, 9/14, 2/20)
https://doi.org/10.1542/peds.112.1.191

CORD BLOOD BANKING FOR POTENTIAL FUTURE TRANSPLANTATION

William T. Shearer, MD, PhD, FAAP; Bertram H. Lubin, MD, FAAP; Mitchell S. Cairo, MD, FAAP; Luigi D. Notarangelo, MD; Section on Hematology/Oncology; and Section on Allergy and Immunology

ABSTRACT. This policy statement is intended to provide information to guide pediatricians, obstetricians, and other medical specialists and health care providers in responding to parents' questions about cord blood donation and banking as well as the types (public versus private) and quality of cord blood

banks. Cord blood is an excellent source of stem cells for hematopoietic stem cell transplantation in children with some fatal diseases. Cord blood transplantation offers another method of definitive therapy for infants, children, and adults with certain hematologic malignancies, hemoglobinopathies, severe forms of T-lymphocyte and other immunodeficiencies, and metabolic diseases. The development of universal screening for severe immunodeficiency assay in a growing number of states is likely to increase the number of cord blood transplants. Both public and private cord blood banks worldwide hold hundreds of thousands of cord blood units designated for the treatment of fatal or debilitating illnesses. The procurement, characterization, and cryopreservation of cord blood is free for families who choose public banking. However, the family cost for private banking is significant and not covered by insurance, and the unit may never be used. Quality-assessment reviews by several national and international accrediting bodies show private cord blood banks to be underused for treatment, less regulated for quality control, and more expensive for the family than public cord blood banks. There is an unquestionable need to study the use of cord blood banking to make new and important alternative means of reconstituting the hematopoietic blood system in patients with malignancies and blood disorders and possibly regenerating tissue systems in the future. Recommendations regarding appropriate ethical and operational standards (including informed consent policies, financial disclosures, and conflict-of-interest policies) are provided for physicians, institutions, and organizations that operate or have a relationship with cord blood banking programs. The information on all aspects of cord blood banking gathered in this policy statement will facilitate parental choice for public or private cord blood banking. (10/17)
https://doi.org/10.1542/peds.2017-2695

CORPORAL PUNISHMENT IN SCHOOLS

Committee on School Health

ABSTRACT. The American Academy of Pediatrics recommends that corporal punishment in schools be abolished in all states by law and that alternative forms of student behavior management be used. (8/00, reaffirmed 6/03, 5/06, 2/12, 12/18)
https://doi.org/10.1542/peds.106.2.343

COUNSELING IN PEDIATRIC POPULATIONS AT RISK FOR INFERTILITY AND/OR SEXUAL FUNCTION CONCERNS (CLINICAL REPORT)

Leena Nahata, MD, FAAP; Gwendolyn P. Quinn, PhD; Amy C. Tishelman, PhD; and Section on Endocrinology

ABSTRACT. Reproductive health is an important yet often overlooked topic in pediatric health care; when addressed, the focus is generally on prevention of sexually transmitted infections and unwanted pregnancy. Two aspects of reproductive health counseling that have received minimal attention in pediatrics are fertility and sexual function for at-risk pediatric populations, and youth across many disciplines are affected. Although professional organizations, such as the American Academy of Pediatrics and the American Society of Clinical Oncology, have published recommendations about fertility preservation discussions, none of these guidelines address how to have ongoing conversations with at-risk youth and their families about the potential for future infertility and sexual dysfunction in developmentally appropriate ways. Researchers suggest many pediatric patients at risk for reproductive problems remain uncertain and confused about their fertility or sexual function status well into young adulthood. Potential infertility may cause distress and anxiety, has been shown to affect formation of romantic relationships, and may lead to unplanned pregnancy in those who incorrectly assumed they were infertile. Sexual dysfunction is also common and may lead to problems with intimacy and self-esteem; survivors of pediatric conditions consistently report inadequate guidance from clinicians in this area. Health care providers and parents report challenges in knowing how and when to discuss these issues. In this context, the goal of this clinical report is to review evidence and considerations for providers related to information sharing about impaired fertility and sexual function in pediatric patients attributable to congenital and acquired conditions or treatments. (7/18)
https://doi.org/10.1542/peds.2018-1435

COUNSELING PARENTS AND TEENS ABOUT MARIJUANA USE IN THE ERA OF LEGALIZATION OF MARIJUANA (CLINICAL REPORT)

Sheryl A. Ryan, MD, FAAP; Seth D. Ammerman, MD, FAAP; and Committee on Substance Use and Prevention

ABSTRACT. Many states have recently made significant changes to their legislation making recreational and/or medical marijuana use by adults legal. Although these laws, for the most part, have not targeted the adolescent population, they have created an environment in which marijuana increasingly is seen as acceptable, safe, and therapeutic. This clinical report offers guidance to the practicing pediatrician based on existing evidence and expert opinion/consensus of the American Academy of Pediatrics regarding anticipatory guidance and counseling to teenagers and their parents about marijuana and its use. The recently published technical report provides the detailed evidence and references regarding the research on which the information in this clinical report is based. (2/17)
https://doi.org/10.1542/peds.2016-4069

COUNTERING VACCINE HESITANCY (CLINICAL REPORT)

Kathryn M. Edwards, MD, FAAP; Jesse M. Hackell, MD, FAAP; Committee on Infectious Diseases; and Committee on Practice and Ambulatory Medicine

ABSTRACT. Immunizations have led to a significant decrease in rates of vaccine-preventable diseases and have made a significant impact on the health of children. However, some parents express concerns about vaccine safety and the necessity of vaccines. The concerns of parents range from hesitancy about some immunizations to refusal of all vaccines. This clinical report provides information about addressing parental concerns about vaccination. (8/16)
https://doi.org/10.1542/peds.2016-2146

COVID-19 VACCINES IN CHILDREN AND ADOLESCENTS

Committee on Infectious Diseases

ABSTRACT. Vaccines are safe and effective in protecting individuals and populations against infectious diseases. New vaccines are evaluated by a long-standing, rigorous, and transparent process through the US Food and Drug Administration (FDA) and the Centers for Disease Control and Prevention (CDC) by which safety and efficacy data are reviewed prior to authorization and recommendation. (7/21)
See full text on page 693.
https://doi.org/10.1542/peds.2021-052336

CRITICAL ELEMENTS FOR THE PEDIATRIC PERIOPERATIVE ANESTHESIA ENVIRONMENT

Section on Anesthesiology and Pain Medicine

ABSTRACT. The American Academy of Pediatrics proposes guidance for the pediatric perioperative anesthesia environment. Essential components are identified to optimize the perioperative environment for the anesthetic care of infants and children. Such an environment promotes the safety and well-being of infants and children by reducing the risk of adverse events. (11/15)
https://doi.org/10.1542/peds.2015-3595

THE CRUCIAL ROLE OF RECESS IN SCHOOL

Council on School Health

ABSTRACT. Recess is at the heart of a vigorous debate over the role of schools in promoting the optimal development of the whole child. A growing trend toward reallocating time in school to accentuate the more academic subjects has put this important facet of a child's school day at risk. Recess serves as a necessary break from the rigors of concentrated, academic challenges in the classroom. But equally important is the fact that safe and well-supervised recess offers cognitive, social, emotional, and physical benefits that may not be fully appreciated when a decision is made to diminish it. Recess is unique from, and a complement to, physical education—not a substitute for it. The American Academy of Pediatrics believes that recess is a crucial and necessary component of a child's development and, as such, it should not be withheld for punitive or academic reasons. (12/12, reaffirmed 8/16)

https://doi.org/10.1542/peds.2012-2993

DEALING WITH THE CARETAKER WHOSE JUDGMENT IS IMPAIRED BY ALCOHOL OR DRUGS: LEGAL AND ETHICAL CONSIDERATIONS (CLINICAL REPORT)

Steven A. Bondi, JD, MD, FAAP; James Scibilia, MD, FAAP; and Committee on Medical Liability and Risk Management

ABSTRACT. An estimated 8.7 million children live in a household with a substance-using parent or guardian. Substance-using caretakers may have impaired judgment that can negatively affect their child's well-being, including his or her ability to receive appropriate medical care. Although the physician-patient relationship exists between the pediatrician and the child, obligations related to safety and confidentiality should be considered as well. In managing encounters with impaired caretakers who may become disruptive or dangerous, pediatricians should be aware of their responsibilities before acting. In addition to fulfilling the duty involved with an established physician-patient relationship, the pediatrician should take reasonable care to safeguard patient confidentiality; protect the safety of their patient, other patients in the facility, visitors, and employees; and comply with reporting mandates. This clinical report identifies and discusses the legal and ethical concepts related to these circumstances. The report offers implementation suggestions when establishing anticipatory procedures and training programs for staff in such situations to maximize the patient's well-being and safety and minimize the liability of the pediatrician. (11/19)

https://doi.org/10.1542/peds.2019-3153

DEATH OF A CHILD IN THE EMERGENCY DEPARTMENT

Committee on Pediatric Emergency Medicine (joint with American College of Emergency Physicians Pediatric Emergency Medicine Committee and Emergency Nurses Association Pediatric Committee)

ABSTRACT. The American Academy of Pediatrics, American College of Emergency Physicians, and Emergency Nurses Association have collaborated to identify practices and principles to guide the care of children, families, and staff in the challenging and uncommon event of the death of a child in the emergency department in this policy statement and in an accompanying technical report. (6/14, reaffirmed 9/19)

https://doi.org/10.1542/peds.2014-1245

DEATH OF A CHILD IN THE EMERGENCY DEPARTMENT (TECHNICAL REPORT)

Patricia J. O'Malley, MD, FAAP; Isabel A. Barata, MD, FACEP, FAAP; Sally K. Snow, RN, BSN, CPEN, FAEN; and Committee on Pediatric Emergency Medicine (joint with American College of Emergency Physicians Pediatric Emergency Medicine Committee and Emergency Nurses Association Pediatric Committee)

ABSTRACT. The death of a child in the emergency department (ED) is one of the most challenging problems facing ED clinicians. This revised technical report and accompanying policy statement reaffirm principles of patient- and family-centered care. Recent literature is examined regarding family presence, termination of resuscitation, bereavement responsibilities of ED clinicians, support of child fatality review efforts, and other issues inherent in caring for the patient, family, and staff when a child dies in the ED. Appendices are provided that offer an approach to bereavement activities in the ED, carrying out forensic responsibilities while providing compassionate care, communicating the news of the death of a child in the acute setting, providing a closing ritual at the time of terminating resuscitation efforts, and managing the child with a terminal condition who presents near death in the ED. (6/14, reaffirmed 9/19)

https://doi.org/10.1542/peds.2014-1246

DEFINITION OF A PEDIATRICIAN

Committee on Pediatric Workforce

POLICY. The American Academy of Pediatrics (AAP) has developed the following definition of pediatrics and a pediatrician:

Pediatrics is the specialty of medical science concerned with the physical, mental, and social health of children from birth to young adulthood. Pediatric care encompasses a broad spectrum of health services ranging from preventive health care to the diagnosis and treatment of acute and chronic diseases.

Pediatrics is a discipline that deals with biological, social, and environmental influences on the developing child and with the impact of disease and dysfunction on development. Children differ from adults anatomically, physiologically, immunologically, psychologically, developmentally, and metabolically.

The pediatrician, a term that includes primary care pediatricians, pediatric medical subspecialists, and pediatric surgical specialists, understands this constantly changing functional status of his or her patients' incident to growth and development and the consequent changing standards of "normal" for age. A pediatrician is a physician who is concerned primarily with the health, welfare, and development of children and is uniquely qualified for these endeavors by virtue of interest and initial training. This training includes 4 years of medical school education, plus an additional year or years (usually at least 3) of intensive training devoted solely to all aspects of medical care for children, adolescents, and young adults. Maintenance of these competencies is achieved by experience, training, continuous education, self-assessment, and practice improvement.

A pediatrician is able to define accurately the child's health status and to serve as a consultant and make use of other specialists as consultants as needed, ideally in the context of, or in conjunction with, the physician-led medical home. Because the child's welfare is heavily dependent on the home and family, the pediatrician supports efforts to create a nurturing environment. Such support includes education about healthful living and anticipatory guidance for both patients and parents.

A pediatrician participates at the community level in preventing or solving problems in child health care and publicly advocates the causes of children. (3/15, reaffirmed 12/19)

https://doi.org/10.1542/peds.2015-0056

DETENTION OF IMMIGRANT CHILDREN

Julie M. Linton, MD, FAAP; Marsha Griffin, MD, FAAP; Alan J. Shapiro, MD, FAAP; and Council on Community Pediatrics

ABSTRACT. Immigrant children seeking safe haven in the United States, whether arriving unaccompanied or in family units, face a complicated evaluation and legal process from the point of arrival through permanent resettlement in communities. The conditions in which children are detained and the support services that are available to them are of great concern

to pediatricians and other advocates for children. In accordance with internationally accepted rights of the child, immigrant and refugee children should be treated with dignity and respect and should not be exposed to conditions that may harm or traumatize them. The Department of Homeland Security facilities do not meet the basic standards for the care of children in residential settings. The recommendations in this statement call for limited exposure of any child to current Department of Homeland Security facilities (ie, Customs and Border Protection and Immigration and Customs Enforcement facilities) and for longitudinal evaluation of the health consequences of detention of immigrant children in the United States. From the moment children are in the custody of the United States, they deserve health care that meets guideline-based standards, treatment that mitigates harm or traumatization, and services that support their health and well-being. This policy statement also provides specific recommendations regarding postrelease services once a child is released into communities across the country, including a coordinated system that facilitates access to a medical home and consistent access to education, child care, interpretation services, and legal services. (4/17)

https://doi.org/10.1542/peds.2017-0483

DEVELOPMENTAL DYSPLASIA OF THE HIP PRACTICE GUIDELINE (TECHNICAL REPORT)

Harold P. Lehmann, MD, PhD; Richard Hinton, MD, MPH; Paola Morello, MD; Jeanne Santoli, MD; in conjunction with Steering Committee on Quality Improvement and Subcommittee on Developmental Dysplasia of the Hip

ABSTRACT. *Objective.* To create a recommendation for pediatricians and other primary care providers about their role as screeners for detecting developmental dysplasia of the hip (DDH) in children.

Patients. Theoretical cohorts of newborns.

Method. Model-based approach using decision analysis as the foundation. Components of the approach include the following:

Perspective: Primary care provider.

Outcomes: DDH, avascular necrosis of the hip (AVN).

Options: Newborn screening by pediatric examination; orthopaedic examination; ultrasonographic examination; orthopaedic or ultrasonographic examination by risk factors. Intercurrent health supervision-based screening.

Preferences: 0 for bad outcomes, 1 for best outcomes.

Model: Influence diagram assessed by the Subcommittee and by the methodology team, with critical feedback from the Subcommittee.

Evidence Sources: Medline and EMBASE search of the research literature through June 1996. Hand search of sentinel journals from June 1996 through March 1997. Ancestor search of accepted articles.

Evidence Quality: Assessed on a custom subjective scale, based primarily on the fit of the evidence to the decision model.

Results. After discussion, explicit modeling, and critique, an influence diagram of 31 nodes was created. The computer-based and the hand literature searches found 534 articles, 101 of which were reviewed by 2 or more readers. Ancestor searches of these yielded a further 17 articles for evidence abstraction. Articles came from around the globe, although primarily Europe, British Isles, Scandinavia, and their descendants. There were 5 controlled trials, each with a sample size less than 40. The remainder were case series. Evidence was available for 17 of the desired 30 probabilities. Evidence quality ranged primarily between one third and two thirds of the maximum attainable score (median: 10–21; interquartile range: 8–14).

Based on the raw evidence and Bayesian hierarchical meta-analyses, our estimate for the incidence of DDH revealed by physical examination performed by pediatricians is 8.6 per 1000; for orthopaedic screening, 11.5; for ultrasonography, 25. The odds ratio for DDH, given breech delivery, is 5.5; for female sex, 4.1; for positive family history, 1.7, although this last factor is not statistically significant. Postneonatal cases of DDH were divided into mid-term (younger than 6 months of age) and late-term (older than 6 months of age). Our estimates for the mid-term rate for screening by pediatricians is 0.34/1000 children screened; for orthopaedists, 0.1; and for ultrasonography, 0.28. Our estimates for late-term DDH rates are 0.21/1000 newborns screened by pediatricians; 0.08, by orthopaedists; and 0.2 for ultrasonography. The rates of AVN for children referred before 6 months of age is estimated at 2.5/1000 infants referred. For those referred after 6 months of age, our estimate is 109/1000 referred infants.

The decision model (reduced, based on available evidence) suggests that orthopaedic screening is optimal, but because orthopaedists in the published studies and in practice would differ, the supply of orthopaedists is relatively limited, and the difference between orthopaedists and pediatricians is statistically insignificant, we conclude that pediatric screening is to be recommended. The place of ultrasonography in the screening process remains to be defined because there are too few data about postneonatal diagnosis by ultrasonographic screening to permit definitive recommendations. These data could be used by others to refine the conclusions based on costs, parental preferences, or physician style. Areas for research are well defined by our model-based approach. (4/00)

https://doi.org/10.1542/peds.105.4.e57

DIAGNOSIS, EVALUATION, AND MANAGEMENT OF HIGH BLOOD PRESSURE IN CHILDREN AND ADOLESCENTS (TECHNICAL REPORT)

Carissa M. Baker-Smith, MD, MS, MPH, FAAP, FAHA; Susan K. Flinn, MA; Joseph T. Flynn, MD, MS, FAAP; David C. Kaelber, MD, PhD, MPH, FAAP, FACP, FACMI; Douglas Blowey, MD; Aaron E. Carroll, MD, MS, FAAP; Stephen R. Daniels, MD, PhD, FAAP; Sarah D. de Ferranti, MD, MPH, FAAP; Janis M. Dionne, MD, FRCPC; Bonita Falkner, MD; Samuel S. Gidding, MD; Celeste Goodwin; Michael G. Leu, MD, MS, MHS, FAAP; Makia E. Powers, MD, MPH, FAAP; Corinna Rea, MD, MPH, FAAP; Joshua Samuels, MD, MPH, FAAP; Madeline Simasek, MD, MSCP, FAAP; Vidhu V. Thaker, MD, FAAP; Elaine M. Urbina, MD, MS, FAAP; and Subcommittee on Screening and Management of High Blood Pressure in Children

ABSTRACT. Systemic hypertension is a major cause of morbidity and mortality in adulthood. High blood pressure (HBP) and repeated measures of HBP, hypertension (HTN), begin in youth. Knowledge of how best to diagnose, manage, and treat systemic HTN in children and adolescents is important for primary and subspecialty care providers.

Objectives: To provide a technical summary of the methodology used to generate the 2017 "Clinical Practice Guideline for Screening and Management of High Blood Pressure in Children and Adolescents," an update to the 2004 "Fourth Report on the Diagnosis, Evaluation, and Treatment of High Blood Pressure in Children and Adolescents."

Data Sources: Medline, Cochrane Central Register of Controlled Trials, and Excerpta Medica Database references published between January 2003 and July 2015 followed by an additional search between August 2015 and July 2016.

Study Selection: English-language observational studies and randomized trials.

Methods: Key action statements (KASs) and additional recommendations regarding the diagnosis, management, and treatment of HBP in youth were the product of a detailed systematic review of the literature. A content outline establishing the

breadth and depth was followed by the generation of 4 patient, intervention, comparison, outcome, time questions. Key questions addressed: (1) diagnosis of systemic HTN, (2) recommended work-up of systemic HTN, (3) optimal blood pressure (BP) goals, and (4) impact of high BP on indirect markers of cardiovascular disease in youth. Once selected, references were subjected to a 2-person review of the abstract and title followed by a separate 2-person full-text review. Full citation information, population data, findings, benefits and harms of the findings, as well as other key reference information were archived. Selected primary references were then used for KAS generation. Level of evidence (LOE) scoring was assigned for each reference and then in aggregate. Appropriate language was used to generate each KAS based on the LOE and the balance of benefit versus harm of the findings. Topics that could not be researched via the stated approach were (1) definition of HTN in youth, and (2) definition of left ventricular hypertrophy. KASs related to these stated topics were generated via expert opinion.

Results: Nearly 15 000 references were identified during an initial literature search. After a deduplication process, 14 382 references were available for title and abstract review, and 1379 underwent full text review. One hundred twenty-four experimental and observational studies published between 2003 and 2016 were selected as primary references for KAS generation, followed by an additional 269 primary references selected between August 2015 and July 2016. The LOE for the majority of references was C. In total, 30 KASs and 27 additional recommendations were generated; 12 were related to the diagnosis of HTN, 13 were related to management and additional diagnostic testing, 3 to treatment goals, and 2 to treatment options. Finally, special additions to the clinical practice guideline included creation of new BP tables based on BP values obtained solely from children with normal weight, creation of a simplified table to enhance screening and recognition of abnormal BP, and a revision of the criteria for diagnosing left ventricular hypertrophy.

Conclusions: An extensive and detailed systematic approach was used to generate evidence-based guidelines for the diagnosis, management, and treatment of youth with systemic HTN. (8/18)

https://doi.org/10.1542/peds.2018-2096

DIAGNOSIS, MANAGEMENT, AND TREATMENT OF FEMALE GENITAL MUTILATION OR CUTTING IN GIRLS (CLINICAL REPORT)

Janine Young, MD, FAAP; Nawal M. Nour, MD, MPH, FACOG; Robert C. Macauley, MD, FAAP; Sandeep K. Narang, MD, JD, FAAP; Crista Johnson-Agbakwu, MD, MSc, FACOG; Section on Global Health; Committee on Medical Liability and Risk Management; and Committee on Bioethics

ABSTRACT. Female genital mutilation or cutting (FGM/C) involves medically unnecessary cutting of parts or all of the external female genitalia. It is outlawed in the United States and much of the world but is still known to occur in more than 30 countries. FGM/C most often is performed on children, from infancy to adolescence, and has significant morbidity and mortality. In 2018, an estimated 200 million girls and women alive at that time had undergone FGM/C worldwide. Some estimate that more than 500 000 girls and women in the United States have had or are at risk for having FGM/C. However, pediatric prevalence of FGM/C is only estimated given that most pediatric cases remain undiagnosed both in countries of origin and in the Western world, including in the United States. It is a cultural practice not directly tied to any specific religion, ethnicity, or race and has occurred in the United States. Although it is mostly a pediatric practice, currently there is no standard FGM/C teaching required for health care providers who care for children, including pediatricians, family physicians, child abuse pediatricians, pediatric urologists, and pediatric urogynecologists. This clinical report is the first comprehensive summary of FGM/C in children and includes education regarding a standard-of-care approach for examination of external female genitalia at all health supervision examinations, diagnosis, complications, management, treatment, culturally sensitive discussion and counseling approaches, and legal and ethical considerations. (7/20)

https://doi.org/10.1542/peds.2020-1012

DIAGNOSIS, TREATMENT, AND PREVENTION OF CONGENITAL TOXOPLASMOSIS IN THE UNITED STATES (TECHNICAL REPORT)

Yvonne A. Maldonado, MD, FAAP; Jennifer S. Read, MD, MS, MPH, DTM&H, FAAP; and Committee on Infectious Diseases

ABSTRACT. Congenital toxoplasmosis (CT) is a parasitic disease that can cause significant fetal and neonatal harm. Coordinated efforts by pregnant women, researchers, physicians, and health policy makers regarding potential primary and secondary preventive measures for CT and their implementation may lead to a lower incidence of CT as well as lower morbidity and mortality rates associated with CT. The purpose of this technical report is to summarize available information regarding the diagnosis, treatment, and prevention of CT. (1/17)

https://doi.org/10.1542/peds.2016-3860

DIAGNOSIS AND MANAGEMENT OF CHILDHOOD OBSTRUCTIVE SLEEP APNEA SYNDROME (TECHNICAL REPORT)

Carole L. Marcus, MBBCh; Lee J. Brooks, MD; Sally Davidson Ward, MD; Kari A. Draper, MD; David Gozal, MD; Ann C. Halbower, MD; Jacqueline Jones, MD; Christopher Lehmann, MD; Michael S. Schechter, MD, MPH; Stephen Sheldon, MD; Richard N. Shiffman, MD, MCIS; Karen Spruyt, PhD; Steering Committee on Quality Improvement and Management; and Subcommittee on Obstructive Sleep Apnea Syndrome

ABSTRACT. *Objective.* This technical report describes the procedures involved in developing recommendations on the management of childhood obstructive sleep apnea syndrome (OSAS).

Methods. The literature from 1999 through 2011 was evaluated.

Results and Conclusions. A total of 3166 titles were reviewed, of which 350 provided relevant data. Most articles were level II through IV. The prevalence of OSAS ranged from 0% to 5.7%, with obesity being an independent risk factor. OSAS was associated with cardiovascular, growth, and neurobehavioral abnormalities and possibly inflammation. Most diagnostic screening tests had low sensitivity and specificity. Treatment of OSAS resulted in improvements in behavior and attention and likely improvement in cognitive abilities. Primary treatment is adenotonsillectomy (AT). Data were insufficient to recommend specific surgical techniques; however, children undergoing partial tonsillectomy should be monitored for possible recurrence of OSAS. Although OSAS improved postoperatively, the proportion of patients who had residual OSAS ranged from 13% to 29% in low-risk populations to 73% when obese children were included and stricter polysomnographic criteria were used. Nevertheless, OSAS may improve after AT even in obese children, thus supporting surgery as a reasonable initial treatment. A significant number of obese patients required intubation or continuous positive airway pressure (CPAP) postoperatively, which reinforces the need for inpatient observation. CPAP was effective in the treatment of OSAS, but adherence is a major barrier. For this reason, CPAP is not recommended as first-line therapy for OSAS when AT is an option. Intranasal steroids may ameliorate mild OSAS, but follow-up is needed. Data were insufficient to recommend rapid maxillary expansion. (8/12)

https://doi.org/10.1542/peds.2012-1672

DIAGNOSIS AND MANAGEMENT OF GASTROESOPHAGEAL REFLUX IN PRETERM INFANTS (CLINICAL REPORT)

Eric C. Eichenwald, MD, FAAP, and Committee on Fetus and Newborn

ABSTRACT. Gastroesophageal reflux (GER), generally defined as the passage of gastric contents into the esophagus, is an almost universal phenomenon in preterm infants. It is a common diagnosis in the NICU; however, there is large variation in its treatment across NICU sites. In this clinical report, the physiology, diagnosis, and symptomatology in preterm infants as well as currently used treatment strategies in the NICU are examined. Conservative measures to control reflux, such as left lateral body position, head elevation, and feeding regimen manipulation, have not been shown to reduce clinically assessed signs of GER in the preterm infant. In addition, preterm infants with clinically diagnosed GER are often treated with pharmacologic agents; however, a lack of evidence of efficacy together with emerging evidence of significant harm (particularly with gastric acid blockade) strongly suggest that these agents should be used sparingly, if at all, in preterm infants. (6/18)

https://doi.org/10.1542/peds.2018-1061

DIAGNOSIS AND MANAGEMENT OF INFANTILE HEMANGIOMA (CLINICAL REPORT)

David H. Darrow, MD, DDS; Arin K. Greene, MD; Anthony J. Mancini, MD; Amy J. Nopper, MD; Section on Dermatology; Section on Otolaryngology—Head & Neck Surgery; and Section on Plastic Surgery

ABSTRACT. Infantile hemangiomas (IHs) are the most common tumors of childhood. Unlike other tumors, they have the unique ability to involute after proliferation, often leading primary care providers to assume they will resolve without intervention or consequence. Unfortunately, a subset of IHs rapidly develop complications, resulting in pain, functional impairment, or permanent disfigurement. As a result, the primary clinician has the task of determining which lesions require early consultation with a specialist. Although several recent reviews have been published, this clinical report is the first based on input from individuals representing the many specialties involved in the treatment of IH. Its purpose is to update the pediatric community regarding recent discoveries in IH pathogenesis, treatment, and clinical associations and to provide a basis for clinical decision-making in the management of IH. (9/15)

https://doi.org/10.1542/peds.2015-2485

DIAGNOSIS AND MANAGEMENT OF INFANTILE HEMANGIOMA: EXECUTIVE SUMMARY

David H. Darrow, MD, DDS, FAAP; Arin K. Greene, MD, FAAP; Anthony J. Mancini, MD, FAAP; Amy J. Nopper, MD, FAAP; Section on Dermatology; Section on Otolaryngology—Head & Neck Surgery; and Section on Plastic Surgery

ABSTRACT. Infantile hemangiomas (IHs) are the most common tumors of childhood. Unlike other tumors, they have the capacity to involute after proliferation, often leading primary care providers to assume they will resolve without intervention or consequence. However, a subset of IHs may be associated with complications, resulting in pain, functional impairment, or permanent disfigurement. As a result, the primary care provider is often called on to decide which lesions should be referred for early consultation with a specialist.

This document provides a summary of the guidance contained in the clinical report "Diagnosis and Management of Infantile Hemangioma," published concurrently in the online version of *Pediatrics* (*Pediatrics.* 2015;136[4]:e1060–e1104, available at: www.pediatrics.org/content/136/4/e1060). The report is uniquely based on input from the many specialties involved in the treatment of IH. Its purpose is to update the pediatric community about recent discoveries in IH pathogenesis, clinical associations, and treatment and to provide a knowledge base and framework for clinical decision-making in the management of IH. (9/15)

https://doi.org/10.1542/peds.2015-2482

DIAGNOSIS AND PREVENTION OF IRON DEFICIENCY AND IRON-DEFICIENCY ANEMIA IN INFANTS AND YOUNG CHILDREN (0–3 YEARS OF AGE) (CLINICAL REPORT)

Robert D. Baker, MD, PhD; Frank R. Greer, MD; and Committee on Nutrition

ABSTRACT. This clinical report covers diagnosis and prevention of iron deficiency and iron-deficiency anemia in infants (both breastfed and formula fed) and toddlers from birth through 3 years of age. Results of recent basic research support the concerns that iron-deficiency anemia and iron deficiency without anemia during infancy and childhood can have long-lasting detrimental effects on neurodevelopment. Therefore, pediatricians and other health care providers should strive to eliminate iron deficiency and iron-deficiency anemia. Appropriate iron intakes for infants and toddlers as well as methods for screening for iron deficiency and iron-deficiency anemia are presented. (10/10)

https://doi.org/10.1542/peds.2010-2576

DIAGNOSIS OF HIV-1 INFECTION IN CHILDREN YOUNGER THAN 18 MONTHS IN THE UNITED STATES (TECHNICAL REPORT)

Jennifer S. Read, MD, MS, MPH, DTM&H, and Committee on Pediatric AIDS

ABSTRACT. The objectives of this technical report are to describe methods of diagnosis of HIV-1 infection in children younger than 18 months in the United States and to review important issues that must be considered by clinicians who care for infants and young children born to HIV-1–infected women. Appropriate HIV-1 diagnostic testing for infants and children younger than 18 months differs from that for older children, adolescents, and adults because of passively transferred maternal HIV-1 antibodies, which may be detectable in the child's bloodstream until 18 months of age. Therefore, routine serologic testing of these infants and young children is generally only informative before the age of 18 months if the test result is negative. Virologic assays, including HIV-1 DNA or RNA assays, represent the gold standard for diagnostic testing of infants and children younger than 18 months. With such testing, the diagnosis of HIV-1 infection (as well as the presumptive exclusion of HIV-1 infection) can be established within the first several weeks of life among nonbreastfed infants. Important factors that must be considered when selecting HIV-1 diagnostic assays for pediatric patients and when choosing the timing of such assays include the age of the child, potential timing of infection of the child, whether the infection status of the child's mother is known or unknown, the antiretroviral exposure history of the mother and of the child, and characteristics of the virus. If the mother's HIV-1 serostatus is unknown, rapid HIV-1 antibody testing of the newborn infant to identify HIV-1 exposure is essential so that antiretroviral prophylaxis can be initiated within the first 12 hours of life if test results are positive. For HIV-1–exposed infants (identified by positive maternal test results or positive antibody results for the infant shortly after birth), it has been recommended that diagnostic testing with HIV-1 DNA or RNA assays be performed within the first 14 days of life, at 1 to 2 months of age, and at 3 to 6 months of age. If any of these test results are positive, repeat testing is recommended to confirm the diagnosis of HIV-1 infection. A diagnosis of HIV-1 infection can be made on the basis of 2 positive HIV-1 DNA or RNA assay results. In nonbreastfeeding children younger than 18 months with no positive HIV-1 virologic test results, presumptive exclusion of HIV-1 infection can be based on 2 negative virologic test results (1 obtained at ≥2 weeks and 1 obtained at ≥4 weeks of age); 1 negative virologic test result obtained at ≥8 weeks of age; or 1 negative HIV-1 anti-

body test result obtained at ≥6 months of age. Alternatively, presumptive exclusion of HIV-1 infection can be based on 1 positive HIV-1 virologic test with at least 2 subsequent negative virologic test results (at least 1 of which is performed at ≥8 weeks of age) or negative HIV-1 antibody test results (at least 1 of which is performed at ≥6 months of age). Definitive exclusion of HIV-1 infection is based on 2 negative virologic test results, 1 obtained at ≥1 month of age and 1 obtained at ≥4 months of age, or 2 negative HIV-1 antibody test results from separate specimens obtained at ≥6 months of age. For both presumptive and definitive exclusion of infection, the child should have no other laboratory (eg, no positive virologic test results) or clinical (eg, no AIDS-defining conditions) evidence of HIV-1 infection. Many clinicians confirm the absence of HIV-1 infection with a negative HIV-1 antibody assay result at 12 to 18 months of age. For breastfeeding infants, a similar testing algorithm can be followed, with timing of testing starting from the date of complete cessation of breastfeeding instead of the date of birth. (12/07, reaffirmed 4/10, 2/15)
https://doi.org/10.1542/peds.2007-2951

DIAGNOSIS OF PREGNANCY AND PROVIDING OPTIONS COUNSELING FOR THE ADOLESCENT PATIENT (CLINICAL REPORT)

Laurie L. Hornberger, MD, MPH, FAAP, and Committee on Adolescence

ABSTRACT. The American Academy of Pediatrics policy statement "Options Counseling for the Pregnant Adolescent Patient" recommends the basic content of the pediatrician's counseling for an adolescent facing a new diagnosis of pregnancy. However, options counseling is just one aspect of what may be one of the more challenging scenarios in the pediatric office. Pediatricians must remain alert to the possibility of pregnancy among their adolescent female patients. When discovering symptoms suggestive of pregnancy, pediatricians must obtain a relevant history, perform diagnostic testing and properly interpret the results, and understand the significance of the results from the patient perspective and reveal them to the patient in a sensitive manner. If the patient is indeed pregnant, the pediatrician, in addition to providing comprehensive options counseling, may need to help recruit adult support for the patient and should offer continued assistance to the adolescent and her family after the office visit. All pediatricians should be aware of the legal aspects of adolescent reproductive care and the resources for pregnant adolescents in their communities. This clinical report presents a more comprehensive view of the evaluation and management of pregnancy in the adolescent patient and a context for options counseling. (8/17)
https://doi.org/10.1542/peds.2017-2273

DIAGNOSTIC IMAGING OF CHILD ABUSE

Section on Radiology

ABSTRACT. The role of imaging in cases of child abuse is to identify the extent of physical injury when abuse is present and to elucidate all imaging findings that point to alternative diagnoses. Effective diagnostic imaging of child abuse rests on high-quality technology as well as a full appreciation of the clinical and pathologic alterations occurring in abused children. This statement is a revision of the previous policy published in 2000. (4/09)
https://doi.org/10.1542/peds.2009-0558

DIGITAL ADVERTISING TO CHILDREN

Jenny Radesky, MD, FAAP; Yolanda (Linda) Reid Chassiakos, MD, FAAP, FACP; Nusheen Ameenuddin, MD, MPH, MPA, FAAP; Dipesh Navsaria, MPH, MSLIS, MD, FAAP; and Council on Communication and Media

ABSTRACT. Advertising to children and teenagers is a multibillion-dollar industry. This policy statement reviews the forms of advertising that children and teenagers encounter, including newer forms of digital marketing, such as sponsored content, influencers, data collection, persuasive design, and personalized behavioral marketing driven by machine learning. Parents and pediatric health care providers need to be aware of the ways different marketing messages reach children and teenagers, including Internet sites, social media, and mobile apps. Evidence suggests that exposure to advertising is associated with unhealthy behaviors, such as intake of high-calorie, low-nutrient food and beverages; use of tobacco products and electronic cigarettes; use of alcohol and marijuana; and indoor tanning. Children are uniquely vulnerable to the persuasive effects of advertising because of immature critical thinking skills and impulse inhibition. School-aged children and teenagers may be able to recognize advertising but often are not able to resist it when it is embedded within trusted social networks, encouraged by celebrity influencers, or delivered next to personalized content. This policy statement expresses concern about the practice of tracking and using children's digital behavior to inform targeted marketing campaigns, which may contribute to health disparities among vulnerable children or populations. Pediatricians should guide parents and children to develop digital literacy skills to prevent or mitigate negative outcomes, but it is equally important that policy makers and technology companies embrace digital design, data collection, and marketing practices within today's broad digital environment that support healthier decision-making and outcomes. (6/20)
https://doi.org/10.1542/peds.2020-1681

DISASTER PREPAREDNESS IN NEONATAL INTENSIVE CARE UNITS (CLINICAL REPORT)

Wanda D. Barfield, MD, MPH, FAAP, RADM USPHS; Steven E. Krug, MD, FAAP; Committee on Fetus and Newborn; and Disaster Preparedness Council

ABSTRACT. Disasters disproportionally affect vulnerable, technology-dependent people, including preterm and critically ill newborn infants. It is important for health care providers to be aware of and prepared for the potential consequences of disasters for the NICU. Neonatal intensive care personnel can provide specialized expertise for their hospital, community, and regional emergency preparedness plans and can help develop institutional surge capacity for mass critical care, including equipment, medications, personnel, and facility resources. (4/17)
https://doi.org/10.1542/peds.2017-0507

DISCLOSURE OF ADVERSE EVENTS IN PEDIATRICS

Committee on Medical Liability and Risk Management and Council on Quality Improvement and Patient Safety

ABSTRACT. Despite increasing attention to issues of patient safety, preventable adverse events (AEs) continue to occur, causing direct and consequential injuries to patients, families, and health care providers. Pediatricians generally agree that there is an ethical obligation to inform patients and families about preventable AEs and medical errors. Nonetheless, barriers, such as fear of liability, interfere with disclosure regarding preventable AEs. Changes to the legal system, improved communications skills, and carefully developed disclosure policies and programs can improve the quality and frequency of appropriate AE disclosure communications. (11/16)
https://doi.org/10.1542/peds.2016-3215

DISPENSING MEDICATIONS AT THE HOSPITAL UPON DISCHARGE FROM AN EMERGENCY DEPARTMENT (TECHNICAL REPORT)

Loren G. Yamamoto, MD, MPH, MBA; Shannon Manzi, PharmD; and Committee on Pediatric Emergency Medicine

ABSTRACT. Although most health care services can and should be provided by their medical home, children will be referred or

require visits to the emergency department (ED) for emergent clinical conditions or injuries. Continuation of medical care after discharge from an ED is dependent on parents or caregivers' understanding of and compliance with follow-up instructions and on adherence to medication recommendations. ED visits often occur at times when the majority of pharmacies are not open and caregivers are concerned with getting their ill or injured child directly home. Approximately one-third of patients fail to obtain priority medications from a pharmacy after discharge from an ED. The option of judiciously dispensing ED discharge medications from the ED's outpatient pharmacy within the facility is a major convenience that overcomes this obstacle, improving the likelihood of medication adherence. Emergency care encounters should be routinely followed up with primary care provider medical homes to ensure complete and comprehensive care. (1/12, reaffirmed 9/15, 7/19)
https://doi.org/10.1542/peds.2011-3444

DISTINGUISHING SUDDEN INFANT DEATH SYNDROME FROM CHILD ABUSE FATALITIES (CLINICAL REPORT)

Kent P. Hymel, MD, and Committee on Child Abuse and Neglect (joint with National Association of Medical Examiners)

ABSTRACT. Fatal child abuse has been mistaken for sudden infant death syndrome. When a healthy infant younger than 1 year dies suddenly and unexpectedly, the cause of death may be certified as sudden infant death syndrome. Sudden infant death syndrome is more common than infanticide. Parents of sudden infant death syndrome victims typically are anxious to provide unlimited information to professionals involved in death investigation or research. They also want and deserve to be approached in a nonaccusatory manner. This clinical report provides professionals with information and suggestions for procedures to help avoid stigmatizing families of sudden infant death syndrome victims while allowing accumulation of appropriate evidence in potential cases of infanticide. This clinical report addresses deficiencies and updates recommendations in the 2001 American Academy of Pediatrics policy statement of the same name. (7/06, reaffirmed 4/09, 3/13, 7/17)
https://doi.org/10.1542/peds.2006-1245

DONOR HUMAN MILK FOR THE HIGH-RISK INFANT: PREPARATION, SAFETY, AND USAGE OPTIONS IN THE UNITED STATES

Committee on Nutrition, Section on Breastfeeding, and Committee on Fetus and Newborn

ABSTRACT. The use of donor human milk is increasing for high-risk infants, primarily for infants born weighing <1500 g or those who have severe intestinal disorders. Pasteurized donor milk may be considered in situations in which the supply of maternal milk is insufficient. The use of pasteurized donor milk is safe when appropriate measures are used to screen donors and collect, store, and pasteurize the milk and then distribute it through established human milk banks. The use of nonpasteurized donor milk and other forms of direct, Internet-based, or informal human milk sharing does not involve this level of safety and is not recommended. It is important that health care providers counsel families considering milk sharing about the risks of bacterial or viral contamination of nonpasteurized human milk and about the possibilities of exposure to medications, drugs, or herbs in human milk. Currently, the use of pasteurized donor milk is limited by its availability and affordability. The development of public policy to improve and expand access to pasteurized donor milk, including policies that support improved governmental and private financial support for donor milk banks and the use of donor milk, is important. (12/16)
https://doi.org/10.1542/peds.2016-3440

DRINKING WATER FROM PRIVATE WELLS AND RISKS TO CHILDREN

Committee on Environmental Health and Committee on Infectious Diseases

ABSTRACT. Drinking water for approximately one sixth of US households is obtained from private wells. These wells can become contaminated by pollutant chemicals or pathogenic organisms and cause illness. Although the US Environmental Protection Agency and all states offer guidance for construction, maintenance, and testing of private wells, there is little regulation. With few exceptions, well owners are responsible for their own wells. Children may also drink well water at child care or when traveling. Illness resulting from children's ingestion of contaminated water can be severe. This policy statement provides recommendations for inspection, testing, and remediation for wells providing drinking water for children. (5/09, reaffirmed 1/13, 9/19)
https://doi.org/10.1542/peds.2009-0751

DRINKING WATER FROM PRIVATE WELLS AND RISKS TO CHILDREN (TECHNICAL REPORT)

Walter J. Rogan, MD; Michael T. Brady, MD; Committee on Environmental Health; and Committee on Infectious Diseases

ABSTRACT. Drinking water for approximately one sixth of US households is obtained from private wells. These wells can become contaminated by pollutant chemicals or pathogenic organisms, leading to significant illness. Although the US Environmental Protection Agency and all states offer guidance for construction, maintenance, and testing of private wells, there is little regulation, and with few exceptions, well owners are responsible for their own wells. Children may also drink well water at child care or when traveling. Illness resulting from children's ingestion of contaminated water can be severe. This report reviews relevant aspects of groundwater and wells; describes the common chemical and microbiologic contaminants; gives an algorithm with recommendations for inspection, testing, and remediation for wells providing drinking water for children; reviews the definitions and uses of various bottled waters; provides current estimates of costs for well testing; and provides federal, national, state, and, where appropriate, tribal contacts for more information. (5/09, reaffirmed 1/13, 9/19)
https://doi.org/10.1542/peds.2009-0752

DRUGS USED TO TREAT PEDIATRIC EMERGENCIES (CLINICAL REPORT)

Rohit P. Shenoi, MD, FAAP; Nathan Timm, MD, FAAP; Committee on Drugs; and Committee on Pediatric Emergency Medicine

ABSTRACT. This clinical report is a revision of "Preparing for Pediatric Emergencies: Drugs to Consider." It updates the list, indications, and dosages of medications used to treat pediatric emergencies in the prehospital, pediatric clinic, and emergency department settings. Although it is not an all-inclusive list of medications that may be used in all emergencies, this resource will be helpful when treating a vast majority of pediatric medical emergencies. Dosage recommendations are consistent with current emergency references such as the Advanced Pediatric Life Support and Pediatric Advanced Life Support textbooks and American Heart Association resuscitation guidelines. (12/19)
https://doi.org/10.1542/peds.2019-3450

E-CIGARETTES AND SIMILAR DEVICES

Brian P. Jenssen, MD, MSHP, FAAP; Susan C. Walley, MD, FAAP; and Section on Tobacco Control

ABSTRACT. Electronic cigarettes (e-cigarettes) are the most commonly used tobacco product among youth. The 2016 US Surgeon General's Report on e-cigarette use among youth and young adults concluded that e-cigarettes are unsafe for children and adolescents. Furthermore, strong and consistent evidence

finds that children and adolescents who use e-cigarettes are significantly more likely to go on to use traditional cigarettes—a product that kills half its long-term users. E-cigarette manufacturers target children with enticing candy and fruit flavors and use marketing strategies that have been previously successful with traditional cigarettes to attract youth to these products. Numerous toxicants and carcinogens have been found in e-cigarette solutions. Nonusers are involuntarily exposed to the emissions of these devices with secondhand and thirdhand aerosol. To prevent children, adolescents, and young adults from transitioning from e-cigarettes to traditional cigarettes and minimize the potential public health harm from e-cigarette use, there is a critical need for e-cigarette regulation, legislative action, and counterpromotion to protect youth. (1/19)
https://doi.org/10.1542/peds.2018-3652

EARLY CHILDHOOD ADVERSITY, TOXIC STRESS, AND THE ROLE OF THE PEDIATRICIAN: TRANSLATING DEVELOPMENTAL SCIENCE INTO LIFELONG HEALTH

Committee on Psychosocial Aspects of Child and Family Health; Committee on Early Childhood, Adoption, and Dependent Care; and Section on Developmental and Behavioral Pediatrics

ABSTRACT. Advances in a wide range of biological, behavioral, and social sciences are expanding our understanding of how early environmental influences (the ecology) and genetic predispositions (the biologic program) affect learning capacities, adaptive behaviors, lifelong physical and mental health, and adult productivity. A supporting technical report from the American Academy of Pediatrics (AAP) presents an integrated ecobiodevelopmental framework to assist in translating these dramatic advances in developmental science into improved health across the life span. Pediatricians are now armed with new information about the adverse effects of toxic stress on brain development, as well as a deeper understanding of the early life origins of many adult diseases. As trusted authorities in child health and development, pediatric providers must now complement the early identification of developmental concerns with a greater focus on those interventions and community investments that reduce external threats to healthy brain growth. To this end, AAP endorses a developing leadership role for the entire pediatric community—one that mobilizes the scientific expertise of both basic and clinical researchers, the family-centered care of the pediatric medical home, and the public influence of AAP and its state chapters—to catalyze fundamental change in early childhood policy and services. AAP is committed to leveraging science to inform the development of innovative strategies to reduce the precipitants of toxic stress in young children and to mitigate their negative effects on the course of development and health across the life span. (12/11, reaffirmed 7/16)
https://doi.org/10.1542/peds.2011-2662

EARLY CHILDHOOD CARIES IN INDIGENOUS COMMUNITIES

Steve Holve, MD; Patricia Braun, MD, MPH; James D. Irvine, MD; Kristen Nadeau, MD, MS; Robert J. Schroth, DMD, MSc, PhD; Committee on Native American Child Health; and Section on Oral Health (joint with Canadian Paediatric Society First Nations Inuit and Métis Health Committee)

ABSTRACT. The oral health of Indigenous children of Canada (First Nations, Inuit, and Métis) and the United States (American Indian and Alaska native) is a major child health disparity when compared with the general population of both countries. Early childhood caries (ECC) occurs in Indigenous children at an earlier age, with a higher prevalence, and at much greater severity than in the general population. ECC results in adverse oral health, affecting childhood health and well-being, and may result in high rates of costly surgical treatment under general anesthesia. ECC is an infectious disease that is influenced by multiple factors, but the social determinants of health are particularly important. This policy statement includes recommendations for preventive and clinical oral health care for infants, toddlers, preschool-aged children, and pregnant women by primary health care providers. It also addresses community-based health-promotion initiatives and access to dental care for Indigenous children. This policy statement encourages oral health interventions at early ages in Indigenous children, including referral to dental care for the use of sealants, interim therapeutic restorations, and silver diamine fluoride. Further community-based research on the microbiology, epidemiology, prevention, and management of ECC in Indigenous communities is also needed to reduce the dismally high rate of caries in this population. (5/21)
See full text on page 697.
https://doi.org/10.1542/peds.2021-051481

EARLY CHILDHOOD HOME VISITING

James H. Duffee, MD, MPH, FAAP; Alan L. Mendelsohn, MD, FAAP; Alice A. Kuo, MD, PhD, FAAP; Lori A. Legano, MD, FAAP; Marian F. Earls, MD, MTS, FAAP; Council on Community Pediatrics; Council on Early Childhood; and Committee on Child Abuse and Neglect

ABSTRACT. High-quality home-visiting services for infants and young children can improve family relationships, advance school readiness, reduce child maltreatment, improve maternal-infant health outcomes, and increase family economic self-sufficiency. The American Academy of Pediatrics supports unwavering federal funding of state home-visiting initiatives, the expansion of evidence-based programs, and a robust, coordinated national evaluation designed to confirm best practices and cost-efficiency. Community home visiting is most effective as a component of a comprehensive early childhood system that actively includes and enhances a family-centered medical home. (8/17)
https://doi.org/10.1542/peds.2017-2150

EARLY INTERVENTION, IDEA PART C SERVICES, AND THE MEDICAL HOME: COLLABORATION FOR BEST PRACTICE AND BEST OUTCOMES (CLINICAL REPORT)

Richard C. Adams, MD; Carl Tapia, MD; and Council on Children With Disabilities

ABSTRACT. The medical home and the Individuals With Disabilities Education Act Part C Early Intervention Program share many common purposes for infants and children ages 0 to 3 years, not the least of which is a family-centered focus. Professionals in pediatric medical home practices see substantial numbers of infants and toddlers with developmental delays and/or complex chronic conditions. Economic, health, and family-focused data each underscore the critical role of timely referral for relationship-based, individualized, accessible early intervention services and the need for collaborative partnerships in care. The medical home process and Individuals With Disabilities Education Act Part C policy both support nurturing relationships and family-centered care; both offer clear value in terms of economic and health outcomes. Best practice models for early intervention services incorporate learning in the natural environment and coaching models. Proactive medical homes provide strategies for effective developmental surveillance, family-centered resources, and tools to support high-risk groups, and comanagement of infants with special health care needs, including the monitoring of services provided and outcomes achieved. (9/13, reaffirmed 5/17)
https://doi.org/10.1542/peds.2013-2305

ECHOCARDIOGRAPHY IN INFANTS AND CHILDREN

Section on Cardiology

ABSTRACT. It is the intent of this statement to inform pediatric providers on the appropriate use of echocardiography. Although

on-site consultation may be impossible, methods should be established to ensure timely review of echocardiograms by a pediatric cardiologist. With advances in data transmission, echocardiography information can be exchanged, in some cases eliminating the need for a costly patient transfer. By cooperating through training, education, and referral, complete and cost-effective echocardiographic services can be provided to all children. (6/97, reaffirmed 3/03, 3/07)
https://doi.org/10.1542/peds.99.6.921

EFFECTIVE DISCIPLINE TO RAISE HEALTHY CHILDREN

Robert D. Sege, MD, PhD, FAAP; Benjamin S. Siegel, MD, FAAP; Council on Child Abuse and Neglect; and Committee on Psychosocial Aspects of Child and Family Health

ABSTRACT. Pediatricians are a source of advice for parents and guardians concerning the management of child behavior, including discipline strategies that are used to teach appropriate behavior and protect their children and others from the adverse effects of challenging behavior. Aversive disciplinary strategies, including all forms of corporal punishment and yelling at or shaming children, are minimally effective in the short-term and not effective in the long-term. With new evidence, researchers link corporal punishment to an increased risk of negative behavioral, cognitive, psychosocial, and emotional outcomes for children. In this Policy Statement, the American Academy of Pediatrics provides guidance for pediatricians and other child health care providers on educating parents about positive and effective parenting strategies of discipline for children at each stage of development as well as references to educational materials. This statement supports the need for adults to avoid physical punishment and verbal abuse of children. (11/18)
https://doi.org/10.1542/peds.2018-3112

THE EFFECTS OF ARMED CONFLICT ON CHILDREN

Sherry Shenoda, MD, FAAP; Ayesha Kadir, MD, MSc, FAAP; Shelly Pitterman, PhD; Jeffrey Goldhagen, MD, MPH, FAAP; and Section on International Child Health

ABSTRACT. Children are increasingly exposed to armed conflict and targeted by governmental and nongovernmental combatants. Armed conflict directly and indirectly affects children's physical, mental, and behavioral health. It can affect every organ system, and its impact can persist throughout the life course. In addition, children are disproportionately impacted by morbidity and mortality associated with armed conflict. A children's rights–based approach provides a framework for collaboration by the American Academy of Pediatrics, child health professionals, and national and international partners to respond in the domains of clinical care, systems development, and policy formulation. The American Academy of Pediatrics and child health professionals have critical and synergistic roles to play in the global response to the impact of armed conflict on children. (11/18)
https://doi.org/10.1542/peds.2018-2585

THE EFFECTS OF ARMED CONFLICT ON CHILDREN (TECHNICAL REPORT)

Ayesha Kadir, MD, MSc, FAAP; Sherry Shenoda, MD, FAAP; Jeffrey Goldhagen, MD, MPH, FAAP; Shelly Pitterman, PhD; and Section on International Child Health

ABSTRACT. More than 1 in 10 children worldwide are affected by armed conflict. The effects are both direct and indirect and are associated with immediate and long-term harm. The direct effects of conflict include death, physical and psychological trauma, and displacement. Indirect effects are related to a large number of factors, including inadequate and unsafe living conditions, environmental hazards, caregiver mental health, separation from family, displacement-related health risks, and the destruction of health, public health, education, and economic infrastructure. Children and health workers are targeted by combatants during attacks, and children are recruited or forced to take part in combat in a variety of ways. Armed conflict is both a toxic stress and a significant social determinant of child health. In this Technical Report, we review the available knowledge on the effects of armed conflict on children and support the recommendations in the accompanying Policy Statement on children and armed conflict. (11/18)
https://doi.org/10.1542/peds.2018-2586

THE EFFECTS OF EARLY NUTRITIONAL INTERVENTIONS ON THE DEVELOPMENT OF ATOPIC DISEASE IN INFANTS AND CHILDREN: THE ROLE OF MATERNAL DIETARY RESTRICTION, BREASTFEEDING, HYDROLYZED FORMULAS, AND TIMING OF INTRODUCTION OF ALLERGENIC COMPLEMENTARY FOODS (CLINICAL REPORT)

Frank R. Greer, MD, FAAP; Scott H. Sicherer, MD, FAAP; A. Wesley Burks, MD, FAAP; Committee on Nutrition; and Section on Allergy and Immunology

ABSTRACT. This clinical report updates and replaces a 2008 clinical report from the American Academy of Pediatrics, which addressed the roles of maternal and early infant diet on the prevention of atopic disease, including atopic dermatitis, asthma, and food allergy. As with the previous report, the available data still limit the ability to draw firm conclusions about various aspects of atopy prevention through early dietary interventions. Current evidence does not support a role for maternal dietary restrictions during pregnancy or lactation. Although there is evidence that exclusive breastfeeding for 3 to 4 months decreases the incidence of eczema in the first 2 years of life, there are no short- or long-term advantages for exclusive breastfeeding beyond 3 to 4 months for prevention of atopic disease. The evidence now suggests that any duration of breastfeeding ≥3 to 4 months is protective against wheezing in the first 2 years of life, and some evidence suggests that longer duration of any breastfeeding protects against asthma even after 5 years of age. No conclusions can be made about the role of breastfeeding in either preventing or delaying the onset of specific food allergies. There is a lack of evidence that partially or extensively hydrolyzed formula prevents atopic disease. There is no evidence that delaying the introduction of allergenic foods, including peanuts, eggs, and fish, beyond 4 to 6 months prevents atopic disease. There is now evidence that early introduction of peanuts may prevent peanut allergy. (3/19)
https://doi.org/10.1542/peds.2019-0281

ELECTRONIC COMMUNICATION OF THE HEALTH RECORD AND INFORMATION WITH PEDIATRIC PATIENTS AND THEIR GUARDIANS

Emily C. Webber, MD, FAAP, FAMIA; David Brick, MD, FAAP; James P. Scibilia, MD, FAAP; Peter Dehnel, MD, FAAP; Council on Clinical Information Technology; Committee on Medical Liability and Risk Management; and Section on Telehealth Care

ABSTRACT. Communication of health data has evolved rapidly with the widespread adoption of electronic health records (EHRs) and communication technology. What used to be sent to patients via paper mail, fax, or e-mail may now be accessed by patients via their EHRs, and patients may also communicate securely with their medical team via certified technology. Although EHR technologies have great potential, their most effective applications and uses for communication between pediatric and adolescent patients, guardians, and medical teams has not been realized. There are wide variations in available technologies, guiding policies, and practices; some physicians and patients are successful in using certified tools but others are forced to limit their patients' access to e-health data and associated communication altogether. In general, pediatric and adolescent patients are less likely than adult patients to have

electronic access and the ability to exchange health data. There are several reasons for these limitations, including inconsistent standards and recommendations regarding the recommended age for independent access, lack of routine EHR support for the ability to filter or proxy such access, and conflicting laws about patients' and physicians' rights to access EHRs and ability to communicate electronically. Effective, safe electronic exchange of health data requires active collaboration between physicians, patients, policy makers, and health information technology vendors. This policy statement addresses current best practices for these stakeholders and delineates the continued gaps and how to address them. (6/19)
https://doi.org/10.1542/peds.2019-1359

ELECTRONIC DOCUMENTATION IN PEDIATRICS: THE RATIONALE AND FUNCTIONALITY REQUIREMENTS

Heather C. O'Donnell, MD, MSc, FAAP; Srinivasan Suresh, MD, MBA, FAAP; and Council on Clinical Information Technology

ABSTRACT. Clinical documentation is a fundamental component of the practice of medicine. It has significantly evolved over the past decade, largely because of the growth of health information technology and electronic health records. Although government agencies and other professional organizations have published position statements on the structure and use of electronic documentation, few have specifically addressed the documentation needs for the care of children. A policy statement on electronic documentation of clinical care by general pediatric and subspecialist providers by the American Academy of Pediatrics is needed. This statement provides insight on the unmet needs of key stakeholders to direct future research and development of the electronic media necessary to enhance the wellness of children and improve health care delivery. It also addresses the challenges and opportunities for efficient and effective clinical documentation in pediatrics. (6/20)
https://doi.org/10.1542/peds.2020-1682

ELECTRONIC DOCUMENTATION IN PEDIATRICS: THE RATIONALE AND FUNCTIONALITY REQUIREMENTS (TECHNICAL REPORT)

Heather C. O'Donnell, MD, MSc, FAAP; Srinivasan Suresh, MD, MBA, FAAP; and Council on Clinical Information Technology

ABSTRACT. Clinical documentation has dramatically changed since the implementation and use of electronic health records and electronic provider documentation. The purpose of this report is to review these changes and promote the development of standards and best practices for electronic documentation for pediatric patients. In this report, we evaluate the unique aspects of clinical documentation for pediatric care, including specialized information needs and stakeholders specific to the care of children. Additionally, we explore new models of documentation, such as shared documentation, in which patients may be both authors and consumers, and among care teams while still maintaining the ability to clearly define care and services provided to patients in a given day or encounter. Finally, we describe alternative documentation techniques and newer technologies that could improve provider efficiency and the reuse of clinical data. (6/20)
https://doi.org/10.1542/peds.2020-1684

ELECTRONIC PRESCRIBING IN PEDIATRICS: TOWARD SAFER AND MORE EFFECTIVE MEDICATION MANAGEMENT

Council on Clinical Information Technology

ABSTRACT. This policy statement identifies the potential value of electronic prescribing (e-prescribing) systems in improving quality and reducing harm in pediatric health care. On the basis of limited but positive pediatric data and on the basis of federal statutes that provide incentives for the use of e-prescribing systems, the American Academy of Pediatrics recommends the adoption of e-prescribing systems with pediatric functionality. The American Academy of Pediatrics also recommends a set of functions that technology vendors should provide when e-prescribing systems are used in environments in which children receive care. (3/13, reaffirmed 12/18)
https://doi.org/10.1542/peds.2013-0192

ELECTRONIC PRESCRIBING IN PEDIATRICS: TOWARD SAFER AND MORE EFFECTIVE MEDICATION MANAGEMENT (TECHNICAL REPORT)

Kevin B. Johnson, MD, MS; Christoph U. Lehmann, MD; and Council on Clinical Information Technology

ABSRACT. This technical report discusses recent advances in electronic prescribing (e-prescribing) systems, including the evidence base supporting their limitations and potential benefits. Specifically, this report acknowledges that there are limited but positive pediatric data supporting the role of e-prescribing in mitigating medication errors, improving communication with dispensing pharmacists, and improving medication adherence. On the basis of these data and on the basis of federal statutes that provide incentives for the use of e-prescribing systems, the American Academy of Pediatrics recommends the adoption of e-prescribing systems with pediatric functionality. This report supports the accompanying policy statement from the American Academy of Pediatrics recommending the adoption of e-prescribing by pediatric health care providers. (3/13, reaffirmed 12/18)
https://doi.org/10.1542/peds.2013-0193

ELIMINATION OF PERINATAL HEPATITIS B: PROVIDING THE FIRST VACCINE DOSE WITHIN 24 HOURS OF BIRTH

Committee on Infectious Diseases and Committee on Fetus and Newborn

ABSTRACT. After the introduction of the hepatitis B vaccine in the United States in 1982, a greater than 90% reduction in new infections was achieved. However, approximately 1000 new cases of perinatal hepatitis B infection are still identified annually in the United States. Prevention of perinatal hepatitis B relies on the proper and timely identification of infants born to mothers who are hepatitis B surface antigen positive and to mothers with unknown status to ensure administration of appropriate postexposure immunoprophylaxis with hepatitis B vaccine and immune globulin. To reduce the incidence of perinatal hepatitis B transmission further, the American Academy of Pediatrics endorses the recommendation of the Advisory Committee on Immunization Practices of the Centers for Disease Control and Prevention that all newborn infants with a birth weight of greater than or equal to 2000 g receive hepatitis B vaccine by 24 hours of age. (8/17)
https://doi.org/10.1542/peds.2017-1870

EMERGENCY CONTRACEPTION

Krishna K. Upadhya, MD, MPH, FAAP, and Committee on Adolescence

ABSTRACT. Despite significant declines over the past 2 decades, the United States continues to experience birth rates among teenagers that are significantly higher than other high-income nations. Use of emergency contraception (EC) within 120 hours after unprotected or underprotected intercourse can reduce the risk of pregnancy. Emergency contraceptive methods include oral medications labeled and dedicated for use as EC by the US Food and Drug Administration (ulipristal and levonorgestrel), the "off-label" use of combined oral contraceptives, and insertion of a copper intrauterine device. Indications for the use of EC include intercourse without use of contraception; condom breakage or slippage; missed or late doses of contraceptives, including the oral contraceptive pill, contraceptive patch, contraceptive

ring, and injectable contraception; vomiting after use of oral contraceptives; and sexual assault. Our aim in this updated policy statement is to (1) educate pediatricians and other physicians on available emergency contraceptive methods; (2) provide current data on the safety, efficacy, and use of EC in teenagers; and (3) encourage routine counseling and advance EC prescription as 1 public health strategy to reduce teenaged pregnancy. (11/19)
https://doi.org/10.1542/peds.2019-3149

EMERGENCY INFORMATION FORMS AND EMERGENCY PREPAREDNESS FOR CHILDREN WITH SPECIAL HEALTH CARE NEEDS

Committee on Pediatric Emergency Medicine and Council on Clinical Information Technology (joint with American College of Emergency Physicians Pediatric Emergency Medicine Committee)

ABSTRACT. Children with chronic medical conditions rely on complex management plans for problems that cause them to be at increased risk for suboptimal outcomes in emergency situations. The emergency information form (EIF) is a medical summary that describes medical condition(s), medications, and special health care needs to inform health care providers of a child's special health conditions and needs so that optimal emergency medical care can be provided. This statement describes updates to EIFs, including computerization of the EIF, expanding the potential benefits of the EIF, quality-improvement programs using the EIF, the EIF as a central repository, and facilitating emergency preparedness in disaster management and drills by using the EIF. (3/10, reaffirmed 7/14, 10/14)
https://doi.org/10.1542/peds.2010-0186

EMERGING ISSUES IN MALE ADOLESCENT SEXUAL AND REPRODUCTIVE HEALTH CARE (CLINICAL REPORT)

Laura K. Grubb, MD, MPH, FAAP; Makia Powers, MD, MPH, MSc, FAAP; and Committee on Adolescence

ABSTRACT. Pediatricians are encouraged to address male adolescent sexual and reproductive health on a regular basis, including taking a sexual history, discussing healthy sexuality, performing an appropriate physical examination, providing patient-centered and age-appropriate anticipatory guidance, and administering appropriate vaccinations. These services can be provided to male adolescent patients in a confidential and culturally appropriate manner, can promote healthy sexual relationships and responsibility, can and involve parents in age-appropriate discussions about sexual health. (4/20)
https://doi.org/10.1542/peds.2020-0627

ENDORSEMENT OF HEALTH AND HUMAN SERVICES RECOMMENDATION FOR PULSE OXIMETRY SCREENING FOR CRITICAL CONGENITAL HEART DISEASE

Section on Cardiology and Cardiac Surgery Executive Committee

ABSTRACT. Incorporation of pulse oximetry to the assessment of the newborn infant can enhance detection of critical congenital heart disease (CCHD). Recently, the Secretary of Health and Human Services (HHS) recommended that screening for CCHD be added to the uniform screening panel. The American Academy of Pediatrics (AAP) has been a strong advocate of early detection of CCHD and fully supports the decision of the Secretary of HHS.

The AAP has published strategies for the implementation of pulse oximetry screening, which addressed critical issues such as necessary equipment, personnel, and training, and also provided specific recommendations for assessment of saturation by using pulse oximetry as well as appropriate management of a positive screening result. The AAP is committed to the safe and effective implementation of pulse oximetry screening and is working with other advocacy groups and governmental agencies to promote pulse oximetry and to support widespread surveillance for CCHD.

Going forward, AAP chapters will partner with state health departments to implement the new screening strategy for CCHD and will work to ensure that there is an adequate system for referral for echocardiographic/pediatric cardiac evaluation after a positive screening result. It is imperative that AAP members engage their respective policy makers in adopting and funding the recommendations made by the Secretary of HHS. (12/11)
https://doi.org/10.1542/peds.2011-3211

ENHANCING PEDIATRIC WORKFORCE DIVERSITY AND PROVIDING CULTURALLY EFFECTIVE PEDIATRIC CARE: IMPLICATIONS FOR PRACTICE, EDUCATION, AND POLICY MAKING

Committee on Pediatric Workforce

ABSTRACT. This policy statement serves to combine and update 2 previously independent but overlapping statements from the American Academy of Pediatrics (AAP) on culturally effective health care (CEHC) and workforce diversity. The AAP has long recognized that with the ever-increasing diversity of the pediatric population in the United States, the health of all children depends on the ability of all pediatricians to practice culturally effective care. CEHC can be defined as the delivery of care within the context of appropriate physician knowledge, understanding, and appreciation of all cultural distinctions, leading to optimal health outcomes. The AAP believes that CEHC is a critical social value and that the knowledge and skills necessary for providing CEHC can be taught and acquired through focused curricula across the spectrum of lifelong learning.

This statement also addresses workforce diversity, health disparities, and affirmative action. The discussion of diversity is broadened to include not only race, ethnicity, and language but also cultural attributes such as gender, religious beliefs, sexual orientation, and disability, which may affect the quality of health care. The AAP believes that efforts must be supported through health policy and advocacy initiatives to promote the delivery of CEHC and to overcome educational, organizational, and other barriers to improving workforce diversity. (9/13, reaffirmed 10/15)
https://doi.org/10.1542/peds.2013-2268

ENSURING COMPREHENSIVE CARE AND SUPPORT FOR TRANSGENDER AND GENDER-DIVERSE CHILDREN AND ADOLESCENTS

Jason Rafferty, MD, MPH, EdM, FAAP; Committee on Psychosocial Aspects of Child and Family Health; Committee on Adolescence; and Section on Lesbian, Gay, Bisexual, and Transgender Health and Wellness

ABSTRACT. As a traditionally underserved population that faces numerous health disparities, youth who identify as transgender and gender diverse (TGD) and their families are increasingly presenting to pediatric providers for education, care, and referrals. The need for more formal training, standardized treatment, and research on safety and medical outcomes often leaves providers feeling ill equipped to support and care for patients that identify as TGD and families. In this policy statement, we review relevant concepts and challenges and provide suggestions for pediatric providers that are focused on promoting the health and positive development of youth that identify as TGD while eliminating discrimination and stigma. (9/18)
https://doi.org/10.1542/peds.2018-2162

ENSURING THE HEALTH OF CHILDREN IN DISASTERS

Disaster Preparedness Advisory Council and Committee on Pediatric Emergency Medicine

ABSTRACT. Infants, children, adolescents, and young adults have unique physical, mental, behavioral, developmental, communication, therapeutic, and social needs that must be addressed and met in all aspects of disaster preparedness, response, and

recovery. Pediatricians, including primary care pediatricians, pediatric medical subspecialists, and pediatric surgical specialists, have key roles to play in preparing and treating families in cases of disasters. Pediatricians should attend to the continuity of practice operations to provide services in time of need and stay abreast of disaster and public health developments to be active participants in community planning efforts. Federal, state, tribal, local, and regional institutions and agencies that serve children should collaborate with pediatricians to ensure the health and well-being of children in disasters. (10/15, reaffirmed 4/21)
https://doi.org/10.1542/peds.2015-3112

EPIDEMIOLOGY AND DIAGNOSIS OF HEALTH CARE–ASSOCIATED INFECTIONS IN THE NICU (TECHNICAL REPORT)

Committee on Fetus and Newborn and Committee on Infectious Diseases

ABSTRACT. Health care–associated infections in the NICU are a major clinical problem resulting in increased morbidity and mortality, prolonged length of hospital stays, and increased medical costs. Neonates are at high risk for health care–associated infections because of impaired host defense mechanisms, limited amounts of protective endogenous flora on skin and mucosal surfaces at time of birth, reduced barrier function of neonatal skin, the use of invasive procedures and devices, and frequent exposure to broad-spectrum antibiotics. This statement will review the epidemiology and diagnosis of health care–associated infections in newborn infants. (3/12, reaffirmed 2/16)
https://doi.org/10.1542/peds.2012-0147

EPINEPHRINE FOR FIRST-AID MANAGEMENT OF ANAPHYLAXIS (CLINICAL REPORT)

Scott H. Sicherer, MD, FAAP; F. Estelle R. Simons, MD, FAAP; and Section on Allergy and Immunology

ABSTRACT. Anaphylaxis is a severe, generalized allergic or hypersensitivity reaction that is rapid in onset and may cause death. Epinephrine (adrenaline) can be life-saving when administered as rapidly as possible once anaphylaxis is recognized. This clinical report from the American Academy of Pediatrics is an update of the 2007 clinical report on this topic. It provides information to help clinicians identify patients at risk of anaphylaxis and new information about epinephrine and epinephrine autoinjectors (EAs). The report also highlights the importance of patient and family education about the recognition and management of anaphylaxis in the community. Key points emphasized include the following: (1) validated clinical criteria are available to facilitate prompt diagnosis of anaphylaxis; (2) prompt intramuscular epinephrine injection in the mid-outer thigh reduces hospitalizations, morbidity, and mortality; (3) prescribing EAs facilitates timely epinephrine injection in community settings for patients with a history of anaphylaxis and, if specific circumstances warrant, for some high-risk patients who have not previously experienced anaphylaxis; (4) prescribing epinephrine for infants and young children weighing <15 kg, especially those who weigh 7.5 kg and under, currently presents a dilemma, because the lowest dose available in EAs, 0.15 mg, is a high dose for many infants and some young children; (5) effective management of anaphylaxis in the community requires a comprehensive approach involving children, families, preschools, schools, camps, and sports organizations; and (6) prevention of anaphylaxis recurrences involves confirmation of the trigger, discussion of specific allergen avoidance, allergen immunotherapy (eg, with stinging insect venom, if relevant), and a written, personalized anaphylaxis emergency action plan; and (7) the management of anaphylaxis also involves education of children and supervising adults about anaphylaxis recognition and first-aid treatment. (2/17)
https://doi.org/10.1542/peds.2016-4006

EQUIPMENT FOR GROUND AMBULANCES

American Academy of Pediatrics (joint with American College of Emergency Physicians, American College of Surgeons Committee on Trauma, Emergency Medical Services for Children, Emergency Nurses Association, National Association of EMS Physicians, and National Association of State EMS Officials)

On January 1, 2014, the American Academy of Pediatrics, American College of Emergency Physicians, American College of Surgeons Committee on Trauma, Emergency Medical Services for Children, Emergency Nurses Association, National Association of EMS Physicians, and National Association of State EMS Officials coauthored a joint policy statement, "Equipment for Ground Ambulances" (*Prehosp Emerg Care.* 2014;19[1]:92–97). The full text of the joint policy statement is available at: http://informahealthcare.com/doi/full/10.3109/10903127.2013.851312. (8/14, reaffirmed 1/20)
https://doi.org/10.1542/peds.2014-1698

ERADICATING POLIO: HOW THE WORLD'S PEDIATRICIANS CAN HELP STOP THIS CRIPPLING ILLNESS FOREVER (CLINICAL REPORT)

Walter A. Orenstein, MD, FAAP, and Committee on Infectious Diseases

ABSTRACT. The American Academy of Pediatrics strongly supports the Polio Eradication and Endgame Strategic Plan of the Global Polio Eradication Initiative. This plan was endorsed in November 2012 by the Strategic Advisory Group of Experts on Immunization of the World Health Organization and published by the World Health Organization in April 2013. As a key component of the plan, it will be necessary to stop oral polio vaccine (OPV) use globally to achieve eradication, because the attenuated viruses in the vaccine rarely can cause polio. The plan includes procedures for elimination of vaccine-associated paralytic polio and circulating vaccine-derived polioviruses (cVDPVs). cVDPVs can proliferate when vaccine viruses are transmitted among susceptible people, resulting in mutations conferring both the neurovirulence and transmissibility characteristics of wild polioviruses. Although there are 3 different types of wild poliovirus strains, the polio eradication effort has already resulted in the global elimination of type 2 poliovirus for more than a decade. Type 3 poliovirus may be eliminated because the wild type 3 poliovirus was last detected in 2012. Thus, of the 3 wild types, only wild type 1 poliovirus is still known to be circulating and causing disease. OPV remains the key vaccine for eradicating wild polioviruses in polio-infected countries because it induces high levels of systemic immunity to prevent paralysis and intestinal immunity to reduce transmission. However, OPV is a rare cause of paralysis and the substantial decrease in wild-type disease has resulted in estimates that the vaccine is causing more polio-related paralysis annually in recent years than the wild virus. The new endgame strategic plan calls for stepwise removal of the type 2 poliovirus component from trivalent oral vaccines, because type 2 wild poliovirus appears to have been eradicated (since 1999) and yet is the main cause of cVDPV outbreaks and approximately 40% of vaccine-associated paralytic polio cases. The Endgame and Strategic Plan will be accomplished by shifting from trivalent OPV to bivalent OPV (containing types 1 and 3 poliovirus only). It will be necessary to introduce trivalent inactivated poliovirus vaccine (IPV) into routine immunization programs in all countries using OPV to provide population immunity to type 2 before the switch from trivalent OPV to bivalent OPV. The Global Polio Eradication Initiative hopes to achieve global eradication of polio by 2018 with this strategy, after which all OPV use will be stopped. Challenges expected for adding IPV into routine immunization schedules include higher cost of IPV compared with OPV, cold-chain capacity limits, more complex administration of vaccine because IPV requires injections as opposed to oral administra-

tion, and inferior intestinal immunity conferred by IPV. The goal of this report is to help pediatricians understand the change in strategy and outline ways that pediatricians can help global polio eradication efforts, including advocating for the resources needed to accomplish polio eradication and for incorporation of IPV into routine immunization programs in all countries. (12/14, reaffirmed 5/19)
https://doi.org/10.1542/peds.2014-3163

ESSENTIAL CONTRACTUAL LANGUAGE FOR MEDICAL NECESSITY IN CHILDREN

Committee on Child Health Financing

ABSTRACT. The previous policy statement from the American Academy of Pediatrics, "Model Language for Medical Necessity in Children," was published in July 2005. Since that time, there have been new and emerging delivery and payment models. The relationship established between health care providers and health plans should promote arrangements that are beneficial to all who are affected by these contractual arrangements. Pediatricians play an important role in ensuring that the needs of children are addressed in these emerging systems. It is important to recognize that health care plans designed for adults may not meet the needs of children. Language in health care contracts should reflect the health care needs of children and families. Informed pediatricians can make a difference in the care of children and influence the role of primary care physicians in the new paradigms. This policy highlights many of the important elements pediatricians should assess as providers develop a role in emerging care models. (7/13, reaffirmed 9/17)
https://doi.org/10.1542/peds.2013-1637

ESTABLISHING A STANDARD PROTOCOL FOR THE VOIDING CYSTOURETHROGRAPHY (CLINICAL REPORT)

Dominic Frimberger, MD; Maria-Gisela Mercado-Deane, MD, FAAP; Section on Urology; and Section on Radiology

ABSTRACT. The voiding cystourethrogram (VCUG) is a frequently performed test to diagnose a variety of urologic conditions, such as vesicoureteral reflux. The test results determine whether continued observation or an interventional procedure is indicated. VCUGs are ordered by many specialists and primary care providers, including pediatricians, family practitioners, nephrologists, hospitalists, emergency department physicians, and urologists. Current protocols for performing and interpreting a VCUG are based on the International Reflux Study in 1985. However, more recent information provided by many national and international institutions suggests a need to refine those recommendations. The lead author of the 1985 study, R.L. Lebowitz, agreed to and participated in the current protocol. In addition, a recent survey directed to the chairpersons of pediatric radiology of 65 children's hospitals throughout the United States and Canada showed that VCUG protocols vary substantially. Recent guidelines from the American Academy of Pediatrics (AAP) recommend a VCUG for children between 2 and 24 months of age with urinary tract infections but did not specify how this test should be performed. To improve patient safety and to standardize the data obtained when a VCUG is performed, the AAP Section on Radiology and the AAP Section on Urology initiated the current VCUG protocol to create a consensus on how to perform this test. (10/16)
https://doi.org/10.1542/peds.2016-2590

ETHICAL AND POLICY ISSUES IN GENETIC TESTING AND SCREENING OF CHILDREN

Committee on Bioethics and Committee on Genetics (joint with American College of Medical Genetics and Genomics)

ABSTRACT. The genetic testing and genetic screening of children are commonplace. Decisions about whether to offer genetic testing and screening should be driven by the best interest of the child. The growing literature on the psychosocial and clinical effects of such testing and screening can help inform best practices. This policy statement represents recommendations developed collaboratively by the American Academy of Pediatrics and the American College of Medical Genetics and Genomics with respect to many of the scenarios in which genetic testing and screening can occur. (2/13, reaffirmed 6/18)
https://doi.org/10.1542/peds.2012-3680

ETHICAL CONSIDERATIONS IN PEDIATRICIANS' USE OF SOCIAL MEDIA (CLINICAL REPORT)

Robert Macauley, MD, FAAP; Nanette Elster, JD, MPH; Jonathan M. Fanaroff, MD, JD, FAAP; Committee on Bioethics; and Committee on Medical Liability and Risk Management

ABSTRACT. Increasing use of social media by patients and clinicians creates opportunities as well as dilemmas for pediatricians, who must recognize the inherent ethical and legal complexity of these communication platforms and maintain professionalism in all contexts. Social media can be a useful tool in the practice of medicine by educating both physicians and patients, expanding access to health care, identifying high-risk behaviors, contributing to research, promoting networking and online support, enhancing advocacy, and nurturing professional compassion. At the same time, there are confidentiality, privacy, professionalism, and boundary issues that need to be considered whenever potential interactions occur between physicians and patients via social media. This clinical report is designed to assist pediatricians in identifying and navigating ethical issues to harness the opportunities and avoid the pitfalls of social media. (2/21)
See full text on page 711.
https://doi.org/10.1542/peds.2020-049685

ETHICAL CONSIDERATIONS IN RESEARCH WITH SOCIALLY IDENTIFIABLE POPULATIONS

Committee on Native American Child Health and Committee on Community Health Services

ABSTRACT. Community-based research raises ethical issues not normally encountered in research conducted in academic settings. In particular, conventional risk-benefits assessments frequently fail to recognize harms that can occur in socially identifiable populations as a result of research participation. Furthermore, many such communities require more stringent measures of beneficence that must be applied directly to the participating communities. In this statement, the American Academy of Pediatrics sets forth recommendations for minimizing harms that may result from community-based research by emphasizing community involvement in the research process. (1/04, reaffirmed 10/07, 1/13)
https://doi.org/10.1542/peds.113.1.148

ETHICAL CONTROVERSIES IN ORGAN DONATION AFTER CIRCULATORY DEATH

Committee on Bioethics

ABSTRACT. The persistent mismatch between the supply of and need for transplantable organs has led to efforts to increase the supply, including controlled donation after circulatory death (DCD). Controlled DCD involves organ recovery after the planned withdrawal of life-sustaining treatment and the declaration of death according to the cardiorespiratory criteria. Two central ethical issues in DCD are when organ recovery can begin and how to manage conflicts of interests. The "dead donor rule" should be maintained, and donors in cases of DCD should only be declared dead after the permanent cessation of circulatory function. Permanence is generally established by a 2- to 5-minute waiting period. Given ongoing controversy over whether the cessation must also be irreversible, physicians should not be required to participate in DCD. Because the preparation for organ recovery in DCD begins before the declaration

of death, there are potential conflicts between the donor's and recipient's interests. These conflicts can be managed in a variety of ways, including informed consent and separating the various participants' roles. For example, informed consent should be sought for premortem interventions to improve organ viability, and organ procurement organization personnel and members of the transplant team should not be involved in the discontinuation of life-sustaining treatment or the declaration of death. It is also important to emphasize that potential donors in cases of DCD should receive integrated interdisciplinary palliative care, including sedation and analgesia. (4/13, reaffirmed 12/16)
https://doi.org/10.1542/peds.2013-0672

EVALUATING CHILDREN WITH FRACTURES FOR CHILD PHYSICAL ABUSE (CLINICAL REPORT)

Emalee G. Flaherty, MD, FAAP; Jeannette M. Perez-Rossello, MD; Michael A. Levine, MD; William L. Hennrikus, MD; Committee on Child Abuse and Neglect; Section on Radiology; Section on Endocrinology; and Section on Orthopaedics (joint with Society for Pediatric Radiology)

ABSTRACT. Fractures are common injuries caused by child abuse. Although the consequences of failing to diagnose an abusive injury in a child can be grave, incorrectly diagnosing child abuse in a child whose fractures have another etiology can be distressing for a family. The aim of this report is to review recent advances in the understanding of fracture specificity, the mechanism of fractures, and other medical diseases that predispose to fractures in infants and children. This clinical report will aid physicians in developing an evidence-based differential diagnosis and performing the appropriate evaluation when assessing a child with fractures. (1/14)
https://doi.org/10.1542/peds.2013-3793

EVALUATING FOR SUSPECTED CHILD ABUSE: CONDITIONS THAT PREDISPOSE TO BLEEDING (TECHNICAL REPORT)

Shannon L. Carpenter, MD, MS; Thomas C. Abshire, MD; James D. Anderst, MD, MS; Section on Hematology/Oncology; and Committee on Child Abuse and Neglect

ABSTRACT. Child abuse might be suspected when children present with cutaneous bruising, intracranial hemorrhage, or other manifestations of bleeding. In these cases, it is necessary to consider medical conditions that predispose to easy bleeding/bruising. When evaluating for the possibility of bleeding disorders and other conditions that predispose to hemorrhage, the pediatrician must consider the child's presenting history, medical history, and physical examination findings before initiating a laboratory investigation. Many medical conditions can predispose to easy bleeding. Before ordering laboratory tests for a disease, it is useful to understand the biochemical basis and clinical presentation of the disorder, condition prevalence, and test characteristics. This technical report reviews the major medical conditions that predispose to bruising/bleeding and should be considered when evaluating for abusive injury. (3/13, reaffirmed 7/16)
https://doi.org/10.1542/peds.2013-0196

EVALUATION AND MANAGEMENT OF CHILDREN AND ADOLESCENTS WITH ACUTE MENTAL HEALTH OR BEHAVIORAL PROBLEMS. PART I: COMMON CLINICAL CHALLENGES OF PATIENTS WITH MENTAL HEALTH AND/OR BEHAVIORAL EMERGENCIES (CLINICAL REPORT)

Thomas H. Chun, MD, MPH, FAAP; Sharon E. Mace, MD, FAAP, FACEP; Emily R. Katz, MD, FAAP; and Committee on Pediatric Emergency Medicine (joint with American College of Emergency Physicians Pediatric Emergency Medicine Committee)

INTRODUCTION. Mental health problems are among the leading contributors to the global burden of disease. Unfortunately, pediatric populations are not spared of mental health problems. In the United States, 21% to 23% of children and adolescents have a diagnosable mental health or substance use disorder. Among patients of emergency departments (EDs), 70% screen positive for at least 1 mental health disorder, 23% meet criteria for 2 or more mental health concerns, 45% have a mental health problem resulting in impaired psychosocial functioning, and 10% of adolescents endorse significant levels of psychiatric distress at the time of their ED visit. In pediatric primary care settings, the reported prevalence of mental health and behavioral disorders is between 12% to 22% of children and adolescents.

Although the American Academy of Pediatrics (AAP) has published a policy statement on mental health competencies and a Mental Health Toolkit for pediatric primary care providers, no such guidelines or resources exist for clinicians who care for pediatric mental health emergencies. This clinical report supports the 2006 joint policy statement of the AAP and American College of Emergency Physicians (ACEP) on pediatric mental health emergencies, with the goal of addressing the knowledge gaps in this area. The report is written primarily from the perspective of ED clinicians, but it is intended for all clinicians who care for children and adolescents with acute mental health and behavioral problems.

Recent epidemiologic studies of mental health visits have revealed a rapid burgeoning of both ED and primary care visits. An especially problematic trend is the increase in "boarding" of psychiatric patients in the ED and inpatient pediatric beds (ie, extended stays lasting days or even weeks). Although investigation of boarding practices is still in its infancy, the ACEP and the American Medical Association have both expressed concern about it, because it significantly taxes the functioning and efficiency of both the ED and hospital, and mental health services may not be available in the ED.

In addition, compared with other pediatric care settings, ED patients are known to be at higher risk of mental health disorders, including depression, anxiety, posttraumatic stress disorder, and substance abuse. These mental health conditions may be unrecognized not only by treating clinicians but also by the child/adolescent and his or her parents. A similar phenomenon has been described with suicidal patients. Individuals who have committed suicide frequently visited a health care provider in the months preceding their death. Although a minority of suicidal patients present with some form of self-harm, many have vague somatic complaints (eg, headache, gastrointestinal tract distress, back pain, concern for a sexually transmitted infection) masking their underlying mental health condition.

Despite studies demonstrating moderate agreement between emergency physicians and psychiatrists in the assessment and management of patients with mental health problems, ED clinicians frequently cite lack of training and confidence in their abilities as barriers to caring for patients with mental health emergencies. Another study of emergency medicine and pediatric emergency medicine training programs found that formal training in psychiatric problems is not required nor offered by most programs. Pediatric primary care providers report similar barriers to caring for their patients with mental health problems.

Part I of this clinical report focuses on the issues relevant to patients presenting to the ED with a mental health chief complaint and covers the following topics:

- Medical clearance of pediatric psychiatric patients
- Suicidal ideation and suicide attempts
- Involuntary hospitalization
- Restraint of the agitated patient
  - — Verbal restraint
  - — Chemical restraint
  - — Physical restraint
- Coordination with the medical home

Part II discusses challenging patients with primarily medical or indeterminate presentations, in which the contribution of an underlying mental health condition may be unclear or a complicating factor, including:

- Somatic symptom and related disorders
- Adverse effects to psychiatric medications
  — Antipsychotic adverse effects
  — Neuroleptic malignant syndrome
  — Serotonin syndrome
- Children with special needs in the ED (autism spectrum and developmental disorders)
- Mental health screening in the ED

An executive summary of this clinical report can be found at www.pediatrics.org/cgi/doi/10.1542/peds.2016-1571. (8/16)
https://doi.org/10.1542/peds.2016-1570

EVALUATION AND MANAGEMENT OF CHILDREN AND ADOLESCENTS WITH ACUTE MENTAL HEALTH OR BEHAVIORAL PROBLEMS. PART I: COMMON CLINICAL CHALLENGES OF PATIENTS WITH MENTAL HEALTH AND/OR BEHAVIORAL EMERGENCIES—EXECUTIVE SUMMARY (CLINICAL REPORT)

Thomas H. Chun, MD, MPH, FAAP; Sharon E. Mace, MD, FAAP, FACEP; Emily R. Katz, MD, FAAP; and Committee on Pediatric Emergency Medicine (joint with American College of Emergency Physicians Pediatric Emergency Medicine Committee)

ABSTRACT. The number of children and adolescents seen in emergency departments (EDs) and primary care settings for mental health problems has skyrocketed in recent years, with up to 23% of patients in both settings having diagnosable mental health conditions. Even when a mental health problem is not the focus of an ED or primary care visit, mental health conditions, both known and occult, may challenge the treating clinician and complicate the patient's care.

Although the American Academy of Pediatrics has published a policy statement on mental health competencies and a Mental Health Toolkit for pediatric primary care providers, no such guidelines or resources exist for clinicians who care for pediatric mental health emergencies. Many ED and primary care physicians report a paucity of training and lack of confidence in caring for pediatric psychiatry patients. The 2 clinical reports (www.pediatrics.org/cgi/doi/10.1542/peds.2016-1570 and www.pediatrics.org/cgi/doi/10.1542/peds.2016-1573) support the 2006 joint policy statement of the American Academy of Pediatrics and the American College of Emergency Physicians on pediatric mental health emergencies, with the goal of addressing the knowledge gaps in this area. Although written primarily from the perspective of ED clinicians, they are intended for all clinicians who care for children and adolescents with acute mental health and behavioral problems.

The clinical reports are organized around the common clinical challenges pediatric caregivers face, both when a child or adolescent presents with a psychiatric chief complaint or emergency (part I) and also when a mental health condition may be an unclear or complicating factor in a non–mental health clinical presentation (part II). Part II of the clinical reports (www.pediatrics.org/cgi/doi/10.1542/peds.2016-1573) includes discussions of somatic symptom and related disorders, adverse effects of psychiatric medications including neuroleptic malignant syndrome and serotonin syndrome, caring for children with special needs such as autism and developmental disorders, and mental health screening. This executive summary is an overview of part I of the clinical reports. The full text of the below topics can be accessed online at (www.pediatrics.org/cgi/doi/10.1542/peds.2016-1570). (8/16)
https://doi.org/10.1542/peds.2016-1571

EVALUATION AND MANAGEMENT OF CHILDREN WITH ACUTE MENTAL HEALTH OR BEHAVIORAL PROBLEMS. PART II: RECOGNITION OF CLINICALLY CHALLENGING MENTAL HEALTH RELATED CONDITIONS PRESENTING WITH MEDICAL OR UNCERTAIN SYMPTOMS (CLINICAL REPORT)

Thomas H. Chun, MD, MPH, FAAP; Sharon E. Mace, MD, FAAP, FACEP; Emily R. Katz, MD, FAAP; and Committee on Pediatric Emergency Medicine (joint with American College of Emergency Physicians Pediatric Emergency Medicine Committee)

INTRODUCTION. Part I of this clinical report (http://www.pediatrics.org/cgi/doi/10.1542/peds.2016-1570) discusses the common clinical issues that may be encountered in caring for children and adolescents presenting to the emergency department (ED) or primary care setting with a mental health condition or emergency and includes the following:

- Medical clearance of pediatric psychiatric patients
- Suicidal ideation and suicide attempts
- Involuntary hospitalization
- Restraint of the agitated patient
  — Verbal restraint
  — Chemical restraint
  — Physical restraint
- Coordination with the medical home

Part II discusses the challenges a pediatric clinician may face when evaluating patients with a mental health condition, which may be contributing to or a complicating factor for a medical or indeterminate clinical presentation. Topics covered include the following:

- Somatic symptom and related disorders
- Adverse effects of psychiatric medications
  — Antipsychotic adverse effects
  — Neuroleptic malignant syndrome
  — Serotonin syndrome
- Children with special needs (autism spectrum disorders [ASDs] and developmental disorders [DDs])
- Mental health screening

The report is written primarily from the perspective of ED clinicians, but it is intended for all clinicians who care for children and adolescents with acute mental health and behavioral problems. An executive summary of this clinical report can be found at http://www.pediatrics.org/cgi/doi/10.1542/peds.2016-1574. (8/16)
https://doi.org/10.1542/peds.2016-1573

EVALUATION AND MANAGEMENT OF CHILDREN WITH ACUTE MENTAL HEALTH OR BEHAVIORAL PROBLEMS. PART II: RECOGNITION OF CLINICALLY CHALLENGING MENTAL HEALTH RELATED CONDITIONS PRESENTING WITH MEDICAL OR UNCERTAIN SYMPTOMS—EXECUTIVE SUMMARY (CLINICAL REPORT)

Thomas H. Chun, MD, MPH, FAAP; Sharon E. Mace, MD, FAAP, FACEP; Emily R. Katz, MD, FAAP; and Committee on Pediatric Emergency Medicine (joint with American College of Emergency Physicians Pediatric Emergency Medicine Committee)

ABSTRACT. The number of children and adolescents seen in emergency departments (EDs) and primary care settings for mental health problems has skyrocketed in recent years, with up to 23% of patients in both settings having diagnosable mental health conditions. Even when a mental health problem is not the focus of an ED or primary care visit, mental health conditions, both known and occult, may challenge the treating clinician and complicate the patient's care.

Although the American Academy of Pediatrics (AAP) has published a policy statement on mental health competencies and a Mental Health Toolkit for pediatric primary care providers,

no such guidelines or resources exist for clinicians who care for pediatric mental health emergencies. Many ED and primary care physicians report paucity of training and lack of confidence in caring for pediatric psychiatry patients. The 2 clinical reports support the 2006 joint policy statement of the AAP and the American College of Emergency Physicians on pediatric mental health emergencies, with the goal of addressing the knowledge gaps in this area. Although written primarily from the perspective of ED clinicians, it is intended for all clinicians who care for children and adolescents with acute mental health and behavioral problems. They are organized around the common clinical challenges pediatric caregivers face, both when a child or adolescent presents with a psychiatric chief complaint or emergency (part I) and when a mental health condition may be an unclear or complicating factor in a non-mental health ED presentation (part II). Part I of the clinical reports includes discussions of Medical Clearance of Pediatric Psychiatric Patients; Suicide and Suicidal Ideation; Restraint of the Agitated Patient Including Verbal, Chemical, and Physical Restraint; and Coordination of Care With the Medical Home, and it can be accessed online at www.pediatrics.org/cgi/doi/10.1542/peds.2016-1570. This executive summary is an overview of part II of the clinical reports. Full text of the following topics can be accessed online at www.pediatrics.org/cgi/doi/10.1542/peds.2016-1573. (8/16)

https://doi.org/10.1542/peds.2016-1574

EVALUATION AND MANAGEMENT OF THE INFANT EXPOSED TO HIV IN THE UNITED STATES (CLINICAL REPORT)

Ellen Gould Chadwick, MD, FAAP; Echezona Edozie Ezeanolue, MD, MPH, FAAP; and Committee on Pediatric AIDS

ABSTRACT. Pediatricians play a crucial role in optimizing the prevention of perinatal transmission of HIV infection. Pediatricians provide antiretroviral prophylaxis to infants born to women with HIV type 1 (HIV) infection during pregnancy and to those whose mother's status was first identified during labor or delivery. Infants whose mothers have an undetermined HIV status should be tested for HIV infection within the boundaries of state laws and receive presumptive HIV therapy if the results are positive. Pediatricians promote avoidance of postnatal HIV transmission by advising mothers with HIV not to breastfeed. Pediatricians test the infant exposed to HIV for determination of HIV infection and monitor possible short- and long-term toxicity from antiretroviral exposure. Finally, pediatricians support families living with HIV by providing counseling to parents or caregivers as an important component of care. (10/20)

https://doi.org/10.1542/peds.2020-029058

EVALUATION AND MANAGEMENT OF WELL-APPEARING FEBRILE INFANTS 8 TO 60 DAYS OLD

Robert H. Pantell, MD, FAAP; Kenneth B. Roberts, MD, FAAP; William G. Adams, MD, FAAP; Benard P. Dreyer, MD, FAAP; Nathan Kuppermann, MD, MPH, FAAP, FACEP; Sean T. O'Leary, MD, MPH, FAAP; Kymika Okechukwu, MPA; Charles R. Woods Jr, MD, MS, FAAP; and Subcommittee on Febrile Infants

ABSTRACT. This guideline addresses the evaluation and management of well-appearing, term infants, 8 to 60 days of age, with fever ≥38.0°C. Exclusions are noted. After a commissioned evidence-based review by the Agency for Healthcare Research and Quality, an additional extensive and ongoing review of the literature, and supplemental data from published, peer-reviewed studies provided by active investigators, 21 key action statements were derived. For each key action statement, the quality of evidence and benefit-harm relationship were assessed and graded to determine the strength of recommendations. When appropriate, parents' values and preferences should be incorporated as part of shared decision-making. For diagnostic testing, the committee has attempted to develop numbers needed to test, and for antimicrobial administration, the committee provided numbers needed to treat. Three algorithms summarize the recommendations for infants 8 to 21 days of age, 22 to 28 days of age, and 29 to 60 days of age. The recommendations in this guideline do not indicate an exclusive course of treatment or serve as a standard of medical care. Variations, taking into account individual circumstances, may be appropriate. (7/21)

See full text on page 503.

https://doi.org/10.1542/peds.2021-052228

EVALUATION AND REFERRAL FOR DEVELOPMENTAL DYSPLASIA OF THE HIP IN INFANTS (CLINICAL REPORT)

Brian A. Shaw, MD, FAAOS, FAAP; Lee S. Segal, MD, FAAOS, FAAP; and Section on Orthopaedics

ABSTRACT. Developmental dysplasia of the hip (DDH) encompasses a wide spectrum of clinical severity, from mild developmental abnormalities to frank dislocation. Clinical hip instability occurs in 1% to 2% of full-term infants, and up to 15% have hip instability or hip immaturity detectable by imaging studies. Hip dysplasia is the most common cause of hip arthritis in women younger than 40 years and accounts for 5% to 10% of all total hip replacements in the United States. Newborn and periodic screening have been practiced for decades, because DDH is clinically silent during the first year of life, can be treated more effectively if detected early, and can have severe consequences if left untreated. However, screening programs and techniques are not uniform, and there is little evidence-based literature to support current practice, leading to controversy. Recent literature shows that many mild forms of DDH resolve without treatment, and there is a lack of agreement on ultrasonographic diagnostic criteria for DDH as a disease versus developmental variations. The American Academy of Pediatrics has not published any policy statements on DDH since its 2000 clinical practice guideline and accompanying technical report. Developments since then include a controversial US Preventive Services Task Force "inconclusive" determination regarding usefulness of DDH screening, several prospective studies supporting observation over treatment of minor ultrasonographic hip variations, and a recent evidence-based clinical practice guideline from the American Academy of Orthopaedic Surgeons on the detection and management of DDH in infants 0 to 6 months of age. The purpose of this clinical report was to provide literature-based updated direction for the clinician in screening and referral for DDH, with the primary goal of preventing and/or detecting a dislocated hip by 6 to 12 months of age in an otherwise healthy child, understanding that no screening program has eliminated late development or presentation of a dislocated hip and that the diagnosis and treatment of milder forms of hip dysplasia remain controversial. (11/16, reaffirmed 6/21)

https://doi.org/10.1542/peds.2016-3107

EVALUATION AND REFERRAL OF CHILDREN WITH SIGNS OF EARLY PUBERTY (CLINICAL REPORT)

Paul Kaplowitz, MD, PhD, FAAP; Clifford Bloch, MD, FAAP; and Section on Endocrinology

ABSTRACT. Concerns about possible early pubertal development are a common cause for referral to pediatric medical subspecialists. Several recent studies have suggested that onset of breast and/or pubic hair development may be occurring earlier than in the past. Although there is a chance of finding pathology in girls with signs of puberty before 8 years of age and in boys before 9 years of age, the vast majority of these children with signs of apparent puberty have variations of normal growth and physical development and do not require laboratory testing, bone age radiographs, or intervention. The most common of these signs of early puberty are premature adrenarche (early onset of pubic hair and/or body odor), premature thelarche (nonprogressive breast development, usually occurring before 2

years of age), and lipomastia, in which girls have apparent breast development which, on careful palpation, is determined to be adipose tissue. Indicators that the signs of sexual maturation may represent true, central precocious puberty include progressive breast development over a 4- to 6-month period of observation or progressive penis and testicular enlargement, especially if accompanied by rapid linear growth. Children exhibiting these true indicators of early puberty need prompt evaluation by the appropriate pediatric medical subspecialist. Therapy with a gonadotropin-releasing hormone agonist may be indicated, as discussed in this report. (12/15)
https://doi.org/10.1542/peds.2015-3732

EVALUATION FOR BLEEDING DISORDERS IN SUSPECTED CHILD ABUSE (CLINICAL REPORT)

James D. Anderst, MD, MS; Shannon L. Carpenter, MD, MS; Thomas C. Abshire, MD; Section on Hematology/Oncology; and Committee on Child Abuse and Neglect

ABSTRACT. Bruising or bleeding in a child can raise the concern for child abuse. Assessing whether the findings are the result of trauma and/or whether the child has a bleeding disorder is critical. Many bleeding disorders are rare, and not every child with bruising/bleeding concerning for abuse requires an evaluation for bleeding disorders. In some instances, however, bleeding disorders can present in a manner similar to child abuse. The history and clinical evaluation can be used to determine the necessity of an evaluation for a possible bleeding disorder, and prevalence and known clinical presentations of individual bleeding disorders can be used to guide the extent of the laboratory testing. This clinical report provides guidance to pediatricians and other clinicians regarding the evaluation for bleeding disorders when child abuse is suspected. (3/13, reaffirmed 7/16)
https://doi.org/10.1542/peds.2013-0195

THE EVALUATION OF CHILDREN IN THE PRIMARY CARE SETTING WHEN SEXUAL ABUSE IS SUSPECTED (CLINICAL REPORT)

Carole Jenny, MD, MBA, FAAP; James E. Crawford-Jakubiak, MD, FAAP; and Committee on Child Abuse and Neglect

ABSTRACT. This clinical report updates a 2005 report from the American Academy of Pediatrics on the evaluation of sexual abuse in children. The medical assessment of suspected child sexual abuse should include obtaining a history, performing a physical examination, and obtaining appropriate laboratory tests. The role of the physician includes determining the need to report suspected sexual abuse; assessing the physical, emotional, and behavioral consequences of sexual abuse; providing information to parents about how to support their child; and coordinating with other professionals to provide comprehensive treatment and follow-up of children exposed to child sexual abuse. (7/13, reaffirmed 8/18)
https://doi.org/10.1542/peds.2013-1741

THE EVALUATION OF SEXUAL BEHAVIORS IN CHILDREN (CLINICAL REPORT)

Nancy D. Kellogg, MD, and Committee on Child Abuse and Neglect

ABSTRACT. Most children will engage in sexual behaviors at some time during childhood. These behaviors may be normal but can be confusing and concerning to parents or disruptive or intrusive to others. Knowledge of age-appropriate sexual behaviors that vary with situational and environmental factors can assist the clinician in differentiating normal sexual behaviors from sexual behavior problems. Most situations that involve sexual behaviors in young children do not require child protective services intervention; for behaviors that are age-appropriate and transient, the pediatrician may provide guidance in supervision and monitoring of the behavior. If the behavior is intrusive, hurtful, and/or age-inappropriate, a more comprehensive assessment is warranted. Some children with sexual behavior problems may reside or have resided in homes characterized by inconsistent parenting, violence, abuse, or neglect and may require more immediate intervention and referrals. (8/09, reaffirmed 3/13, 10/18)
https://doi.org/10.1542/peds.2009-1692

THE EVALUATION OF SUSPECTED CHILD PHYSICAL ABUSE (CLINICAL REPORT)

Cindy W. Christian, MD, FAAP, and Committee on Child Abuse and Neglect

ABSTRACT. Child physical abuse is an important cause of pediatric morbidity and mortality and is associated with major physical and mental health problems that can extend into adulthood. Pediatricians are in a unique position to identify and prevent child abuse, and this clinical report provides guidance to the practitioner regarding indicators and evaluation of suspected physical abuse of children. The role of the physician may include identifying abused children with suspicious injuries who present for care, reporting suspected abuse to the child protection agency for investigation, supporting families who are affected by child abuse, coordinating with other professionals and community agencies to provide immediate and long-term treatment to victimized children, providing court testimony when necessary, providing preventive care and anticipatory guidance in the office, and advocating for policies and programs that support families and protect vulnerable children. (4/15)
https://doi.org/10.1542/peds.2015-0356

EVIDENCE FOR THE DIAGNOSIS AND TREATMENT OF ACUTE UNCOMPLICATED SINUSITIS IN CHILDREN: A SYSTEMATIC REVIEW (TECHNICAL REPORT)

Michael J. Smith, MD, MSCE

ABSTRACT. In 2001, the American Academy of Pediatrics published clinical practice guidelines for the management of acute bacterial sinusitis (ABS) in children. The technical report accompanying those guidelines included 21 studies that assessed the diagnosis and management of ABS in children. This update to that report incorporates studies of pediatric ABS that have been performed since 2001. Overall, 17 randomized controlled trials of the treatment of sinusitis in children were identified and analyzed. Four randomized, double-blind, placebo-controlled trials of antimicrobial therapy have been published. The results of these studies varied, likely due to differences in inclusion and exclusion criteria. Because of this heterogeneity, formal meta-analyses were not performed. However, qualitative analysis of these studies suggests that children with greater severity of illness at presentation are more likely to benefit from antimicrobial therapy. An additional 5 trials compared different antimicrobial therapies but did not include placebo groups. Six trials assessed a variety of ancillary treatments for ABS in children, and 3 focused on subacute sinusitis. Although the number of pediatric trials has increased since 2001, there are still limited data to guide the diagnosis and management of ABS in children. Diagnostic and treatment guidelines focusing on severity of illness at the time of presentation have the potential to identify those children most likely to benefit from antimicrobial therapy and at the same time minimize unnecessary use of antibiotics. (6/13)
https://doi.org/10.1542/peds.2013-1072

EXECUTIVE SUMMARY: CRITERIA FOR CRITICAL CARE OF INFANTS AND CHILDREN: PICU ADMISSION, DISCHARGE, AND TRIAGE PRACTICE STATEMENT AND LEVELS OF CARE GUIDANCE

Benson S. Hsu, MD, MBA, FAAP; Vanessa Hill, MD, FAAP; Lorry R. Frankel, MD, FCCM; Timothy S. Yeh, MD, MCCM; Shari Simone, CRNP, DNP, FCCM, FAANP, FAAN; Marjorie J. Arca, MD, FACS, FAAP; Jorge A. Coss-Bu, MD; Mary E. Fallat, MD, FACS, FAAP; Jason Foland, MD; Samir Gadepalli, MD, MBA; Michael O. Gayle, BS, MD, FCCM; Lori A. Harmon, RRT, MBA, CPHQ; Christa A. Joseph, RN, MSN; Aaron D. Kessel, BS, MD; Niranjan Kissoon, MD, MCCM; Michele Moss, MD, FCCM; Mohan R. Mysore, MD, FAAP, FCCM; Michele C. Papo, MD, MPH, FCCM; Kari L. Rajzer-Wakeham, CCRN, MSN, PCCNP, RN; Tom B. Rice, MD; David L. Rosenberg, MD, FAAP, FCCM; Martin K. Wakeham, MD; Edward E. Conway, Jr, MD, FCCM, MS; Michael S.D. Agus, MD, FAAP, FCCM

ABSTRACT. This is an executive summary of the 2019 update of the 2004 guidelines and levels of care for PICU. Since previous guidelines, there has been a tremendous transformation of Pediatric Critical Care Medicine with advancements in pediatric cardiovascular medicine, transplant, neurology, trauma, and oncology as well as improvements of care in general PICUs. This has led to the evolution of resources and training in the provision of care through the PICU. Outcome and quality research related to admission, transfer, and discharge criteria as well as literature regarding PICU levels of care to include volume, staffing, and structure were reviewed and included in this statement as appropriate. Consequently, the purposes of this significant update are to address the transformation of the field and codify a revised set of guidelines that will enable hospitals, institutions, and individuals in developing the appropriate PICU for their community needs. The target audiences of the practice statement and guidance are broad and include critical care professionals; pediatricians; pediatric subspecialists; pediatric surgeons; pediatric surgical subspecialists; pediatric imaging physicians; and other members of the patient care team such as nurses, therapists, dieticians, pharmacists, social workers, care coordinators, and hospital administrators who make daily administrative and clinical decisions in all PICU levels of care. (9/19)
https://doi.org/10.1542/peds.2019-2433

EXECUTIVE SUMMARY: IDENTIFICATION, EVALUATION, AND MANAGEMENT OF CHILDREN WITH AUTISM SPECTRUM DISORDER (CLINICAL REPORT)

Susan L. Hyman, MD, FAAP; Susan E. Levy, MD, MPH, FAAP; Scott M. Myers, MD, FAAP; Council on Children With Disabilities; and Section on Developmental and Behavioral Pediatrics

ABSTRACT. Autism spectrum disorder (ASD) is a common neurodevelopmental disorder with reported prevalence in the United States of 1 in 59 children (approximately 1.7%). ASD significantly influences the lives of affected children and families because they may need extensive behavioral, educational, health, and other services. Primary care providers play a critical role in identifying, diagnosing, and managing ASD in children and providing support for their families. This document provides a summary of the clinical report "Identification, Evaluation, and Management of Children with Autism Spectrum Disorder," published concurrently in the online version of *Pediatrics*. In the years since 2007, when the American Academy of Pediatrics published the clinical reports "Identification and Diagnosis of Children with Autism Spectrum Disorders" and "Management of Children with Autism Spectrum Disorders," reported prevalence rates of children with ASD have increased, understanding of potential risk factors has expanded, awareness of co-occurring medical and behavioral conditions and genetic contribution to etiology has improved, and the body of research supporting evidence-based interventions has grown substantially. The updated document discusses evaluation and treatment as a continuum in 1 publication with a table of contents to help the reader identify topic areas within the report. ASD is more commonly diagnosed than in the past, and the significant health, educational, and social needs of individuals with ASD and their families constitute an area of critical need for resources, research, and professional education. (12/19)
https://doi.org/10.1542/peds.2019-3448

EXPERT WITNESS PARTICIPATION IN CIVIL AND CRIMINAL PROCEEDINGS

Stephan R. Paul, MD, JD, FAAP; Sandeep K. Narang, MD, JD, FAAP; and Committee on Medical Liability and Risk Management

ABSTRACT. The interests of the public and both the medical and legal professions are best served when scientifically sound and unbiased expert witness testimony is readily available in civil and criminal proceedings. As members of the medical community, patient advocates, and private citizens, pediatricians have ethical and professional obligations to assist in the civil and criminal judicial processes. This policy statement offers recommendations on advocacy, education, research, qualifications, standards, and ethical business practices all aimed at improving expert testimony. (2/17)
https://doi.org/10.1542/peds.2016-3862

EXPERT WITNESS PARTICIPATION IN CIVIL AND CRIMINAL PROCEEDINGS (TECHNICAL REPORT)

Sandeep K. Narang, MD, JD, FAAP; Stephan R. Paul, MD, JD, FAAP; and Committee on Medical Liability and Risk Management

ABSTRACT. The interests of the public and both the medical and legal professions are best served when scientifically sound and unbiased expert witness testimony is readily available in civil and criminal proceedings. As members of the medical community, patient advocates, and private citizens, pediatricians have ethical and professional obligations to assist in the civil and criminal judicial processes. This technical report explains how the role of the expert witness differs in civil and criminal proceedings, legal and ethical standards for expert witnesses, and strategies that have been employed to deter unscientific and irresponsible testimony. A companion policy statement offers recommendations on advocacy, education, research, qualifications, standards, and ethical business practices all aimed at improving expert testimony. (2/17)
https://doi.org/10.1542/peds.2016-4122

EXPOSURE TO NONTRADITIONAL PETS AT HOME AND TO ANIMALS IN PUBLIC SETTINGS: RISKS TO CHILDREN (CLINICAL REPORT)

Larry K. Pickering, MD; Nina Marano, DVM, MPH; Joseph A. Bocchini, MD; Frederick J. Angulo, DVM, PhD; and Committee on Infectious Diseases

ABSTRACT. Exposure to animals can provide many benefits during the growth and development of children. However, there are potential risks associated with animal exposures, including exposure to nontraditional pets in the home and animals in public settings. Educational materials, regulations, and guidelines have been developed to minimize these risks. Pediatricians, veterinarians, and other health care professionals can provide advice on selection of appropriate pets as well as prevention of disease transmission from nontraditional pets and when children contact animals in public settings. (10/08, reaffirmed 12/11, 1/15, 6/15, 5/19)
https://doi.org/10.1542/peds.2008-1942

THE EYE EXAMINATION IN THE EVALUATION OF CHILD ABUSE (CLINICAL REPORT)

Cindy W. Christian, MD, FAAP; Alex V. Levin, MD, MHSc, FAAO, FRCSC, FAAP; Council on Child Abuse and Neglect; and Section on Ophthalmology (joint with American Association of Certified Orthoptists, American Association for Pediatric Ophthalmology and Strabismus, and American Academy of Ophthalmology)

ABSTRACT. Child abuse can cause injury to any part of the eye. The most common manifestations are retinal hemorrhages (RHs) in infants and young children with abusive head trauma (AHT). Although RHs are an important indicator of possible AHT, they are also found in other conditions. Distinguishing the number, type, location, and pattern of RHs is important in evaluating a differential diagnosis. Eye trauma can be seen in cases of physical abuse or AHT and may prompt referral for ophthalmologic assessment. Physicians have a responsibility to consider abuse in the differential diagnosis of pediatric eye trauma. Identification and documentation of inflicted ocular trauma requires a thorough examination by an ophthalmologist, including indirect ophthalmoscopy, most optimally through a dilated pupil, especially for the evaluation of possible RHs. An eye examination is helpful in detecting abnormalities that can help identify a medical or traumatic etiology for previously well young children who experience unexpected and unexplained mental status changes with no obvious cause, children with head trauma that results in significant intracranial hemorrhage and brain injury, and children with unexplained death. (7/18)

https://doi.org/10.1542/peds.2018-1411

FACILITIES AND EQUIPMENT FOR THE CARE OF PEDIATRIC PATIENTS IN A COMMUNITY HOSPITAL (CLINICAL REPORT)

Committee on Hospital Care

ABSTRACT. Many children who require hospitalization are admitted to community hospitals that are more accessible for families and their primary care physicians but vary substantially in their pediatric resources. The intent of this clinical report is to provide basic guidelines for furnishing and equipping a pediatric area in a community hospital. (5/03, reaffirmed 5/07, 8/13, 1/17)

https://doi.org/10.1542/peds.111.5.1120

FALLS FROM HEIGHTS: WINDOWS, ROOFS, AND BALCONIES

Committee on Injury and Poison Prevention

ABSTRACT. Falls of all kinds represent an important cause of child injury and death. In the United States, approximately 140 deaths from falls occur annually in children younger than 15 years. Three million children require emergency department care for fall-related injuries. This policy statement examines the epidemiology of falls from heights and recommends preventive strategies for pediatricians and other child health care professionals. Such strategies involve parent counseling, community programs, building code changes, legislation, and environmental modification, such as the installation of window guards and balcony railings. (5/01, reaffirmed 10/04, 5/07, 6/10)

https://doi.org/10.1542/peds.107.5.1188

FAMILIES AFFECTED BY PARENTAL SUBSTANCE USE (CLINICAL REPORT)

Vincent C. Smith, MD, MPH, FAAP; Celeste R. Wilson, MD, FAAP; and Committee on Substance Use and Prevention

ABSTRACT. Children whose parents or caregivers use drugs or alcohol are at increased risk of short- and long-term sequelae ranging from medical problems to psychosocial and behavioral challenges. In the course of providing health care services to children, pediatricians are likely to encounter families affected by parental substance use and are in a unique position to intervene. Therefore, pediatricians need to know how to assess a child's risk in the context of a parent's substance use. The purposes of this clinical report are to review some of the short-term effects of maternal substance use during pregnancy and long-term implications of fetal exposure; describe typical medical, psychiatric, and behavioral symptoms of children and adolescents in families affected by substance use; and suggest proficiencies for pediatricians involved in the care of children and adolescents of families affected by substance use, including screening families, mandated reporting requirements, and directing families to community, regional, and state resources that can address needs and problems. (7/16)

https://doi.org/10.1542/peds.2016-1575

FATHERS' ROLES IN THE CARE AND DEVELOPMENT OF THEIR CHILDREN: THE ROLE OF PEDIATRICIANS (CLINICAL REPORT)

Michael Yogman, MD, FAAP; Craig F. Garfield, MD, FAAP; and Committee on Psychosocial Aspects of Child and Family Health

ABSTRACT. Fathers' involvement in and influence on the health and development of their children have increased in a myriad of ways in the past 10 years and have been widely studied. The role of pediatricians in working with fathers has correspondingly increased in importance. This report reviews new studies of the epidemiology of father involvement, including nonresidential as well as residential fathers. The effects of father involvement on child outcomes are discussed within each phase of a child's development. Particular emphasis is placed on (1) fathers' involvement across childhood ages and (2) the influence of fathers' physical and mental health on their children. Implications and advice for all child health providers to encourage and support father involvement are outlined. (6/16)

https://doi.org/10.1542/peds.2016-1128

THE FEMALE ATHLETE TRIAD (CLINICAL REPORT)

Amanda K. Weiss Kelly, MD, FAAP; Suzanne Hecht, MD, FACSM; and Council on Sports Medicine and Fitness

ABSTRACT. The number of girls participating in sports has increased significantly since the introduction of Title XI in 1972. As a result, more girls have been able to experience the social, educational, and health-related benefits of sports participation. However, there are risks associated with sports participation, including the female athlete triad. The triad was originally recognized as the interrelationship of amenorrhea, osteoporosis, and disordered eating, but our understanding has evolved to recognize that each of the components of the triad exists on a spectrum from optimal health to disease. The triad occurs when energy intake does not adequately compensate for exercise-related energy expenditure, leading to adverse effects on reproductive, bone, and cardiovascular health. Athletes can present with a single component or any combination of the components. The triad can have a more significant effect on the health of adolescent athletes than on adults because adolescence is a critical time for bone mass accumulation. This report outlines the current state of knowledge on the epidemiology, diagnosis, and treatment of the triad conditions. (7/16)

https://doi.org/10.1542/peds.2016-0922

FERTILITY PRESERVATION FOR PEDIATRIC AND ADOLESCENT PATIENTS WITH CANCER: MEDICAL AND ETHICAL CONSIDERATIONS (CLINICAL REPORT)

Sigal Klipstein, MD, FACOG; Mary E. Fallat, MD, FAAP; Stephanie Savelli, MD, FAAP; Committee on Bioethics; Section on Hematology/Oncology; and Section on Surgery

ABSTRACT. Many cancers presenting in children and adolescents are curable with surgery, chemotherapy, and/or radiotherapy. Potential adverse consequences of treatment include

sterility, infertility, or subfertility as a result of gonad removal, damage to germ cells as a result of adjuvant therapy, or damage to the pituitary and hypothalamus or uterus as a result of irradiation. In recent years, treatment of solid tumors and hematologic malignancies has been modified in an attempt to reduce damage to the gonadal axis. Simultaneously, advances in assisted reproductive technology have led to new possibilities for the prevention and treatment of infertility. This clinical report reviews the medical aspects and ethical considerations that arise when considering fertility preservation in pediatric and adolescent patients with cancer. (2/20)
https://doi.org/10.1542/peds.2019-3994

FETAL ALCOHOL SPECTRUM DISORDERS (CLINICAL REPORT)

Janet F. Williams, MD, FAAP; Vincent C. Smith, MD, MPH, FAAP; and Committee on Substance Abuse

ABSTRACT. Prenatal exposure to alcohol can damage the developing fetus and is the leading preventable cause of birth defects and intellectual and neurodevelopmental disabilities. In 1973, fetal alcohol syndrome was first described as a specific cluster of birth defects resulting from alcohol exposure in utero. Subsequently, research unequivocally revealed that prenatal alcohol exposure causes a broad range of adverse developmental effects. Fetal alcohol spectrum disorder (FASD) is the general term that encompasses the range of adverse effects associated with prenatal alcohol exposure. The diagnostic criteria for fetal alcohol syndrome are specific, and comprehensive efforts are ongoing to establish definitive criteria for diagnosing the other FASDs. A large and growing body of research has led to evidence-based FASD education of professionals and the public, broader prevention initiatives, and recommended treatment approaches based on the following premises:

- Alcohol-related birth defects and developmental disabilities are completely preventable when pregnant women abstain from alcohol use.
- Neurocognitive and behavioral problems resulting from prenatal alcohol exposure are lifelong.
- Early recognition, diagnosis, and therapy for any condition along the FASD continuum can result in improved outcomes.
- During pregnancy:
  - — no amount of alcohol intake should be considered safe;
  - — there is no safe trimester to drink alcohol;
  - — all forms of alcohol, such as beer, wine, and liquor, pose similar risk; and
  - — binge drinking poses dose-related risk to the developing fetus. (10/15, reaffirmed 1/21)

https://doi.org/10.1542/peds.2015-3113

FEVER AND ANTIPYRETIC USE IN CHILDREN (CLINICAL REPORT)

Janice E. Sullivan, MD; Henry C. Farrar, MD; Section on Clinical Pharmacology and Therapeutics; and Committee on Drugs

ABSTRACT. Fever in a child is one of the most common clinical symptoms managed by pediatricians and other health care providers and a frequent cause of parental concern. Many parents administer antipyretics even when there is minimal or no fever, because they are concerned that the child must maintain a "normal" temperature. Fever, however, is not the primary illness but is a physiologic mechanism that has beneficial effects in fighting infection. There is no evidence that fever itself worsens the course of an illness or that it causes long-term neurologic complications. Thus, the primary goal of treating the febrile child should be to improve the child's overall comfort rather than focus on the normalization of body temperature. When counseling the parents or caregivers of a febrile child, the general well-being of the child, the importance of monitoring activity, observing for signs of serious illness, encouraging appropriate fluid intake, and the safe storage of antipyretics should be emphasized. Current evidence suggests that there is no substantial difference in the safety and effectiveness of acetaminophen and ibuprofen in the care of a generally healthy child with fever. There is evidence that combining these 2 products is more effective than the use of a single agent alone; however, there are concerns that combined treatment may be more complicated and contribute to the unsafe use of these drugs. Pediatricians should also promote patient safety by advocating for simplified formulations, dosing instructions, and dosing devices. (2/11, reaffirmed 7/16)

https://doi.org/10.1542/peds.2010-3852

FINANCING GRADUATE MEDICAL EDUCATION TO MEET THE NEEDS OF CHILDREN AND THE FUTURE PEDIATRICIAN WORKFORCE

Committee on Pediatric Workforce

ABSTRACT. The American Academy of Pediatrics (AAP) believes that an appropriately financed graduate medical education (GME) system is critical to ensuring that sufficient numbers of trained pediatricians are available to provide optimal health care to all children. A shortage of pediatric medical subspecialists and pediatric surgical specialists currently exists in the United States, and this shortage is likely to intensify because of the growing numbers of children with chronic health problems and special health care needs. It is equally important to maintain the supply of primary care pediatricians. The AAP, therefore, recommends that children's hospital GME positions funded by the Health Resources and Services Administration be increased to address this escalating demand for pediatric health services. The AAP also recommends that GME funding for pediatric physician training provide full financial support for all years of training necessary to meet program requirements. In addition, all other entities that gain from GME training should participate in its funding in a manner that does not influence curriculum, requirements, or outcomes. Furthermore, the AAP supports funding for training innovations that improve the health of children. Finally, the AAP recommends that all institutional recipients of GME funding allocate these funds directly to the settings where training occurs in a transparent manner. (3/16)

https://doi.org/10.1542/peds.2016-0211

FINANCING OF PEDIATRIC HOME HEALTH CARE

Edwin Simpser, MD, FAAP; Mark L. Hudak, MD, FAAP; Section on Home Care; and Committee on Child Health Financing

ABSTRACT. Pediatric home health care is an effective and holistic venue of treatment of children with medical complexity or developmental disabilities who otherwise may experience frequent and/or prolonged hospitalizations or who may enter chronic institutional care. Demand for pediatric home health care is increasing while the provider base is eroding, primarily because of inadequate payment or restrictions on benefits. As a result, home care responsibilities assumed by family caregivers have increased and imposed financial, physical, and psychological burdens on the family. The Patient Protection and Affordable Care Act set forth 10 mandated essential health benefits. Home care should be considered as an integral component of the habilitative and rehabilitative services and devices benefit, even though it is not explicitly recognized as a specific category of service. Pediatric-specific home health care services should be defined clearly as components of pediatric services, the 10th essential benefit, and recognized by all payers. Payments for home health care services should be sufficient to maintain an adequate provider work force with the pediatric-specific expertise and skills to care for children with medical complexity or developmental disability. Furthermore, coordination of care among various providers and the necessary direct patient care

from which these care coordination plans are developed should be required and enabled by adequate payment. The American Academy of Pediatrics advocates for high-quality care by calling for development of pediatric-specific home health regulations and the licensure and certification of pediatric home health providers. (2/17)
https://doi.org/10.1542/peds.2016-4202

FIREARM-RELATED INJURIES AFFECTING THE PEDIATRIC POPULATION

Council on Injury, Violence, and Poison Prevention Executive Committee

ABSTRACT. The absence of guns from children's homes and communities is the most reliable and effective measure to prevent firearm-related injuries in children and adolescents. Adolescent suicide risk is strongly associated with firearm availability. Safe gun storage (guns unloaded and locked, ammunition locked separately) reduces children's risk of injury. Physician counseling of parents about firearm safety appears to be effective, but firearm safety education programs directed at children are ineffective. The American Academy of Pediatrics continues to support a number of specific measures to reduce the destructive effects of guns in the lives of children and adolescents, including the regulation of the manufacture, sale, purchase, ownership, and use of firearms; a ban on semiautomatic assault weapons; and the strongest possible regulations of handguns for civilian use. (10/12, reaffirmed 12/16, 1/21)
https://doi.org/10.1542/peds.2012-2481

FIREWORKS-RELATED INJURIES TO CHILDREN

Committee on Injury and Poison Prevention

ABSTRACT. An estimated 8500 individuals, approximately 45% of them children younger than 15 years, were treated in US hospital emergency departments during 1999 for fireworks-related injuries. The hands (40%), eyes (20%), and head and face (20%) are the body areas most often involved. Approximately one third of eye injuries from fireworks result in permanent blindness. During 1999, 16 people died as a result of injuries associated with fireworks. Every type of legally available consumer (so-called "safe and sane") firework has been associated with serious injury or death. In 1997, 20,100 fires were caused by fireworks, resulting in $22.7 million in direct property damage. Fireworks typically cause more fires in the United States on the Fourth of July than all other causes of fire combined on that day. Pediatricians should educate parents, children, community leaders, and others about the dangers of fireworks. Fireworks for individual private use should be banned. Children and their families should be encouraged to enjoy fireworks at public fireworks displays conducted by professionals rather than purchase fireworks for home or private use. (7/01, reaffirmed 1/05, 2/08, 10/11, 11/14)
https://doi.org/10.1542/peds.108.1.190

FISH, SHELLFISH, AND CHILDREN'S HEALTH: AN ASSESSMENT OF BENEFITS, RISKS, AND SUSTAINABILITY (TECHNICAL REPORT)

Aaron S. Bernstein, MD, MPH, FAAP; Emily Oken, MD, MPH; Sarah de Ferranti, MD, MPH, FAAP; Council on Environmental Health; and Committee on Nutrition

ABSTRACT. American children eat relatively little fish and shellfish in comparison with other sources of animal protein, despite the health benefits that eating fish and shellfish may confer. At the same time, fish and shellfish may be sources of toxicants. This report serves to inform pediatricians about available research that elucidates health risks and benefits associated with fish and shellfish consumption in childhood as well as the sustainability of fish and shellfish harvests. (5/19)
https://doi.org/10.1542/peds.2019-0999

FLUORIDE USE IN CARIES PREVENTION IN THE PRIMARY CARE SETTING (CLINICAL REPORT)

Melinda B. Clark, MD, FAAP; Martha Ann Keels, DDS, PhD; Rebecca L. Slayton, DDS, PhD; and Section on Oral Health

ABSTRACT. Dental caries remains the most common chronic disease of childhood in the United States. Caries is a largely preventable condition, and fluoride has proven effectiveness in caries prevention. This clinical report aims to clarify the use of available fluoride modalities for caries prevention in the primary care setting and to assist pediatricians in using fluoride to achieve maximum protection against dental caries, while minimizing the likelihood of enamel fluorosis. Fluoride varnish application is now considered the standard of care in pediatric primary care. This report highlights administration, billing, and payment information regarding the fluoride varnish procedure. (11/20)
https://doi.org/10.1542/peds.2020-034637

FOLIC ACID FOR THE PREVENTION OF NEURAL TUBE DEFECTS

Committee on Genetics

ABSTRACT. The American Academy of Pediatrics endorses the US Public Health Service (USPHS) recommendation that all women capable of becoming pregnant consume 400 µg of folic acid daily to prevent neural tube defects (NTDs). Studies have demonstrated that periconceptional folic acid supplementation can prevent 50% or more of NTDs such as spina bifida and anencephaly. For women who have previously had an NTD-affected pregnancy, the Centers for Disease Control and Prevention (CDC) recommends increasing the intake of folic acid to 4000 µg per day beginning at least 1 month before conception and continuing through the first trimester. Implementation of these recommendations is essential for the primary prevention of these serious and disabling birth defects. Because fewer than 1 in 3 women consume the amount of folic acid recommended by the USPHS, the Academy notes that the prevention of NTDs depends on an urgent and effective campaign to close this prevention gap. (8/99, reaffirmed 9/16)
https://doi.org/10.1542/peds.104.2.325

FOLLOW-UP MANAGEMENT OF CHILDREN WITH TYMPANOSTOMY TUBES

Section on Otolaryngology and Bronchoesophagology

ABSTRACT. The follow-up care of children in whom tympanostomy tubes have been placed is shared by the pediatrician and the otolaryngologist. Guidelines are provided for routine follow-up evaluation, perioperative hearing assessment, and the identification of specific conditions and complications that warrant urgent otolaryngologic consultation. These guidelines have been developed by a consensus of expert opinions. (2/02)
https://doi.org/10.1542/peds.109.2.328

FOOD ADDITIVES AND CHILD HEALTH

Leonardo Trasande, MD, MPP, FAAP; Rachel M. Shaffer, MPH; Sheela Sathyanarayana, MD, MPH; and Council on Environmental Health

ABSTRACT. Our purposes with this policy statement and its accompanying technical report are to review and highlight emerging child health concerns related to the use of colorings, flavorings, and chemicals deliberately added to food during processing (direct food additives) as well as substances in food contact materials, including adhesives, dyes, coatings, paper, paperboard, plastic, and other polymers, which may contaminate food as part of packaging or manufacturing equipment (indirect food additives); to make reasonable recommendations that the pediatrician might be able to adopt into the guidance

provided during pediatric visits; and to propose urgently needed reforms to the current regulatory process at the US Food and Drug Administration (FDA) for food additives. Concern regarding food additives has increased in the past 2 decades, in part because of studies in which authors document endocrine disruption and other adverse health effects. In some cases, exposure to these chemicals is disproportionate among minority and low-income populations. Regulation and oversight of many food additives is inadequate because of several key problems in the Federal Food, Drug, and Cosmetic Act. Current requirements for a "generally recognized as safe" (GRAS) designation are insufficient to ensure the safety of food additives and do not contain sufficient protections against conflict of interest. Additionally, the FDA does not have adequate authority to acquire data on chemicals on the market or reassess their safety for human health. These are critical weaknesses in the current regulatory system for food additives. Data about health effects of food additives on infants and children are limited or missing; however, in general, infants and children are more vulnerable to chemical exposures. Substantial improvements to the food additives regulatory system are urgently needed, including greatly strengthening or replacing the "generally recognized as safe" (GRAS) determination process, updating the scientific foundation of the FDA's safety assessment program, retesting all previously approved chemicals, and labeling direct additives with limited or no toxicity data. (7/18)
https://doi.org/10.1542/peds.2018-1410

FOOD ADDITIVES AND CHILD HEALTH (TECHNICAL REPORT)

Leonardo Trasande, MD, MPP, FAAP; Rachel M. Shaffer, MPH; Sheela Sathyanarayana, MD, MPH; and Council on Environmental Health

ABSTRACT. Increasing scientific evidence suggests potential adverse effects on children's health from synthetic chemicals used as food additives, both those deliberately added to food during processing (direct) and those used in materials that may contaminate food as part of packaging or manufacturing (indirect). Concern regarding food additives has increased in the past 2 decades in part because of studies that increasingly document endocrine disruption and other adverse health effects. In some cases, exposure to these chemicals is disproportionate among minority and low-income populations. This report focuses on those food additives with the strongest scientific evidence for concern. Further research is needed to study effects of exposure over various points in the life course, and toxicity testing must be advanced to be able to better identify health concerns prior to widespread population exposure. The accompanying policy statement describes approaches policy makers and pediatricians can take to prevent the disease and disability that are increasingly being identified in relation to chemicals used as food additives, among other uses. (7/18)
https://doi.org/10.1542/peds.2018-1410

FORGOING MEDICALLY PROVIDED NUTRITION AND HYDRATION IN CHILDREN (CLINICAL REPORT)

Douglas S. Diekema, MD, MPH; Jeffrey R. Botkin, MD, MPH; and Committee on Bioethics

ABSTRACT. There is broad consensus that withholding or withdrawing medical interventions is morally permissible when requested by competent patients or, in the case of patients without decision-making capacity, when the interventions no longer confer a benefit to the patient or when the burdens associated with the interventions outweigh the benefits received. The withdrawal or withholding of measures such as attempted resuscitation, ventilators, and critical care medications is common in the terminal care of adults and children. In the case of adults, a consensus has emerged in law and ethics that the medical administration of fluid and nutrition is not fundamentally different from other medical interventions such as use of ventilators; therefore, it can be forgone or withdrawn when a competent adult or legally authorized surrogate requests withdrawal or when the intervention no longer provides a net benefit to the patient. In pediatrics, forgoing or withdrawing medically administered fluids and nutrition has been more controversial because of the inability of children to make autonomous decisions and the emotional power of feeding as a basic element of the care of children. This statement reviews the medical, ethical, and legal issues relevant to the withholding or withdrawing of medically provided fluids and nutrition in children. The American Academy of Pediatrics concludes that the withdrawal of medically administered fluids and nutrition for pediatric patients is ethically acceptable in limited circumstances. Ethics consultation is strongly recommended when particularly difficult or controversial decisions are being considered. (7/09, reaffirmed 1/14)
https://doi.org/10.1542/peds.2009-1299

FRUIT JUICE IN INFANTS, CHILDREN, AND ADOLESCENTS: CURRENT RECOMMENDATIONS

Melvin B. Heyman, MD, FAAP; Steven A. Abrams, MD, FAAP; Section on Gastroenterology, Hepatology, and Nutrition; and Committee on Nutrition

ABSTRACT. Historically, fruit juice was recommended by pediatricians as a source of vitamin C and as an extra source of water for healthy infants and young children as their diets expanded to include solid foods with higher renal solute load. It was also sometimes recommended for children with constipation. Fruit juice is marketed as a healthy, natural source of vitamins and, in some instances, calcium. Because juice tastes good, children readily accept it. Although juice consumption has some benefits, it also has potential detrimental effects. High sugar content in juice contributes to increased calorie consumption and the risk of dental caries. In addition, the lack of protein and fiber in juice can predispose to inappropriate weight gain (too much or too little). Pediatricians need to be knowledgeable about juice to inform parents and patients on its appropriate uses. (5/17)
https://doi.org/10.1542/peds.2017-0967

GASTROESOPHAGEAL REFLUX: MANAGEMENT GUIDANCE FOR THE PEDIATRICIAN (CLINICAL REPORT)

Jenifer R. Lightdale, MD, MPH; David A. Gremse, MD; and Section on Gastroenterology, Hepatology, and Nutrition

ABSTRACT. Recent comprehensive guidelines developed by the North American Society for Pediatric Gastroenterology, Hepatology, and Nutrition define the common entities of gastroesophageal reflux (GER) as the physiologic passage of gastric contents into the esophagus and gastroesophageal reflux disease (GERD) as reflux associated with troublesome symptoms or complications. The ability to distinguish between GER and GERD is increasingly important to implement best practices in the management of acid reflux in patients across all pediatric age groups, as children with GERD may benefit from further evaluation and treatment, whereas conservative recommendations are the only indicated therapy in those with uncomplicated physiologic reflux. This clinical report endorses the rigorously developed, well-referenced North American Society for Pediatric Gastroenterology, Hepatology, and Nutrition guidelines and likewise emphasizes important concepts for the general pediatrician. A key issue is distinguishing between clinical manifestations of GER and GERD in term infants, children, and adolescents to identify patients who can be managed with conservative treatment by the pediatrician and to refer patients who require consultation with the gastroenterologist. Accordingly, the evidence basis presented by the guidelines for diagnostic approaches as well as treatments is discussed. Lifestyle changes are emphasized as first-line therapy in both GER and GERD,

whereas medications are explicitly indicated only for patients with GERD. Surgical therapies are reserved for children with intractable symptoms or who are at risk for life-threatening complications of GERD. Recent black box warnings from the US Food and Drug Administration are discussed, and caution is underlined when using promoters of gastric emptying and motility. Finally, attention is paid to increasing evidence of inappropriate prescriptions for proton pump inhibitors in the pediatric population. (4/13)
https://doi.org/10.1542/peds.2013-0421

GENERIC PRESCRIBING, GENERIC SUBSTITUTION, AND THERAPEUTIC SUBSTITUTION

Committee on Drugs
(5/87, reaffirmed 6/93, 5/96, 6/99, 5/01, 5/05, 10/08, 10/12, 9/19)
https://doi.org/10.1542/peds.79.5.835

GLOBAL CLIMATE CHANGE AND CHILDREN'S HEALTH

Council on Environmental Health
ABSTRACT. Rising global temperatures are causing major physical, chemical, and ecological changes in the planet. There is wide consensus among scientific organizations and climatologists that these broad effects, known as "climate change," are the result of contemporary human activity. Climate change poses threats to human health, safety, and security, and children are uniquely vulnerable to these threats. The effects of climate change on child health include: physical and psychological sequelae of weather disasters; increased heat stress; decreased air quality; altered disease patterns of some climate-sensitive infections; and food, water, and nutrient insecurity in vulnerable regions. The social foundations of children's mental and physical health are threatened by the specter of far-reaching effects of unchecked climate change, including community and global instability, mass migrations, and increased conflict. Given this knowledge, failure to take prompt, substantive action would be an act of injustice to all children. A paradigm shift in production and consumption of energy is both a necessity and an opportunity for major innovation, job creation, and significant, immediate associated health benefits. Pediatricians have a uniquely valuable role to play in the societal response to this global challenge. (10/15, reaffirmed 5/21)
https://doi.org/10.1542/peds.2015-3232

GLOBAL CLIMATE CHANGE AND CHILDREN'S HEALTH (TECHNICAL REPORT)

Samantha Ahdoot, MD, FAAP; Susan E. Pacheco, MD, FAAP; and Council on Environmental Health
ABSTRACT. Rising global temperature is causing major physical, chemical, and ecological changes across the planet. There is wide consensus among scientific organizations and climatologists that these broad effects, known as climate change, are the result of contemporary human activity. Climate change poses threats to human health, safety, and security. Children are uniquely vulnerable to these threats. The effects of climate change on child health include physical and psychological sequelae of weather disasters, increased heat stress, decreased air quality, altered disease patterns of some climate-sensitive infections, and food, water, and nutrient insecurity in vulnerable regions. Prompt implementation of mitigation and adaptation strategies will protect children against worsening of the problem and its associated health effects. This technical report reviews the nature of climate change and its associated child health effects and supports the recommendations in the accompanying policy statement on climate change and children's health. (10/15, reaffirmed 5/21)
https://doi.org/10.1542/peds.2015-3233

GLOBAL HUMAN TRAFFICKING AND CHILD VICTIMIZATION

Jordan Greenbaum, MD; Nia Bodrick, MD, MPH, FAAP; Committee on Child Abuse and Neglect; and Section on International Child Health
ABSTRACT. Trafficking of children for labor and sexual exploitation violates basic human rights and constitutes a major global public health problem. Pediatricians and other health care professionals may encounter victims who present with infections, injuries, posttraumatic stress disorder, suicidality, or a variety of other physical or behavioral health conditions. Preventing child trafficking, recognizing victimization, and intervening appropriately require a public health approach that incorporates rigorous research on the risk factors, health impact, and effective treatment options for child exploitation as well as implementation and evaluation of primary prevention programs. Health care professionals need training to recognize possible signs of exploitation and to intervene appropriately. They need to adopt a multidisciplinary, outward-focused approach to service provision, working with nonmedical professionals in the community to assist victims. Pediatricians also need to advocate for legislation and policies that promote child rights and victim services as well as those that address the social determinants of health, which influence the vulnerability to human trafficking. This policy statement outlines major issues regarding public policy, medical education, research, and collaboration in the area of child labor and sex trafficking and provides recommendations for future work. (11/17)
https://doi.org/10.1542/peds.2017-3138

GUIDANCE FOR THE ADMINISTRATION OF MEDICATION IN SCHOOL

Council on School Health
ABSTRACT. Many children who take medications require them during the school day. This policy statement is designed to guide prescribing health care professionals, school physicians, and school health councils on the administration of medications to children at school. All districts and schools need to have policies and plans in place for safe, effective, and efficient administration of medications at school. Having full-time licensed registered nurses administering all routine and emergency medications in schools is the best situation. When a licensed registered nurse is not available, a licensed practical nurse may administer medications. When a nurse cannot administer medication in school, the American Academy of Pediatrics supports appropriate delegation of nursing services in the school setting. Delegation is a tool that may be used by the licensed registered school nurse to allow unlicensed assistive personnel to provide standardized, routine health services under the supervision of the nurse and on the basis of physician guidance and school nursing assessment of the unique needs of the individual child and the suitability of delegation of specific nursing tasks. Any delegation of nursing duties must be consistent with the requirements of state nurse practice acts, state regulations, and guidelines provided by professional nursing organizations. Long-term, emergency, and short-term medications; over-the-counter medications; alternative medications; and experimental drugs that are administered as part of a clinical trial are discussed in this statement. This statement has been endorsed by the American School Health Association. (9/09, reaffirmed 2/13)
https://doi.org/10.1542/peds.2009-1953

GUIDANCE ON COMPLETING A WRITTEN ALLERGY AND ANAPHYLAXIS EMERGENCY PLAN (CLINICAL REPORT)

Julie Wang, MD, FAAP; Scott H. Sicherer, MD, FAAP; and Section on Allergy and Immunology
ABSTRACT. Anaphylaxis is a potentially life-threatening, severe allergic reaction. The immediate assessment of patients having an allergic reaction and prompt administration of epinephrine,

if criteria for anaphylaxis are met, promote optimal outcomes. National and international guidelines for the management of anaphylaxis, including those for management of allergic reactions at school, as well as several clinical reports from the American Academy of Pediatrics, recommend the provision of written emergency action plans to those at risk of anaphylaxis, in addition to the prescription of epinephrine autoinjectors. This clinical report provides information to help health care providers understand the role of a written, personalized allergy and anaphylaxis emergency plan to enhance the care of children at risk of allergic reactions, including anaphylaxis. This report offers a comprehensive written plan, with advice on individualizing instructions to suit specific patient circumstances. (2/17)
https://doi.org/10.1542/peds.2016-4005

GUIDANCE ON FORGOING LIFE-SUSTAINING MEDICAL TREATMENT

Kathryn L. Weise, MD, MA, FAAP; Alexander L. Okun, MD, FAAP; Brian S. Carter, MD, FAAP; Cindy W. Christian, MD, FAAP; Committee on Bioethics; Section on Hospice and Palliative Medicine; and Committee on Child Abuse and Neglect

ABSTRACT. Pediatric health care is practiced with the goal of promoting the best interests of the child. Treatment generally is rendered under a presumption in favor of sustaining life. However, in some circumstances, the balance of benefits and burdens to the child leads to an assessment that forgoing life-sustaining medical treatment (LSMT) is ethically supportable or advisable. Parents are given wide latitude in decision-making concerning end-of-life care for their children in most situations. Collaborative decision-making around LSMT is improved by thorough communication among all stakeholders, including medical staff, the family, and the patient, when possible, throughout the evolving course of the patient's illness. Clear communication of overall goals of care is advised to promote agreed-on plans, including resuscitation status. Perceived disagreement among the team of professionals may be stressful to families. At the same time, understanding the range of professional opinions behind treatment recommendations is critical to informing family decision-making. Input from specialists in palliative care, ethics, pastoral care, and other disciplines enhances support for families and medical staff when decisions to forgo LSMT are being considered. Understanding specific applicability of institutional, regional, state, and national regulations related to forgoing LSMT is important to practice ethically within existing legal frameworks. This guidance represents an update of the 1994 statement from the American Academy of Pediatrics on forgoing LSMT. (8/17)
https://doi.org/10.1542/peds.2017-1905

GUIDANCE ON MANAGEMENT OF ASYMPTOMATIC NEONATES BORN TO WOMEN WITH ACTIVE GENITAL HERPES LESIONS (CLINICAL REPORT)

Committee on Infectious Diseases and Committee on Fetus and Newborn

ABSTRACT. Herpes simplex virus (HSV) infection of the neonate is uncommon, but genital herpes infections in adults are very common. Thus, although treating an infant with neonatal herpes is a relatively rare occurrence, managing infants potentially exposed to HSV at the time of delivery occurs more frequently. The risk of transmitting HSV to an infant during delivery is determined in part by the mother's previous immunity to HSV. Women with primary genital HSV infections who are shedding HSV at delivery are 10 to 30 times more likely to transmit the virus to their newborn infants than are women with recurrent HSV infection who are shedding virus at delivery. With the availability of commercial serological tests that reliably can distinguish type-specific HSV antibodies, it is now possible to determine the type of maternal infection and, thus, further refine management of infants delivered to women who have active genital HSV lesions. The management algorithm presented herein uses both serological and virological studies to determine the risk of HSV transmission to the neonate who is delivered to a mother with active herpetic genital lesions and tailors management accordingly. The algorithm does not address the approach to asymptomatic neonates delivered to women with a history of genital herpes but no active lesions at delivery. (1/13, reaffirmed 9/16)
https://doi.org/10.1542/peds.2012-3216

GUIDELINES FOR DEVELOPING ADMISSION AND DISCHARGE POLICIES FOR THE PEDIATRIC INTENSIVE CARE UNIT (CLINICAL REPORT)

Committee on Hospital Care and Section on Critical Care (joint with Society of Critical Care Medicine Pediatric Section Admission Criteria Task Force)

ABSTRACT. These guidelines were developed to provide a reference for preparing policies on admission to and discharge from pediatric intensive care units. They represent a consensus opinion of physicians, nurses, and allied health care professionals. By using this document as a framework for developing multidisciplinary admission and discharge policies, use of pediatric intensive care units can be optimized and patients can receive the level of care appropriate for their condition. (4/99, reaffirmed 5/17)
https://doi.org/10.1542/peds.103.4.840

GUIDELINES FOR MONITORING AND MANAGEMENT OF PEDIATRIC PATIENTS BEFORE, DURING, AND AFTER SEDATION FOR DIAGNOSTIC AND THERAPEUTIC PROCEDURES

Charles J. Coté, MD, FAAP; Stephen Wilson, DMD, MA, PhD; and American Academy of Pediatrics (joint with American Academy of Pediatric Dentistry)

ABSTRACT. The safe sedation of children for procedures requires a systematic approach that includes the following: no administration of sedating medication without the safety net of medical/dental supervision, careful presedation evaluation for underlying medical or surgical conditions that would place the child at increased risk from sedating medications, appropriate fasting for elective procedures and a balance between the depth of sedation and risk for those who are unable to fast because of the urgent nature of the procedure, a focused airway examination for large (kissing) tonsils or anatomic airway abnormalities that might increase the potential for airway obstruction, a clear understanding of the medication's pharmacokinetic and pharmacodynamic effects and drug interactions, appropriate training and skills in airway management to allow rescue of the patient, age- and size-appropriate equipment for airway management and venous access, appropriate medications and reversal agents, sufficient numbers of appropriately trained staff to both carry out the procedure and monitor the patient, appropriate physiologic monitoring during and after the procedure, a properly equipped and staffed recovery area, recovery to the presedation level of consciousness before discharge from medical/dental supervision, and appropriate discharge instructions. This report was developed through a collaborative effort of the American Academy of Pediatrics and the American Academy of Pediatric Dentistry to offer pediatric providers updated information and guidance in delivering safe sedation to children. (5/19)
https://doi.org/10.1542/peds.2019-1000

GUIDELINES FOR PEDIATRIC CANCER CENTERS

Section on Hematology/Oncology

ABSTRACT. Since the American Academy of Pediatrics published guidelines for pediatric cancer centers in 1986 and 1997, significant changes in the delivery of health care have prompted a review of the role of tertiary medical centers in the

care of pediatric patients. The potential effect of these changes on the treatment and survival rates of children with cancer led to this revision. The intent of this statement is to delineate personnel and facilities that are essential to provide state-of-the-art care for children and adolescents with cancer. This statement emphasizes the importance of board-certified pediatric hematologists/oncologists, pediatric subspecialty consultants, and appropriately qualified pediatric medical subspecialists and pediatric surgical specialists overseeing the care of all pediatric and adolescent cancer patients and the need for facilities available only at a tertiary center as essential for the initial management and much of the follow-up for pediatric and adolescent cancer patients. (6/04, reaffirmed 10/08, 10/18)
https://doi.org/10.1542/peds.113.6.1833

GUIDELINES FOR THE DETERMINATION OF BRAIN DEATH IN INFANTS AND CHILDREN: AN UPDATE OF THE 1987 TASK FORCE RECOMMENDATIONS (CLINICAL REPORT)

Thomas A. Nakagawa, MD; Stephen Ashwal, MD; Mudit Mathur, MD; Mohan Mysore, MD; Section on Critical Care; and Section on Neurology (joint with Society of Critical Care Medicine and Child Neurology Society)

ABSTRACT. *Objective.* To review and revise the 1987 pediatric brain death guidelines.

Methods. Relevant literature was reviewed. Recommendations were developed using the GRADE system.

Conclusions and Recommendations.

1. Determination of brain death in term newborns, infants and children is a clinical diagnosis based on the absence of neurologic function with a known irreversible cause of coma. Because of insufficient data in the literature, recommendations for preterm infants less than 37 weeks' gestational age are not included in this guideline.
2. Hypotension, hypothermia, and metabolic disturbances should be treated and corrected and medications that can interfere with the neurologic examination and apnea testing should be discontinued allowing for adequate clearance before proceeding with these evaluations.
3. Two examinations including apnea testing with each examination separated by an observation period are required. Examinations should be performed by different attending physicians. Apnea testing may be performed by the same physician. An observation period of 24 hours for term newborns (37 weeks' gestational age) to 30 days of age, and 12 hours for infants and children (> 30 days to 18 years) is recommended. The first examination determines the child has met the accepted neurologic examination criteria for brain death. The second examination confirms brain death based on an unchanged and irreversible condition. Assessment of neurologic function following cardiopulmonary resuscitation or other severe acute brain injuries should be deferred for 24 hours or longer if there are concerns or inconsistencies in the examination.
4. Apnea testing to support the diagnosis of brain death must be performed safely and requires documentation of an arterial $Paco_2$ 20 mm Hg above the baseline and ≥60 mm Hg with no respiratory effort during the testing period. If the apnea test cannot be safely completed, an ancillary study should be performed.
5. Ancillary studies (electroencephalogram and radionuclide cerebral blood flow) are not required to establish brain death and are not a substitute for the neurologic examination. Ancillary studies may be used to assist the clinician in making the diagnosis of brain death (1) when components of the examination or apnea testing cannot be completed safely due to the underlying medical condition of the patient; (2) if there is uncertainty about the results of the neurologic examination; (3) if a medication effect may be present; or (4) to reduce the inter-examination observation period. When ancillary studies are used, a second clinical examination and apnea test should be performed and components that can be completed must remain consistent with brain death. In this instance the observation interval may be shortened and the second neurologic examination and apnea test (or all components that are able to be completed safely) can be performed at any time thereafter.
6. Death is declared when the above criteria are fulfilled. (8/11, reaffirmed 1/15, 5/19)

https://doi.org/10.1542/peds.2011-1511

GUIDELINES FOR THE ETHICAL CONDUCT OF STUDIES TO EVALUATE DRUGS IN PEDIATRIC POPULATIONS (CLINICAL REPORT)

Robert E. Shaddy, MD; Scott C. Denne, MD; Committee on Drugs; and Committee on Pediatric Research

ABSTRACT. The proper ethical conduct of studies to evaluate drugs in children is of paramount importance to all those involved in these types of studies. This report is an updated revision to the previously published guidelines from the American Academy of Pediatrics in 1995. Since the previous publication, there have been great strides made in the science and ethics of studying drugs in children. There have also been numerous legislative and regulatory advancements that have promoted the study of drugs in children while simultaneously allowing for the protection of this particularly vulnerable group. This report summarizes these changes and advances and provides a framework from which to guide and monitor the ethical conduct of studies to evaluate drugs in children. (3/10, reaffirmed 1/14, 2/18)
https://doi.org/10.1542/peds.2010-0082

GUIDING PRINCIPLES FOR MANAGED CARE ARRANGEMENTS FOR THE HEALTH CARE OF NEWBORNS, INFANTS, CHILDREN, ADOLESCENTS, AND YOUNG ADULTS

Committee on Child Health Financing

ABSTRACT. By including the precepts of primary care and the medical home in the delivery of services, managed care can be effective in increasing access to a full range of health care services and clinicians. A carefully designed and administered managed care plan can minimize patient under- and overutilization of services, as well as enhance quality of care. Therefore, the American Academy of Pediatrics urges the use of the key principles outlined in this statement in designing and implementing managed care programs for newborns, infants, children, adolescents, and young adults to maximize the positive potential of managed care for pediatrics. (10/13)
https://doi.org/10.1542/peds.2013-2655

GUIDING PRINCIPLES FOR TEAM-BASED PEDIATRIC CARE

Julie P. Katkin, MD, FAAP; Susan J. Kressly, MD, FAAP; Anne R. Edwards, MD, FAAP; James M. Perrin, MD, FAAP; Colleen A. Kraft, MD, FAAP; Julia E. Richerson, MD, FAAP; Joel S. Tieder, MD, MPH, FAAP; Liz Wall; and Task Force on Pediatric Practice Change

ABSTRACT. The American Academy of Pediatrics (AAP) recognizes that children's unique and ever-changing needs depend on a variety of support systems. Key components of effective support systems address the needs of the child and family in the context of their home and community and are dynamic so that they reflect, monitor, and respond to changes as the needs of the child and family change. The AAP believes that team-based care involving medical providers and community partners (eg, teachers and state agencies) is a crucial and necessary component of providing high-quality care to children and their families.

Team-based care builds on the foundation of the medical home by reaching out to a potentially broad array of participants in the life of a child and incorporating them into the care provided. Importantly, the AAP believes that a high-functioning team includes children and their families as essential partners. The overall goal of team-based care is to enhance communication and cooperation among the varied medical, social, and educational partners in a child's life to better meet the global needs of children and their families, helping them to achieve their best potential. In support of the team-based approach, the AAP urges stakeholders to invest in infrastructure, education, and privacy-secured technology to meet the needs of children. This statement includes limited specific examples of potential team members, including health care providers and community partners, that are meant to be illustrative and in no way represent a complete or comprehensive listing of all team members who may be of importance for a specific child and family. (7/17)
https://doi.org/10.1542/peds.2017-1489

GYNECOLOGIC EXAMINATION FOR ADOLESCENTS IN THE PEDIATRIC OFFICE SETTING (CLINICAL REPORT)

Paula K. Braverman, MD; Lesley Breech, MD; and Committee on Adolescence

ABSTRACT. The American Academy of Pediatrics promotes the inclusion of the gynecologic examination in the primary care setting within the medical home. Gynecologic issues are commonly seen by clinicians who provide primary care to adolescents. Some of the most common concerns include questions related to pubertal development; menstrual disorders such as dysmenorrhea, amenorrhea, oligomenorrhea, and abnormal uterine bleeding; contraception; and sexually transmitted and non–sexually transmitted infections. The gynecologic examination is a key element in assessing pubertal status and documenting physical findings. Most adolescents do not need an internal examination involving a speculum or bimanual examination. However, for cases in which more extensive examination is needed, the primary care office with the primary care clinician who has established rapport and trust with the patient is often the best setting for pelvic examination. This report reviews the gynecologic examination, including indications for the pelvic examination in adolescents and the approach to this examination in the office setting. Indications for referral to a gynecologist are included. The pelvic examination may be successfully completed when conducted without pressure and approached as a normal part of routine young women's health care. (8/10, reaffirmed 5/13)
https://doi.org/10.1542/peds.2010-1564

HALF CENTURY SINCE SIDS: A REAPPRAISAL OF TERMINOLOGY (CLINICAL REPORT)

Carrie K. Shapiro-Mendoza, PhD, MPH; Vincent J. Palusci, MD, MS, FAAP; Benjamin Hoffman, MD, FAAP; Erich Batra, MD, FAAP; Marc Yester, MD, FAAP; Tracey S. Corey, MD; Mary Ann Sens, MD, PhD; Task Force on Sudden Infant Death Syndrome; Council on Child Abuse and Neglect; Council on Injury, Violence, and Poison Prevention; and Section on Child Death Review and Prevention (joint with National Association of Medical Examiners)

ABSTRACT. After a sudden infant death, parents and caregivers need accurate and open communication about why their infant died. Communicating tragic news about a child's death to families and caregivers is difficult. Shared and consistent terminology is essential for pediatricians, other physicians, and nonphysician clinicians to improve communication with families and among themselves. When families do not have complete information about why their child died, pediatricians will not be able to support them through the process and make appropriate referrals for pediatric specialty and mental health care. Families can only speculate about the cause and may blame themselves or others for the infant's death. The terminology used to describe infant deaths that occur suddenly and unexpectedly includes an assortment of terms that vary across and among pediatrician, other physician, or nonphysician clinician disciplines. Having consistent terminology is critical to improve the understanding of the etiology, pathophysiology, and epidemiology of these deaths and communicate with families. A lack of consistent terminology also makes it difficult to reliably monitor trends in mortality and hampers the ability to develop effective interventions. This report describes the history of sudden infant death terminology and summarizes the debate over the terminology and the resulting diagnostic shift of these deaths. This information is to assist pediatricians, other physicians, and nonphysician clinicians in caring for families during this difficult time. The importance of consistent terminology is outlined, followed by a summary of progress toward consensus. Recommendations for pediatricians, other physicians, and nonphysician clinicians are proposed. (9/21)
See full text on page 725.
https://doi.org/10.1542/peds.2021-053746

HANDOFFS: TRANSITIONS OF CARE FOR CHILDREN IN THE EMERGENCY DEPARTMENT

Committee on Pediatric Emergency Medicine (joint with American College of Emergency Physicians Pediatric Emergency Medicine Committee and Emergency Nurses Association Pediatric Committee)

ABSTRACT. Transitions of care (ToCs), also referred to as handoffs or sign-outs, occur when the responsibility for a patient's care transfers from 1 health care provider to another. Transitions are common in the acute care setting and have been noted to be vulnerable events with opportunities for error. Health care is taking ideas from other high-risk industries, such as aerospace and nuclear power, to create models of structured transition processes. Although little literature currently exists to establish 1 model as superior, multiorganizational consensus groups agree that standardization is warranted and that additional work is needed to establish characteristics of ToCs that are associated with clinical or practice outcomes. The rationale for structuring ToCs, specifically those related to the care of children in the emergency setting, and a description of identified strategies are presented, along with resources for educating health care providers on ToCs. Recommendations for development, education, and implementation of transition models are included. (10/16, reaffirmed 12/20)
https://doi.org/10.1542/peds.2016-2680

HEAD LICE (CLINICAL REPORT)

Cynthia D. Devore, MD, FAAP; Gordon E. Schutze, MD, FAAP; Council on School Health; and Committee on Infectious Diseases

ABSTRACT. Head lice infestation is associated with limited morbidity but causes a high level of anxiety among parents of school-aged children. Since the 2010 clinical report on head lice was published by the American Academy of Pediatrics, newer medications have been approved for the treatment of head lice. This revised clinical report clarifies current diagnosis and treatment protocols and provides guidance for the management of children with head lice in the school setting. (4/15, reaffirmed 6/20)
https://doi.org/10.1542/peds.2015-0746

HEALTH AND MENTAL HEALTH NEEDS OF CHILDREN IN US MILITARY FAMILIES (CLINICAL REPORT)

CDR Chadley R. Huebner, MD, MPH, FAAP; Section on Uniformed Services; and Committee on Psychosocial Aspects of Child and Family Health

ABSTRACT. Children in US military families share common experiences and unique challenges, including parental

deployment and frequent relocation. Although some of the stressors of military life have been associated with higher rates of mental health disorders and increased health care use among family members, there are various factors and interventions that have been found to promote resilience. Military children often live on or near military installations, where they may attend Department of Defense–sponsored child care programs and schools and receive medical care through military treatment facilities. However, many families live in remote communities without access to these services. Because of this wide geographic distribution, military children are cared for in both military and civilian medical practices. This clinical report provides a background to military culture and offers practical guidance to assist civilian and military pediatricians caring for military children. (12/18)
https://doi.org/10.1542/peds.2018-3258

HEALTH CARE ISSUES FOR CHILDREN AND ADOLESCENTS IN FOSTER CARE AND KINSHIP CARE

Council on Foster Care, Adoption, and Kinship Care; Committee on Adolescence; and Council on Early Childhood

ABSTRACT. Children and adolescents who enter foster care often do so with complicated and serious medical, mental health, developmental, oral health, and psychosocial problems rooted in their history of childhood trauma. Ideally, health care for this population is provided in a pediatric medical home by physicians who are familiar with the sequelae of childhood trauma and adversity. As youth with special health care needs, children and adolescents in foster care require more frequent monitoring of their health status, and pediatricians have a critical role in ensuring the well-being of children in out-of-home care through the provision of high-quality pediatric health services, health care coordination, and advocacy on their behalves. (9/15)
https://doi.org/10.1542/peds.2015-2655

HEALTH CARE ISSUES FOR CHILDREN AND ADOLESCENTS IN FOSTER CARE AND KINSHIP CARE (TECHNICAL REPORT)

Moira A. Szilagyi, MD, PhD; David S. Rosen, MD, MPH; David Rubin, MD, MSCE; Sarah Zlotnik, MSW, MSPH; Council on Foster Care, Adoption, and Kinship Care; Committee on Adolescence; and Council on Early Childhood

ABSTRACT. Children and adolescents involved with child welfare, especially those who are removed from their family of origin and placed in out-of-home care, often present with complex and serious physical, mental health, developmental, and psychosocial problems rooted in childhood adversity and trauma. As such, they are designated as children with special health care needs. There are many barriers to providing high-quality comprehensive health care services to children and adolescents whose lives are characterized by transience and uncertainty. Pediatricians have a critical role in ensuring the well-being of children in out-of-home care through the provision of high-quality pediatric health services in the context of a medical home, and health care coordination and advocacy on their behalf. This technical report supports the policy statement of the same title. (9/15)
https://doi.org/10.1542/peds.2015-2656

HEALTH CARE OF YOUTH AGING OUT OF FOSTER CARE

Council on Foster Care, Adoption, and Kinship Care and Committee on Early Childhood

ABSTRACT. Youth transitioning out of foster care face significant medical and mental health care needs. Unfortunately, these youth rarely receive the services they need because of lack of health insurance. Through many policies and programs, the federal government has taken steps to support older youth in foster care and those aging out. The Fostering Connections to Success and Increasing Adoptions Act of 2008 (Pub L No. 110-354) requires states to work with youth to develop a transition plan that addresses issues such as health insurance. In addition, beginning in 2014, the Patient Protection and Affordable Care Act of 2010 (Pub L No. 111-148) makes youth aging out of foster care eligible for Medicaid coverage until age 26 years, regardless of income. Pediatricians can support youth aging out of foster care by working collaboratively with the child welfare agency in their state to ensure that the ongoing health needs of transitioning youth are met. (11/12, reaffirmed 7/17)
https://doi.org/10.1542/peds.2012-2603

HEALTH CARE SUPERVISION FOR CHILDREN WITH WILLIAMS SYNDROME (CLINICAL REPORT)

Colleen A. Morris, MD; Stephen R. Braddock, MD; and Council on Genetics

ABSTRACT. This set of recommendations is designed to assist the pediatrician in caring for children with Williams syndrome (WS) who were diagnosed by using clinical features and with chromosome 7 microdeletion confirmed by fluorescence in situ hybridization, chromosome microarray, or multiplex ligation-dependent probe amplification. The recommendations in this report reflect review of the current literature, including previously peer-reviewed and published management suggestions for WS, as well as the consensus of physicians and psychologists with expertise in the care of individuals with WS. These general recommendations for the syndrome do not replace individualized medical assessment and treatment. (1/20)
https://doi.org/10.1542/peds.2019-3761

HEALTH DISPARITIES IN TOBACCO USE AND EXPOSURE: A STRUCTURAL COMPETENCY APPROACH

Jyothi Marbin, MD, FAAP; Sophie J. Balk, MD, FAAP; Valerie Gribben, MD, FAAP; Judith Groner, MD, FAAP; and Section on Tobacco Control

ABSTRACT. Fourteen percent of US adults use tobacco products. Because many of those who use tobacco are parents and/or caregivers, children are disproportionately exposed to tobacco smoke. People who use tobacco products often become addicted to nicotine, resulting in tobacco dependence, a chronic, relapsing disease. Tobacco use and exposure are more likely to occur in vulnerable and marginalized groups, including those living in poverty. Although some view tobacco use as a personal choice, evidence suggests that structural forces play an important role in tobacco uptake, subsequent nicotine addiction, and perpetuation of use. Viewing tobacco use and tobacco dependence through a structural competency lens promotes recognition of the larger systemic forces perpetuating tobacco use, including deliberate targeting of groups by the tobacco industry, lack of enforcement of age-for-sale laws, inferior access to health insurance and health care, poor access to cessation resources, and economic stress. Each of these forces perpetuates tobacco initiation and use; in turn, tobacco use perpetuates the user's adverse health and economic conditions. Pediatricians are urged to view family tobacco use as a social determinant of health. In addition to screening adolescents for tobacco use and providing resources and treatment of tobacco dependence, pediatricians are encouraged to systematically screen children for secondhand smoke exposure and support family members who smoke with tobacco cessation. Additionally, pediatricians can address the structural issues perpetuating tobacco use by becoming involved in policy and advocacy initiatives. (12/20)

See full text on page 739.

https://doi.org/10.1542/peds.2020-040253

HEALTH INFORMATION TECHNOLOGY AND THE MEDICAL HOME

Council on Clinical Information Technology

ABSTRACT. The American Academy of Pediatrics (AAP) supports development and universal implementation of a comprehensive electronic infrastructure to support pediatric information functions of the medical home. These functions include (1) timely and continuous management and tracking of health data and services over a patient's lifetime for all providers, patients, families, and guardians, (2) comprehensive organization and secure transfer of health data during patient-care transitions between providers, institutions, and practices, (3) establishment and maintenance of central coordination of a patient's health information among multiple repositories (including personal health records and information exchanges), (4) translation of evidence into actionable clinical decision support, and (5) reuse of archived clinical data for continuous quality improvement. The AAP supports universal, secure, and vendor-neutral portability of health information for all patients contained within the medical home across all care settings (ambulatory practices, inpatient settings, emergency departments, pharmacies, consultants, support service providers, and therapists) for multiple purposes including direct care, personal health records, public health, and registries. The AAP also supports financial incentives that promote the development of information tools that meet the needs of pediatric workflows and that appropriately recognize the added value of medical homes to pediatric care. (4/11, reaffirmed 7/15)

https://doi.org/10.1542/peds.2011-0454

HEALTH SUPERVISION FOR CHILDREN WITH DOWN SYNDROME (CLINICAL REPORT)

Marilyn J. Bull, MD, and Committee on Genetics

ABSTRACT. These guidelines are designed to assist the pediatrician in caring for the child in whom a diagnosis of Down syndrome has been confirmed by chromosome analysis. Although a pediatrician's initial contact with the child is usually during infancy, occasionally the pregnant woman who has been given a prenatal diagnosis of Down syndrome will be referred for review of the condition and the genetic counseling provided. Therefore, this report offers guidance for this situation as well. (7/11, reaffirmed 9/16, 1/18)

https://doi.org/10.1542/peds.2011-1605

HEALTH SUPERVISION FOR CHILDREN WITH FRAGILE X SYNDROME (CLINICAL REPORT)

Joseph H. Hersh, MD; Robert A. Saul, MD; and Committee on Genetics

ABSTRACT. Fragile X syndrome (an *FMR1*–related disorder) is the most commonly inherited form of mental retardation. Early physical recognition is difficult, so boys with developmental delay should be strongly considered for molecular testing. The characteristic adult phenotype usually does not develop until the second decade of life. Girls can also be affected with developmental delay. Because multiple family members can be affected with mental retardation and other conditions (premature ovarian failure and tremor/ataxia), family history information is of critical importance for the diagnosis and management of affected patients and their families. This report summarizes issues for fragile X syndrome regarding clinical diagnosis, laboratory diagnosis, genetic counseling, related health problems, behavior management, and age-related health supervision guidelines. The diagnosis of fragile X syndrome not only involves the affected children but also potentially has significant health consequences for multiple generations in each family. (4/11)

https://doi.org/10.1542/peds.2010-3500

HEALTH SUPERVISION FOR CHILDREN WITH MARFAN SYNDROME (CLINICAL REPORT)

Brad T. Tinkle, MD, PhD; Howard M. Saal, MD; and Committee on Genetics

ABSTRACT. Marfan syndrome is a systemic, heritable connective tissue disorder that affects many different organ systems and is best managed by using a multidisciplinary approach. The guidance in this report is designed to assist the pediatrician in recognizing the features of Marfan syndrome as well as caring for the individual with this disorder. (9/13, reaffirmed 10/19)

https://doi.org/10.1542/peds.2013-2063

HEALTH SUPERVISION FOR CHILDREN WITH NEUROFIBROMATOSIS TYPE 1 (CLINICAL REPORT)

David T. Miller, MD, PhD, FAAP; Debra Freedenberg, MD, PhD, FAAP; Elizabeth Schorry, MD; Nicole J. Ullrich, MD, PhD; David Viskochil, MD, PhD; Bruce R. Korf, MD, PhD, FAAP; and Council on Genetics (joint with American College of Medical Genetics and Genomics)

ABSTRACT. Neurofibromatosis type 1 (NF1) is a multisystem disorder that primarily involves the skin and peripheral nervous system. Its population prevalence is approximately 1 in 3000. The condition is usually recognized in early childhood, when pigmentary manifestations emerge. Although NF1 is associated with marked clinical variability, most children affected follow patterns of growth and development within the normal range. Some features of NF1 can be present at birth, but most manifestations emerge with age, necessitating periodic monitoring to address ongoing health and developmental needs and minimize the risk of serious medical complications. In this report, we provide a review of the clinical criteria needed to establish a diagnosis, the inheritance pattern of NF1, its major clinical and developmental manifestations, and guidelines for monitoring and providing intervention to maximize the health and quality of life of a child affected. (4/19)

https://doi.org/10.1542/peds.2019-0660

HEALTH SUPERVISION FOR CHILDREN WITH PRADER-WILLI SYNDROME (CLINICAL REPORT)

Shawn E. McCandless, MD, and Committee on Genetics

ABSTRACT. This set of guidelines was designed to assist the pediatrician in caring for children with Prader-Willi syndrome diagnosed by clinical features and confirmed by molecular testing. Prader-Willi syndrome provides an excellent example of how early diagnosis and management can improve the long-term outcome for some genetic disorders. (12/10)

https://doi.org/10.1542/peds.2010-2820

HEALTH SUPERVISION FOR CHILDREN WITH SICKLE CELL DISEASE

Section on Hematology/Oncology and Committee on Genetics

ABSTRACT. Sickle cell disease (SCD) is a group of complex genetic disorders with multisystem manifestations. This statement provides pediatricians in primary care and subspecialty practice with an overview of the genetics, diagnosis, clinical manifestations, and treatment of SCD. Specialized comprehensive medical care decreases morbidity and mortality during childhood. The provision of comprehensive care is a time-intensive endeavor that includes ongoing patient and family education, periodic comprehensive evaluations and other disease-specific health maintenance services, psychosocial care, and genetic counseling. Timely and appropriate treatment of acute illness is critical, because life-threatening complications develop rapidly. It is essential that every child with SCD receive comprehensive care that is coordinated through a medical home with appropriate expertise. (3/02, reaffirmed 1/06, 1/11, 2/16, 9/20)

https://doi.org/10.1542/peds.109.3.526

HEALTH SUPERVISION FOR PEOPLE WITH ACHONDROPLASIA (CLINICAL REPORT)

Julie Hoover-Fong, MD, PhD, FACMG; Charles I. Scott, MD, FAAP; Marilyn C. Jones, MD, FAAP; and Committee on Genetics

ABSTRACT. Achondroplasia is the most common short-stature skeletal dysplasia, additionally marked by rhizomelia, macrocephaly, midface hypoplasia, and normal cognition. Potential medical complications associated with achondroplasia include lower extremity long bone bowing, middle-ear dysfunction, obstructive sleep apnea, and, more rarely, cervicomedullary compression, hydrocephalus, thoracolumbar kyphosis, and central sleep apnea. This is the second revision to the original 1995 health supervision guidance from the American Academy of Pediatrics for caring for patients with achondroplasia. Although many of the previously published recommendations remain appropriate for contemporary medical care, this document highlights interval advancements in the clinical methods available to monitor for complications associated with achondroplasia. This document is intended to provide guidance for health care providers to help identify individual patients at high risk of developing serious sequelae and to enable intervention before complications develop. (5/20)

https://doi.org/10.1542/peds.2020-1010

HELPING CHILDREN AND FAMILIES DEAL WITH DIVORCE AND SEPARATION (CLINICAL REPORT)

George J. Cohen, MD, FAAP; Carol C. Weitzman, MD, FAAP; Committee on Psychosocial Aspects of Child and Family Health; and Section on Developmental and Behavioral Pediatrics

ABSTRACT. For the past several years in the United States, there have been more than 800 000 divorces and parent separations annually, with over 1 million children affected. Children and their parents can experience emotional trauma before, during, and after a separation or divorce. Pediatricians can be aware of their patients' behavior and parental attitudes and behaviors that may indicate family dysfunction and that can indicate need for intervention. Age-appropriate explanation and counseling for the child and advice and guidance for the parents, as well as recommendation of reading material, may help reduce the potential negative effects of divorce. Often, referral to professionals with expertise in the social, emotional, and legal aspects of the separation and its aftermath may be helpful for these families. (11/16)

https://doi.org/10.1542/peds.2016-3020

HIGH-DEDUCTIBLE HEALTH PLANS

Committee on Child Health Financing

ABSTRACT. High-deductible health plans (HDHPs) are insurance policies with higher deductibles than conventional plans. The Medicare Prescription Drug Improvement and Modernization Act of 2003 linked many HDHPs with tax-advantaged spending accounts. The 2010 Patient Protection and Affordable Care Act continues to provide for HDHPs in its lower-level plans on the health insurance marketplace and provides for them in employer-offered plans. HDHPs decrease the premium cost of insurance policies for purchasers and shift the risk of further payments to the individual subscriber. HDHPs reduce utilization and total medical costs, at least in the short term. Because HDHPs require out-of-pocket payment in the initial stages of care, primary care and other outpatient services as well as elective procedures are the services most affected, whereas higher-cost services in the health care system, incurred after the deductible is met, are unaffected. HDHPs promote adverse selection because healthier and wealthier patients tend to opt out of conventional plans in favor of HDHPs. Because the ill pay more than the healthy under HDHPs, families with children with special health care needs bear an increased cost burden in this model. HDHPs discourage use of nonpreventive primary care and thus are at odds with most recommendations for improving the organization of health care, which focus on strengthening primary care.

This policy statement provides background information on HDHPs, discusses the implications for families and pediatric care providers, and suggests courses of action. (4/14, reaffirmed 10/18)

https://doi.org/10.1542/peds.2014-0555

HIV TESTING AND PROPHYLAXIS TO PREVENT MOTHER-TO-CHILD TRANSMISSION IN THE UNITED STATES

Committee on Pediatric AIDS

ABSTRACT. Universal HIV testing of pregnant women in the United States is the key to prevention of mother-to-child transmission of HIV. Repeat testing in the third trimester and rapid HIV testing at labor and delivery are additional strategies to further reduce the rate of perinatal HIV transmission. Prevention of mother-to-child transmission of HIV is most effective when antiretroviral drugs are received by the mother during her pregnancy and continued through delivery and then administered to the infant after birth. Antiretroviral drugs are effective in reducing the risk of mother-to-child transmission of HIV even when prophylaxis is started for the infant soon after birth. New rapid testing methods allow identification of HIV-infected women or HIV-exposed infants in 20 to 60 minutes. The American Academy of Pediatrics recommends documented, routine HIV testing for all pregnant women in the United States after notifying the patient that testing will be performed, unless the patient declines HIV testing ("opt-out" consent or "right of refusal"). For women in labor with undocumented HIV-infection status during the current pregnancy, immediate maternal HIV testing with opt-out consent, using a rapid HIV antibody test, is recommended. Positive HIV antibody screening test results should be confirmed with immunofluorescent antibody or Western blot assay. For women with a positive rapid HIV antibody test result, antiretroviral prophylaxis should be administered promptly to the mother and newborn infant on the basis of the positive result of the rapid antibody test without waiting for results of confirmatory HIV testing. If the confirmatory test result is negative, then prophylaxis should be discontinued. For a newborn infant whose mother's HIV serostatus is unknown, the health care professional should perform rapid HIV antibody testing on the mother or on the newborn infant, with results reported to the health care professional no later than 12 hours after the infant's birth. If the rapid HIV antibody test result is positive, antiretroviral prophylaxis should be instituted as soon as possible after birth but certainly by 12 hours after delivery, pending completion of confirmatory HIV testing. The mother should be counseled not to breastfeed the infant. Assistance with immediate initiation of hand and pump expression to stimulate milk production should be offered to the mother, given the possibility that the confirmatory test result may be negative. If the confirmatory test result is negative, then prophylaxis should be stopped and breastfeeding may be initiated. If the confirmatory test result is positive, infants should receive antiretroviral prophylaxis for 6 weeks after birth, and the mother should not breastfeed the infant. (11/08, reaffirmed 6/11, 11/14, 10/20)

https://doi.org/10.1542/peds.2008-2175

HOME CARE OF CHILDREN AND YOUTH WITH COMPLEX HEALTH CARE NEEDS AND TECHNOLOGY DEPENDENCIES (CLINICAL REPORT)

Ellen Roy Elias, MD; Nancy A. Murphy, MD; and Council on Children With Disabilities

ABSTRACT. Children and youth with complex medical issues, especially those with technology dependencies, experience frequent and often lengthy hospitalizations. Hospital discharges for these children can be a complicated process that requires a delib-

erate, multistep approach. In addition to successful discharges to home, it is essential that pediatric providers develop and implement an interdisciplinary and coordinated plan of care that addresses the child's ongoing health care needs. The goal is to ensure that each child remains healthy, thrives, and obtains optimal medical home and developmental supports that promote ongoing care at home and minimize recurrent hospitalizations. This clinical report presents an approach to discharging the child with complex medical needs with technology dependencies from hospital to home and then continually addressing the needs of the child and family in the home environment. (4/12, reaffirmed 5/17)
https://doi.org/10.1542/peds.2012-0606

HONORING DO-NOT-ATTEMPT-RESUSCITATION REQUESTS IN SCHOOLS

Council on School Health and Committee on Bioethics

ABSTRACT. Increasingly, children and adolescents with complex chronic conditions are living in the community. Federal legislation and regulations facilitate their participation in school. Some of these children and adolescents and their families may wish to forego life-sustaining medical treatment, including cardiopulmonary resuscitation, because they would be ineffective or because the risks outweigh the benefits. Honoring these requests in the school environment is complex because of the limited availability of school nurses and the frequent lack of supporting state legislation and regulations. Understanding and collaboration on the part of all parties is essential. Pediatricians have an important role in helping school nurses incorporate a specific action plan into the student's individualized health care plan. The action plan should include both communication and comfort-care plans. Pediatricians who work directly with schools can also help implement policies, and professional organizations can advocate for regulations and legislation that enable students and their families to effectuate their preferences. (4/10, reaffirmed 7/13, 8/16)
https://doi.org/10.1542/peds.2010-0452

HOSPITAL DISCHARGE OF THE HIGH-RISK NEONATE

Committee on Fetus and Newborn

ABSTRACT. This policy statement updates the guidelines on discharge of the high-risk neonate first published by the American Academy of Pediatrics in 1998. As with the earlier document, this statement is based, insofar as possible, on published, scientifically derived information. This updated statement incorporates new knowledge about risks and medical care of the high-risk neonate, the timing of discharge, and planning for care after discharge. It also refers to other American Academy of Pediatrics publications that are relevant to these issues. This statement draws on the previous classification of high-risk infants into 4 categories: (1) the preterm infant; (2) the infant with special health care needs or dependence on technology; (3) the infant at risk because of family issues; and (4) the infant with anticipated early death. The issues of deciding when discharge is appropriate, defining the specific needs for follow-up care, and the process of detailed discharge planning are addressed as they apply in general to all 4 categories; in addition, special attention is directed to the particular issues presented by the 4 individual categories. Recommendations are given to aid in deciding when discharge is appropriate and to ensure that all necessary care will be available and well coordinated after discharge. The need for individualized planning and physician judgment is emphasized. (11/08, reaffirmed 5/11, 11/18)
https://doi.org/10.1542/peds.2008-2174

THE HOSPITAL RECORD OF THE INJURED CHILD AND THE NEED FOR EXTERNAL CAUSE-OF-INJURY CODES

Committee on Injury and Poison Prevention

ABSTRACT. Proper record-keeping of emergency department visits and hospitalizations of injured children is vital for appropriate patient management. Determination and documentation of the circumstances surrounding the injury event are essential. This information not only is the basis for preventive counseling, but also provides clues about how similar injuries in other youth can be avoided. The hospital records have an important secondary purpose; namely, if sufficient information about the cause and mechanism of injury is documented, it can be subsequently coded, electronically compiled, and retrieved later to provide an epidemiologic profile of the injury, the first step in prevention at the population level. To be of greatest use, hospital records should indicate the "who, what, when, where, why, and how" of the injury occurrence and whether protective equipment (eg, a seat belt) was used. The pediatrician has two important roles in this area: to document fully the injury event and to advocate the use of standardized external cause-of-injury codes, which allow such data to be compiled and analyzed. (2/99, reaffirmed 5/02, 5/05, 10/08, 10/13)
https://doi.org/10.1542/peds.103.2.524

HOSPITAL STAY FOR HEALTHY TERM NEWBORN INFANTS

William E. Benitz, MD, FAAP, and Committee on Fetus and Newborn

ABSTRACT. The hospital stay of the mother and her healthy term newborn infant should be long enough to allow identification of problems and to ensure that the mother is sufficiently recovered and prepared to care for herself and her newborn at home. The length of stay should be based on the unique characteristics of each mother-infant dyad, including the health of the mother, the health and stability of the newborn, the ability and confidence of the mother to care for herself and her newborn, the adequacy of support systems at home, and access to appropriate follow-up care in a medical home. Input from the mother and her obstetrical care provider should be considered before a decision to discharge a newborn is made, and all efforts should be made to keep a mother and her newborn together to ensure simultaneous discharge. (4/15)
https://doi.org/10.1542/peds.2015-0699

HUMAN EMBRYONIC STEM CELL (HESC) AND HUMAN EMBRYO RESEARCH

Committee on Pediatric Research and Committee on Bioethics

ABSTRACT. Human embryonic stem cell research has emerged as an important platform for the understanding and treatment of pediatric diseases. From its inception, however, it has raised ethical concerns based not on the use of stem cells themselves but on objections to the source of the cells—specifically, the destruction of preimplantation human embryos. Despite differences in public opinion on this issue, a large majority of the public supports continued research using embryonic stem cells. Given the possible substantial benefit of stem cell research on child health and development, the American Academy of Pediatrics believes that funding and oversight for human embryo and embryonic stem cell research should continue. (10/12, reaffirmed 7/17)
https://doi.org/10.1542/peds.2012-2482

HYPOTHERMIA AND NEONATAL ENCEPHALOPATHY (CLINICAL REPORT)

Committee on Fetus and Newborn

ABSTRACT. Data from large randomized clinical trials indicate that therapeutic hypothermia, using either selective head cooling or systemic cooling, is an effective therapy for neonatal encephalopathy. Infants selected for cooling must meet the criteria outlined in published clinical trials. The implementation of cooling

needs to be performed at centers that have the capability to manage medically complex infants. Because the majority of infants who have neonatal encephalopathy are born at community hospitals, centers that perform cooling should work with their referring hospitals to implement education programs focused on increasing the awareness and identification of infants at risk for encephalopathy, and the initial clinical management of affected infants. (5/14)
https://doi.org/10.1542/peds.2014-0899

IDENTIFICATION, EVALUATION, AND MANAGEMENT OF CHILDREN WITH AUTISM SPECTRUM DISORDER (CLINICAL REPORT)

Susan L. Hyman, MD, FAAP; Susan E. Levy, MD, MPH, FAAP; Scott M. Myers, MD, FAAP; Council on Children With Disabilities; and Section on Developmental and Behavioral Pediatrics

ABSTRACT. Autism spectrum disorder (ASD) is a common neurodevelopmental disorder with reported prevalence in the United States of 1 in 59 children (approximately 1.7%). Core deficits are identified in 2 domains: social communication/interaction and restrictive, repetitive patterns of behavior. Children and youth with ASD have service needs in behavioral, educational, health, leisure, family support, and other areas. Standardized screening for ASD at 18 and 24 months of age with ongoing developmental surveillance continues to be recommended in primary care (although it may be performed in other settings), because ASD is common, can be diagnosed as young as 18 months of age, and has evidenced-based interventions that may improve function. More accurate and culturally sensitive screening approaches are needed. Primary care providers should be familiar with the diagnostic criteria for ASD, appropriate etiologic evaluation, and co-occurring medical and behavioral conditions (such as disorders of sleep and feeding, gastrointestinal tract symptoms, obesity, seizures, attention-deficit/hyperactivity disorder, anxiety, and wandering) that affect the child's function and quality of life. There is an increasing evidence base to support behavioral and other interventions to address specific skills and symptoms. Shared decision making calls for collaboration with families in evaluation and choice of interventions. This single clinical report updates the 2007 American Academy of Pediatrics clinical reports on the evaluation and treatment of ASD in one publication with an online table of contents and section view available through the American Academy of Pediatrics Gateway to help the reader identify topic areas within the report. (12/19)
https://doi.org/10.1542/peds.2019-3447

IDENTIFICATION AND CARE OF HIV-EXPOSED AND HIV-INFECTED INFANTS, CHILDREN, AND ADOLESCENTS IN FOSTER CARE

Committee on Pediatric AIDS

ABSTRACT. As a consequence of the expanding human immunodeficiency virus (HIV) epidemic and major advances in medical management of HIV-exposed and HIV-infected persons, revised recommendations are provided for HIV testing of infants, children, and adolescents in foster care. Updated recommendations also are provided for the care of HIV-exposed and HIV-infected persons who are in foster care. (7/00, reaffirmed 12/16)
https://doi.org/10.1542/peds.106.1.149

IDENTIFICATION AND MANAGEMENT OF EATING DISORDERS IN CHILDREN AND ADOLESCENTS (CLINICAL REPORT)

Laurie L. Hornberger, MD, MPH, FAAP; Margo A. Lane, MD, FRCPC, FAAP; and Committee on Adolescence

ABSTRACT. Eating disorders are serious, potentially life-threatening illnesses afflicting individuals through the life span, with a particular impact on both the physical and psychological development of children and adolescents. Because care for children and adolescents with eating disorders can be complex and resources for the treatment of eating disorders are often limited, pediatricians may be called on to not only provide medical supervision for their patients with diagnosed eating disorders but also coordinate care and advocate for appropriate services. This clinical report includes a review of common eating disorders diagnosed in children and adolescents, outlines the medical evaluation of patients suspected of having an eating disorder, presents an overview of treatment strategies, and highlights opportunities for advocacy. (12/20)
See full text on page 755.
https://doi.org/10.1542/peds.2020-040279

IDENTIFYING CHILD ABUSE FATALITIES DURING INFANCY (CLINICAL REPORT)

Vincent J. Palusci, MD, MS, FAAP; Amanda J. Kay, MD, MPH, FAAP; Erich Batra, MD, FAAP; Rachel Y. Moon, MD, FAAP; Council on Child Abuse and Neglect; Section on Child Death Review and Prevention; and Task Force on Sudden Infant Death Syndrome (joint with Tracey S. Corey, MD; Thomas Andrew, MD; Michael Graham, MD; and National Association of Medical Examiners)

ABSTRACT. When a healthy infant dies suddenly and unexpectedly, it is critical to correctly determine if the death was caused by child abuse or neglect. Sudden unexpected infant deaths should be comprehensively investigated, ancillary tests and forensic procedures should be used to more-accurately identify the cause of death, and parents deserve to be approached in a nonaccusatory manner during the investigation. Missing a child abuse death can place other children at risk, and inappropriately approaching a sleep-related death as maltreatment can result in inappropriate criminal and protective services investigations. Communities can learn from these deaths by using multidisciplinary child death reviews. Pediatricians can support families during investigation, advocate for and support state policies that require autopsies and scene investigation, and advocate for establishing comprehensive and fully funded child death investigation and reviews at the local and state levels. Additional funding is also needed for research to advance our ability to prevent these deaths. (8/19)
https://doi.org/10.1542/peds.2019-2076

IDENTIFYING INFANTS AND YOUNG CHILDREN WITH DEVELOPMENTAL DISORDERS IN THE MEDICAL HOME: AN ALGORITHM FOR DEVELOPMENTAL SURVEILLANCE AND SCREENING

Council on Children With Disabilities, Section on Developmental and Behavioral Pediatrics, Bright Futures Steering Committee, and Medical Home Initiatives for Children With Special Needs Project Advisory Committee

ABSTRACT. Early identification of developmental disorders is critical to the well-being of children and their families. It is an integral function of the primary care medical home and an appropriate responsibility of all pediatric health care professionals. This statement provides an algorithm as a strategy to support health care professionals in developing a pattern and practice for addressing developmental concerns in children from birth through 3 years of age. The authors recommend that developmental surveillance be incorporated at every well-child preventive care visit. Any concerns raised during surveillance should be promptly addressed with standardized developmental screening tests. In addition, screening tests should be administered regularly at the 9-, 18-, and 30-month visits. (Because the 30-month visit is not yet a part of the preventive care system and is often not reimbursable by third-party payers at this time, developmental screening can be performed at 24 months of age.

In addition, because the frequency of regular pediatric visits decreases after 24 months of age, a pediatrician who expects that his or her patients will have difficulty attending a 30-month visit should conduct screening during the 24-month visit.) The early identification of developmental problems should lead to further developmental and medical evaluation, diagnosis, and treatment, including early developmental intervention. Children diagnosed with developmental disorders should be identified as children with special health care needs, and chronic-condition management should be initiated. Identification of a developmental disorder and its underlying etiology may also drive a range of treatment planning, from medical treatment of the child to family planning for his or her parents. (7/06, reaffirmed 12/09, 8/14)
https://doi.org/10.1542/peds.2006-1231

IDENTIFYING THE MISSHAPEN HEAD: CRANIOSYNOSTOSIS AND RELATED DISORDERS (CLINICAL REPORT)

Mark S. Dias, MD, FAAP, FAANS; Thomas Samson, MD, FAAP; Elias B. Rizk, MD, FAAP, FAANS; Lance S. Governale, MD, FAAP, FAANS; Joan T. Richtsmeier, PhD; Section on Neurologic Surgery; and Section on Plastic and Reconstructive Surgery

ABSTRACT. Pediatric care providers, pediatricians, pediatric subspecialty physicians, and other health care providers should be able to recognize children with abnormal head shapes that occur as a result of both synostotic and deformational processes. The purpose of this clinical report is to review the characteristic head shape changes, as well as secondary craniofacial characteristics, that occur in the setting of the various primary craniosynostoses and deformations. As an introduction, the physiology and genetics of skull growth as well as the pathophysiology underlying craniosynostosis are reviewed. This is followed by a description of each type of primary craniosynostosis (metopic, unicoronal, bicoronal, sagittal, lambdoid, and frontosphenoidal) and their resultant head shape changes, with an emphasis on differentiating conditions that require surgical correction from those (bathrocephaly, deformational plagiocephaly/brachycephaly, and neonatal intensive care unit-associated skill deformation, known as NICUcephaly) that do not. The report ends with a brief discussion of microcephaly as it relates to craniosynostosis as well as fontanelle closure. The intent is to improve pediatric care providers' recognition and timely referral for craniosynostosis and their differentiation of synostotic from deformational and other nonoperative head shape changes. (8/20)
https://doi.org/10.1542/peds.2020-015511

IMMERSION IN WATER DURING LABOR AND DELIVERY (CLINICAL REPORT)

Committee on Fetus and Newborn (joint with American College of Obstetricians and Gynecologists Committee on Obstetric Practice)

ABSTRACT. Immersion in water has been suggested as a beneficial alternative for labor, delivery, or both and over the past decades has gained popularity in many parts of the world. Immersion in water during the first stage of labor may be associated with decreased pain or use of anesthesia and decreased duration of labor. However, there is no evidence that immersion in water during the first stage of labor otherwise improves perinatal outcomes, and it should not prevent or inhibit other elements of care. The safety and efficacy of immersion in water during the second stage of labor have not been established, and immersion in water during the second stage of labor has not been associated with maternal or fetal benefit. Given these facts and case reports of rare but serious adverse effects in the newborn, the practice of immersion in the second stage of labor (underwater delivery) should be considered an experimental procedure that only should be performed within the context of an appropriately designed clinical trial with informed consent. Facilities that plan to offer immersion in the first stage of labor need to establish rigorous protocols for candidate selection, maintenance and cleaning of tubs and immersion pools, infection control procedures, monitoring of mothers and fetuses at appropriate intervals while immersed, and immediately and safely moving women out of the tubs if maternal or fetal concerns develop. (3/14)
https://doi.org/10.1542/peds.2013-3794

IMMUNIZATION INFORMATION SYSTEMS

Committee on Practice and Ambulatory Medicine

ABSTRACT. The American Academy of Pediatrics continues to support the development and implementation of immunization information systems, previously referred to as immunization registries, and other systems for the benefit of children, pediatricians, and their communities. Pediatricians and others must be aware of the value that immunization information systems have for society, the potential fiscal influences on their practice, the costs and benefits, and areas for future improvement. (9/06, reaffirmed 10/11)
https://doi.org/10.1542/peds.2006-1723

IMMUNIZING AGAINST HATE: OVERCOMING ASIAN AMERICAN AND PACIFIC ISLANDER RACISM

Lee Savio Beers, MD, FAAP; Moira Szilagyi, MD, PhD, FAAP; Warren M. Seigel, MD, MBA, FAAP; Wendy S. Davis, MD, FAAP; Yasuko Fukuda, MD, FAAP; Madeline Joseph, MD, FAAP; Joseph L. Wright, MD, MPH, FAAP; Sara H. Goza, MD, FAAP; Board of Directors Executive Committee; and Board Committee on Equity

ABSTRACT. It has been more than a year since Immediate Past President of the American Academy of Pediatrics (AAP), Sally Goza, MD, FAAP, warned against the threat severe acute respiratory syndrome-coronavirus 2 (SARS-CoV-2) posed to children and families, including the harm coronavirus disease 2019 (COVID-19)–fueled racism and xenophobia could cause the Asian American community. Sadly, as the COVID-19 pandemic spread, racism and violent attacks on Asian Americans spread along with it. (6/21)
See full text on page 781.
https://doi.org/10.1542/peds.2021-051836

IMMUNIZING PARENTS AND OTHER CLOSE FAMILY CONTACTS IN THE PEDIATRIC OFFICE SETTING (TECHNICAL REPORT)

Herschel R. Lessin, MD; Kathryn M. Edwards, MD; Committee on Practice and Ambulatory Medicine; and Committee on Infectious Diseases

ABSTRACT. Additional strategies are needed to protect children from vaccine-preventable diseases. In particular, very young infants, as well as children who are immunocompromised, are at especially high risk for developing the serious consequences of vaccine-preventable diseases and cannot be immunized completely. There is some evidence that children who become infected with these diseases are exposed to pathogens through household contacts, particularly from parents or other close family contacts. Such infections likely are attributable to adults who are not fully protected from these diseases, either because their immunity to vaccine-preventable diseases has waned over time or because they have not received a vaccine. There are many challenges that have added to low adult immunization rates in the United States. One option to increase immunization coverage for parents and close family contacts of infants and vulnerable children is to provide alternative locations for these adults to be immunized, such as the pediatric office setting. Ideally, adults should receive immunizations in their medical homes; however, to provide greater protection to these adults and reduce the exposure of children to pathogens, immunizing parents or other adult family contacts in the pediatric office setting could increase immunization coverage for this population to protect themselves

as well as children to whom they provide care. (12/11, reaffirmed 8/16)
https://doi.org/10.1542/peds.2011-2937

THE IMPACT OF MARIJUANA POLICIES ON YOUTH: CLINICAL, RESEARCH, AND LEGAL UPDATE

Committee on Substance Abuse and Committee on Adolescence

ABSTRACT. This policy statement is an update of the American Academy of Pediatrics policy statement "Legalization of Marijuana: Potential Impact on Youth," published in 2004. Pediatricians have special expertise in the care of children and adolescents and may be called on to advise legislators about the potential impact of changes in the legal status of marijuana on adolescents. Parents also may look to pediatricians for advice as they consider whether to support state-level initiatives that propose to legalize the use of marijuana for medical and nonmedical purposes or to decriminalize the possession of small amounts of marijuana. This policy statement provides the position of the American Academy of Pediatrics on the issue of marijuana legalization. The accompanying technical report reviews what is currently known about the relationships of marijuana use with health and the developing brain and the legal status of marijuana and adolescents' use of marijuana to better understand how change in legal status might influence the degree of marijuana use by adolescents in the future. (2/15)
https://doi.org/10.1542/peds.2014-4146

THE IMPACT OF MARIJUANA POLICIES ON YOUTH: CLINICAL, RESEARCH, AND LEGAL UPDATE (TECHNICAL REPORT)

Seth Ammerman, MD, FAAP; Sheryl Ryan, MD, FAAP; William P. Adelman, MD, FAAP; Committee on Substance Abuse; and Committee on Adolescence

ABSTRACT. This technical report updates the 2004 American Academy of Pediatrics technical report on the legalization of marijuana. Current epidemiology of marijuana use is presented, as are definitions and biology of marijuana compounds, side effects of marijuana use, and effects of use on adolescent brain development. Issues concerning medical marijuana specifically are also addressed. Concerning legalization of marijuana, 4 different approaches in the United States are discussed: legalization of marijuana solely for medical purposes, decriminalization of recreational use of marijuana, legalization of recreational use of marijuana, and criminal prosecution of recreational (and medical) use of marijuana. These approaches are compared, and the latest available data are presented to aid in forming public policy. The effects on youth of criminal penalties for marijuana use and possession are also addressed, as are the effects or potential effects of the other 3 policy approaches on adolescent marijuana use. Recommendations are included in the accompanying policy statement. (2/15)
https://doi.org/10.1542/peds.2014-4147

THE IMPACT OF RACISM ON CHILD AND ADOLESCENT HEALTH

Maria Trent, MD, MPH, FAAP, FSAHM; Danielle G. Dooley, MD, MPhil, FAAP; Jacqueline Dougé, MD, MPH, FAAP; Section on Adolescent Health; Council on Community Pediatrics; and Committee on Adolescence

ABSTRACT. The American Academy of Pediatrics is committed to addressing the factors that affect child and adolescent health with a focus on issues that may leave some children more vulnerable than others. Racism is a social determinant of health that has a profound impact on the health status of children, adolescents, emerging adults, and their families. Although progress has been made toward racial equality and equity, the evidence to support the continued negative impact of racism on health and well-being through implicit and explicit biases, institutional structures, and interpersonal relationships is clear. The objective of this policy statement is to provide an evidence-based document focused on the role of racism in child and adolescent development and health outcomes. By acknowledging the role of racism in child and adolescent health, pediatricians and other pediatric health professionals will be able to proactively engage in strategies to optimize clinical care, workforce development, professional education, systems engagement, and research in a manner designed to reduce the health effects of structural, personally mediated, and internalized racism and improve the health and well-being of all children, adolescents, emerging adults, and their families. (7/19)
https://doi.org/10.1542/peds.2019-1765

THE IMPACT OF SOCIAL MEDIA ON CHILDREN, ADOLESCENTS, AND FAMILIES (CLINICAL REPORT)

Gwenn Schurgin O'Keeffe, MD; Kathleen Clarke-Pearson, MD; and Council on Communications and Media

ABSTRACT. Using social media Web sites is among the most common activity of today's children and adolescents. Any Web site that allows social interaction is considered a social media site, including social networking sites such as Facebook, MySpace, and Twitter; gaming sites and virtual worlds such as Club Penguin, Second Life, and the Sims; video sites such as YouTube; and blogs. Such sites offer today's youth a portal for entertainment and communication and have grown exponentially in recent years. For this reason, it is important that parents become aware of the nature of social media sites, given that not all of them are healthy environments for children and adolescents. Pediatricians are in a unique position to help families understand these sites and to encourage healthy use and urge parents to monitor for potential problems with cyberbullying, "Facebook depression," sexting, and exposure to inappropriate content. (3/11)
https://doi.org/10.1542/peds.2011-0054

IMPROVING HEALTH AND SAFETY AT CAMP

Michael J. Ambrose, MD, FAAP; Edward A. Walton, MD, FAAP; and Council on School Health

ABSTRACT. The American Academy of Pediatrics has created recommendations for health appraisal and preparation of young people before participation in day, resident, or family camps and to guide health and safety practices at camp. These recommendations are intended for parents and families, primary health care providers, and camp administration and health center staff. Although camps have diverse environments, there are general guidelines that apply to all situations and specific recommendations that are appropriate under special conditions. This policy statement has been reviewed and is supported by the American Camp Association and Association of Camp Nursing. (6/19)
https://doi.org/10.1542/peds.2019-1355

INCIDENTAL FINDINGS ON BRAIN AND SPINE IMAGING IN CHILDREN (CLINICAL REPORT)

Cormac O. Maher, MD, FAAP; Joseph H. Piatt Jr, MD, FAAP; and Section on Neurologic Surgery

ABSTRACT. In recent years, the utilization of diagnostic imaging of the brain and spine in children has increased dramatically, leading to a corresponding increase in the detection of incidental findings of the central nervous system. Patients with unexpected findings on imaging are often referred for subspecialty evaluation. Even with rational use of diagnostic imaging and subspecialty consultation, the diagnostic process will always generate unexpected findings that must be explained and managed. Familiarity with the most common findings that are discovered incidentally on diagnostic imaging of the brain and spine will assist the pediatrician in providing counseling to families and in making recommendations in conjunction with a

neurosurgeon, when needed, regarding additional treatments and prognosis. (3/15)
https://doi.org/10.1542/peds.2015-0071

INCORPORATING RECOGNITION AND MANAGEMENT OF PERINATAL DEPRESSION INTO PEDIATRIC PRACTICE

Marian F. Earls, MD, MTS, FAAP; Michael W. Yogman, MD, FAAP; Gerri Mattson, MD, MSPH, FAAP; Jason Rafferty, MD, MPH, EdM, FAAP; and Committee on Psychosocial Aspects of Child and Family Health

ABSTRACT. Perinatal depression (PND) is the most common obstetric complication in the United States. Even when screening results are positive, mothers often do not receive further evaluation, and even when PND is diagnosed, mothers do not receive evidence-based treatments. Studies reveal that postpartum depression (PPD), a subset of PND, leads to increased costs of medical care, inappropriate medical treatment of the infant, discontinuation of breastfeeding, family dysfunction, and an increased risk of abuse and neglect. PPD, specifically, adversely affects this critical early period of infant brain development. PND is an example of an adverse childhood experience that has potential long-term adverse health complications for the mother, her partner, the infant, and the mother-infant dyad. However, PND can be treated effectively, and the stress on the infant can be buffered. Pediatric medical homes should coordinate care more effectively with prenatal providers for women with prenatally diagnosed maternal depression; establish a system to implement PPD screening at the 1-, 2-, 4-, and 6-month well-child visits; use community resources for the treatment and referral of the mother with depression; and provide support for the maternal-child (dyad) relationship, including breastfeeding support. State chapters of the American Academy of Pediatrics, working with state departments of public health, public and private payers, and maternal and child health programs, should advocate for payment and for increased training for PND screening and treatment. American Academy of Pediatrics recommends advocacy for workforce development for mental health professionals who care for young children and mother-infant dyads, and for promotion of evidence-based interventions focused on healthy attachment and parent-child relationships. (12/18)
https://doi.org/10.1542/peds.2018-3259

INCORPORATING RECOGNITION AND MANAGEMENT OF PERINATAL DEPRESSION INTO PEDIATRIC PRACTICE (TECHNICAL REPORT)

Jason Rafferty, MD, MPH, EdM, FAAP; Gerri Mattson, MD, MSPH, FAAP; Marian F. Earls, MD, MTS, FAAP; Michael W. Yogman, MD, FAAP; and Committee on Psychosocial Aspects of Child and Family Health

ABSTRACT. Perinatal depression is the most common obstetric complication in the United States, with prevalence rates of 15% to 20% among new mothers. Untreated, it can adversly affect the well-being of children and families through increasing the risk for costly complications during birth and lead to deterioration of core supports, including partner relationships and social networks. Perinatal depression contributes to long-lasting, and even permanent, consequences for the physical and mental health of parents and children, including poor family functioning, increased risk of child abuse and neglect, delayed infant development, perinatal obstetric complications, challenges with breastfeeding, and costly increases in health care use. Perinatal depression can interfere with early parent-infant interaction and attachment, leading to potentially long-term disturbances in the child's physical, emotional, cognitive, and social development. Fortunately, perinatal depression is identifiable and treatable. The US Preventive Services Task Force, Centers for Medicare and Medicaid Services, and many professional organizations recommend routine universal screening for perinatal depression in women to facilitate early evidence-based treatment and referrals, if necessary. Despite significant gains in screening rates from 2004 to 2013, a minority of pediatricians routinely screen for postpartum depression, and many mothers are still not identified or treated. Pediatric primary care clinicians, with a core mission of promoting child and family health, are in an ideal position to implement routine postpartum depression screens at several well-child visits throughout infancy and to provide mental health support through referrals and/or the interdisciplinary services of a pediatric patient-centered medical home model. (12/18)
https://doi.org/10.1542/peds.2018-3260

INCREASING ANTIRETROVIRAL DRUG ACCESS FOR CHILDREN WITH HIV INFECTION

Committee on Pediatric AIDS and Section on International Child Health

ABSTRACT. Although there have been great gains in the prevention of pediatric HIV infection and provision of antiretroviral therapy for children with HIV infection in resource-rich countries, many barriers remain to scaling up HIV prevention and treatment for children in resource-limited areas of the world. Appropriate testing technologies need to be made more widely available to identify HIV infection in infants. Training of practitioners in the skills required to care for children with HIV infection is required to increase the number of children receiving antiretroviral therapy. Lack of availability of appropriate antiretroviral drug formulations that are easily usable and inexpensive is a major impediment to optimal care for children with HIV. The time and energy spent trying to develop liquid antiretroviral formulations might be better used in the manufacture of smaller pill sizes or crushable tablets, which are easier to dispense, transport, store, and administer to children. (4/07, reaffirmed 4/10, 4/16)
https://doi.org/10.1542/peds.2007-0273

INCREASING IMMUNIZATION COVERAGE

Committee on Practice and Ambulatory Medicine and Council on Community Pediatrics

ABSTRACT. In 1977, the American Academy of Pediatrics issued a statement calling for universal immunization of all children for whom vaccines are not contraindicated. In 1995, the policy statement "Implementation of the Immunization Policy" was published by the American Academy of Pediatrics, followed in 2003 with publication of the first version of this statement, "Increasing Immunization Coverage." Since 2003, there have continued to be improvements in immunization coverage, with progress toward meeting the goals set forth in *Healthy People 2010.* Data from the 2007 National Immunization Survey showed that 90% of children 19 to 35 months of age have received recommended doses of each of the following vaccines: inactivated poliovirus (IPV), measles-mumps-rubella (MMR), varicella-zoster virus (VZB), hepatitis B virus (HBV), and *Haemophilus influenzae* type b (Hib). For diphtheria and tetanus and acellular pertussis (DTaP) vaccine, 84.5% have received the recommended 4 doses by 35 months of age. Nevertheless, the *Healthy People 2010* goal of at least 80% coverage for the full series (at least 4 doses of DTaP, 3 doses of IPV, 1 dose of MMR, 3 doses of Hib, 3 doses of HBV, and 1 dose of varicella-zoster virus vaccine) has not yet been met, and immunization coverage of adolescents continues to lag behind the goals set forth in *Healthy People 2010.* Despite these encouraging data, a vast number of new challenges that threaten continued success toward the goal of universal immunization coverage have emerged. These challenges include an increase in new vaccines and new vaccine combinations as well as a significant number of vaccines currently under development; a dramatic increase in the acquisition cost of vaccines, coupled with a lack

of adequate payment to practitioners to buy and administer vaccines; unanticipated manufacturing and delivery problems that have caused significant shortages of various vaccine products; and the rise of a public antivaccination movement that uses the Internet as well as standard media outlets to advance a position, wholly unsupported by any scientific evidence, linking vaccines with various childhood conditions, particularly autism. Much remains to be accomplished by physician organizations; vaccine manufacturers; third-party payers; the media; and local, state, and federal governments to ensure dependable vaccine supply and payments that are sufficient to continue to provide immunizations in public and private settings and to promote effective strategies to combat unjustified misstatements by the antivaccination movement.

Pediatricians should work individually and collectively at the local, state, and national levels to ensure that all children without a valid contraindication receive all childhood immunizations on time. Pediatricians and pediatric organizations, in conjunction with government agencies such as the Centers for Disease Control and Prevention, must communicate effectively with parents to maximize their understanding of the overall safety and efficacy of vaccines. Most parents and children have not experienced many of the vaccine-preventable diseases, and the general public is not well informed about the risks and sequelae of these conditions. A number of recommendations are included for pediatricians, individually and collectively, to support further progress toward the goal of universal immunization coverage of all children for whom vaccines are not contraindicated. (5/10)
https://doi.org/10.1542/peds.2010-0743

THE INDIVIDUALS WITH DISABILITIES EDUCATION ACT (IDEA) FOR CHILDREN WITH SPECIAL EDUCATIONAL NEEDS (CLINICAL REPORT)

Paul H. Lipkin, MD, FAAP; Jeffrey Okamoto, MD, FAAP; Council on Children With Disabilities; and Council on School Health

ABSTRACT. The pediatric health care provider has a critical role in supporting the health and well-being of children and adolescents in all settings, including early intervention (EI), preschool, and school environments. It is estimated that 15% of children in the United States have a disability. The Individuals with Disabilities Education Act entitles every affected child in the United States from infancy to young adulthood to a free appropriate public education through EI and special education services. These services bolster development and learning of children with various disabilities. This clinical report provides the pediatric health care provider with a summary of key components of the most recent version of this law. Guidance is also provided to ensure that every child in need receives the EI and special education services to which he or she is entitled. (11/15, reaffirmed 10/19)
https://doi.org/10.1542/peds.2015-3409

INDOOR ENVIRONMENTAL CONTROL PRACTICES AND ASTHMA MANAGEMENT (CLINICAL REPORT)

Elizabeth C. Matsui, MD, MHS, FAAP; Stuart L. Abramson, MD, PhD, AE-C, FAAP; Megan T. Sandel, MD, MPH, FAAP; Section on Allergy and Immunology; and Council on Environmental Health

ABSTRACT. Indoor environmental exposures, particularly allergens and pollutants, are major contributors to asthma morbidity in children; environmental control practices aimed at reducing these exposures are an integral component of asthma management. Some individually tailored environmental control practices that have been shown to reduce asthma symptoms and exacerbations are similar in efficacy and cost to controller medications. As a part of developing tailored strategies regarding environmental control measures, an environmental history can be obtained to evaluate the key indoor environmental exposures that are known to trigger asthma symptoms and exacerbations, including both indoor pollutants and allergens. An environmental history includes questions regarding the presence of pets or pests or evidence of pests in the home, as well as knowledge regarding whether the climatic characteristics in the community favor dust mites. In addition, the history focuses on sources of indoor air pollution, including the presence of smokers who live in the home or care for children and the use of gas stoves and appliances in the home. Serum allergen-specific immunoglobulin E antibody tests can be performed or the patient can be referred for allergy skin testing to identify indoor allergens that are most likely to be clinically relevant. Environmental control strategies are tailored to each potentially relevant indoor exposure and are based on knowledge of the sources and underlying characteristics of the exposure. Strategies include source removal, source control, and mitigation strategies, such as high-efficiency particulate air purifiers and allergen-proof mattress and pillow encasements, as well as education, which can be delivered by primary care pediatricians, allergists, pediatric pulmonologists, other health care workers, or community health workers trained in asthma environmental control and asthma education. (10/16)
https://doi.org/10.1542/peds.2016-2589

INFANT FEEDING AND TRANSMISSION OF HUMAN IMMUNODEFICIENCY VIRUS IN THE UNITED STATES

Committee on Pediatric AIDS

ABSTRACT. Physicians caring for infants born to women infected with HIV are likely to be involved in providing guidance to HIV-infected mothers on appropriate infant feeding practices. It is critical that physicians are aware of the HIV transmission risk from human milk and the current recommendations for feeding HIV-exposed infants in the United States. Because the only intervention to completely prevent HIV transmission via human milk is not to breastfeed, in the United States, where clean water and affordable replacement feeding are available, the American Academy of Pediatrics recommends that HIV-infected mothers not breastfeed their infants, regardless of maternal viral load and antiretroviral therapy. (1/13, reaffirmed 4/16)
https://doi.org/10.1542/peds.2012-3543

INFANT METHEMOGLOBINEMIA: THE ROLE OF DIETARY NITRATE IN FOOD AND WATER (CLINICAL REPORT)

Frank R. Greer, MD; Michael Shannon, MD; Committee on Nutrition; and Committee on Environmental Health

ABSTRACT. Infants for whom formula may be prepared with well water remain a high-risk group for nitrate poisoning. This clinical report reinforces the need for testing of well water for nitrate content. There seems to be little or no risk of nitrate poisoning from commercially prepared infant foods in the United States. However, reports of nitrate poisoning from home-prepared vegetable foods for infants continue to occur. Breastfeeding infants are not at risk of methemoglobinemia even when mothers ingest water with very high concentrations of nitrate nitrogen (100 ppm). (9/05, reaffirmed 4/09)
https://doi.org/10.1542/peds.2005-1497

INFECTION PREVENTION AND CONTROL IN PEDIATRIC AMBULATORY SETTINGS

Mobeen H. Rathore, MD, FAAP; Mary Anne Jackson, MD, FAAP; and Committee on Infectious Diseases

ABSTRACT. Since the American Academy of Pediatrics published its statement titled "Infection Prevention and Control in Pediatric Ambulatory Settings" in 2007, there have been significant changes that prompted this updated statement. Infection prevention and control is an integral part of pediatric practice in ambulatory medical settings as well as in hospitals.

Infection prevention and control practices should begin at the time the ambulatory visit is scheduled. All health care personnel should be educated regarding the routes of transmission and techniques used to prevent the transmission of infectious agents. Policies for infection prevention and control should be written, readily available, updated every 2 years, and enforced. Many of the recommendations for infection control and prevention from the Centers for Disease Control and Prevention for hospitalized patients are also applicable in the ambulatory setting. These recommendations include requirements for pediatricians to take precautions to identify and protect employees likely to be exposed to blood or other potentially infectious materials while on the job. In addition to emphasizing the key principles of infection prevention and control in this policy, we update those that are relevant to the ambulatory care patient. These guidelines emphasize the role of hand hygiene and the implementation of diagnosis- and syndrome-specific isolation precautions, with the exemption of the use of gloves for routine diaper changes and wiping a well child's nose or tears for most patient encounters. Additional topics include respiratory hygiene and cough etiquette strategies for patients with a respiratory tract infection, including those relevant for special populations like patients with cystic fibrosis or those in short-term residential facilities; separation of infected, contagious children from uninfected children when feasible; safe handling and disposal of needles and other sharp medical devices; appropriate use of personal protective equipment, such as gloves, gowns, masks, and eye protection; and appropriate use of sterilization, disinfection, and antisepsis. Lastly, in this policy, we emphasize the importance of public health interventions, including vaccination for patients and health care personnel, and outline the responsibilities of the health care provider related to prompt public health notification for specific reportable diseases and communication with colleagues who may be providing subsequent care of an infected patient to optimize the use of isolation precautions and limit the spread of contagions. (10/17)
https://doi.org/10.1542/peds.2017-2857

INFECTIOUS COMPLICATIONS WITH THE USE OF BIOLOGIC RESPONSE MODIFIERS IN INFANTS AND CHILDREN (CLINICAL REPORT)

H. Dele Davies, MD, FAAP, and Committee on Infectious Diseases

ABSTRACT. Biologic response modifiers (BRMs) are substances that interact with and modify the host immune system. BRMs that dampen the immune system are used to treat conditions such as juvenile idiopathic arthritis, psoriatic arthritis, or inflammatory bowel disease and often in combination with other immunosuppressive agents, such as methotrexate and corticosteroids. Cytokines that are targeted include tumor necrosis factor α; interleukins (ILs) 6, 12, and 23; and the receptors for IL-1α (IL-1A) and IL-1β (IL-1B) as well as other molecules. Although the risk varies with the class of BRM, patients receiving immune-dampening BRMs generally are at increased risk of infection or reactivation with mycobacterial infections (*Mycobacterium tuberculosis* and nontuberculous mycobacteria), some viral (herpes simplex virus, varicella-zoster virus, Epstein-Barr virus, hepatitis B) and fungal (histoplasmosis, coccidioidomycosis) infections, as well as other opportunistic infections. The use of BRMs warrants careful determination of infectious risk on the basis of history (including exposure, residence, and travel and immunization history) and selected baseline screening test results. Routine immunizations should be given at least 2 weeks (inactivated or subunit vaccines) or 4 weeks (live vaccines) before initiation of BRMs whenever feasible, and inactivated influenza vaccine should be given annually. Inactivated and subunit vaccines should be given when needed while taking BRMs, but live vaccines should be avoided unless under special circumstances in consultation with an infectious diseases specialist. If the patient develops a febrile or serious respiratory illness during BRM therapy, consideration should be given to stopping the BRM while actively searching for and treating possible infectious causes. (7/16, reaffirmed 3/21)
https://doi.org/10.1542/peds.2016-1209

INFECTIOUS DISEASES ASSOCIATED WITH ORGANIZED SPORTS AND OUTBREAK CONTROL (CLINICAL REPORT)

H. Dele Davies, MD, MS, MHCM, FAAP; Mary Anne Jackson, MD, FAAP; Stephen G. Rice, MD, PhD, MPH, FAAP; Committee on Infectious Diseases; and Council on Sports Medicine and Fitness

ABSTRACT. Participation in organized sports has a variety of health benefits but also has the potential to expose the athlete to a variety of infectious diseases, some of which may produce outbreaks. Major risk factors for infection include skin-to-skin contact with athletes who have active skin infections, environmental exposures and physical trauma, and sharing of equipment and contact with contaminated fomites. Close contact that is intrinsic to team sports and psychosocial factors associated with adolescence are additional risks. Minimizing risk requires leadership by the organized sports community (including the athlete's primary care provider) and depends on outlining key hygiene behaviors, recognition, diagnosis, and treatment of common sports-related infections, and the implementation of preventive interventions. (9/17)
https://doi.org/10.1542/peds.2017-2477

INFLUENZA IMMUNIZATION FOR ALL HEALTH CARE PERSONNEL: KEEP IT MANDATORY

Committee on Infectious Diseases

ABSTRACT. The purpose of this statement is to reaffirm the American Academy of Pediatrics' support for a mandatory influenza immunization policy for all health care personnel. With an increasing number of organizations requiring influenza vaccination, coverage among health care personnel has risen to 75% in the 2013 to 2014 influenza season but still remains below the Healthy People 2020 objective of 90%. Mandatory influenza immunization for all health care personnel is ethical, just, and necessary to improve patient safety. It is a crucial step in efforts to reduce health care–associated influenza infections. (9/15, reaffirmed 3/20)
https://doi.org/10.1542/peds.2015-2922

INFORMED CONSENT IN DECISION-MAKING IN PEDIATRIC PRACTICE

Committee on Bioethics

ABSTRACT. Informed consent should be seen as an essential part of health care practice; parental permission and childhood assent is an active process that engages patients, both adults and children, in health care. Pediatric practice is unique in that developmental maturation allows, over time, for increasing inclusion of the child's and adolescent's opinion in medical decision-making in clinical practice and research. (7/16)
https://doi.org/10.1542/peds.2016-1484

INFORMED CONSENT IN DECISION-MAKING IN PEDIATRIC PRACTICE (TECHNICAL REPORT)

Aviva L. Katz, MD, FAAP; Sally A. Webb, MD, FAAP; and Committee on Bioethics

ABSTRACT. Informed consent should be seen as an essential part of health care practice; parental permission and childhood assent is an active process that engages patients, both adults and children, in their health care. Pediatric practice is unique in that developmental maturation allows, over time, for increasing inclusion of the child's and adolescent's opinion in medical decision-making in clinical practice and research. This technical

report, which accompanies the policy statement "Informed Consent in Decision-Making in Pediatric Practice," was written to provide a broader background on the nature of informed consent, surrogate decision-making in pediatric practice, information on child and adolescent decision-making, and special issues in adolescent informed consent, assent, and refusal. It is anticipated that this information will help provide support for the recommendations included in the policy statement. (7/16)
https://doi.org/10.1542/peds.2016-1485

INJURIES ASSOCIATED WITH INFANT WALKERS

Committee on Injury and Poison Prevention

ABSTRACT. In 1999, an estimated 8800 children younger than 15 months were treated in hospital emergency departments in the United States for injuries associated with infant walkers. Thirty-four infant walker-related deaths were reported from 1973 through 1998. The vast majority of injuries occur from falls down stairs, and head injuries are common. Walkers do not help a child learn to walk; indeed, they can delay normal motor and mental development. The use of warning labels, public education, adult supervision during walker use, and stair gates have all been demonstrated to be insufficient strategies to prevent injuries associated with infant walkers. To comply with the revised voluntary standard (ASTM F977-96), walkers manufactured after June 30, 1997, must be wider than a 36-in doorway or must have a braking mechanism designed to stop the walker if 1 or more wheels drop off the riding surface, such as at the top of a stairway. Because data indicate a considerable risk of major and minor injury and even death from the use of infant walkers, and because there is no clear benefit from their use, the American Academy of Pediatrics recommends a ban on the manufacture and sale of mobile infant walkers. If a parent insists on using a mobile infant walker, it is vital that they choose a walker that meets the performance standards of ASTM F977-96 to prevent falls down stairs. Stationary activity centers should be promoted as a safer alternative to mobile infant walkers. (9/01, reaffirmed 1/05, 2/08, 10/11, 11/14)
https://doi.org/10.1542/peds.108.3.790

INJURY RISK OF NONPOWDER GUNS (TECHNICAL REPORT)

Committee on Injury, Violence, and Poison Prevention

ABSTRACT. Nonpowder guns (ball-bearing [BB] guns, pellet guns, air rifles, paintball guns) continue to cause serious injuries to children and adolescents. The muzzle velocity of these guns can range from approximately 150 ft/second to 1200 ft/second (the muzzle velocities of traditional firearm pistols are 750 ft/second to 1450 ft/second). Both low- and high-velocity nonpowder guns are associated with serious injuries, and fatalities can result from high-velocity guns. A persisting problem is the lack of medical recognition of the severity of injuries that can result from these guns, including penetration of the eye, skin, internal organs, and bone. Nationally, in 2000, there were an estimated 21840 (coefficient of variation: 0.0821) injuries related to nonpowder guns, with approximately 4% resulting in hospitalization. Between 1990 and 2000, the US Consumer Product Safety Commission reported 39 nonpowder gun–related deaths, of which 32 were children younger than 15 years. The introduction of high-powered air rifles in the 1970s has been associated with approximately 4 deaths per year. The advent of war games and the use of paintball guns have resulted in a number of reports of injuries, especially to the eye. Injuries associated with nonpowder guns should receive prompt medical management similar to the management of firearm-related injuries, and nonpowder guns should never be characterized as toys. (11/04, reaffirmed 2/08, 10/11)
https://doi.org/10.1542/peds.2004-1799

IN-LINE SKATING INJURIES IN CHILDREN AND ADOLESCENTS

Committee on Injury and Poison Prevention and Committee on Sports Medicine and Fitness

ABSTRACT. In-line skating has become one of the fastest-growing recreational sports in the United States. Recent studies emphasize the value of protective gear in reducing the incidence of injuries. Recommendations are provided for parents and pediatricians, with special emphasis on the novice or inexperienced skater. (4/98, reaffirmed 1/02, 1/06, 1/09, 11/11)
https://doi.org/10.1542/peds.101.4.720

INSTITUTIONAL ETHICS COMMITTEES

Margaret Moon, MD, MPH, FAAP, and Committee on Bioethics

ABSTRACT. In hospitals throughout the United States, institutional ethics committees (IECs) have become a standard vehicle for the education of health professionals about biomedical ethics, for the drafting and review of hospital policy, and for clinical ethics case consultation. In addition, there is increasing interest in a role for the IEC in organizational ethics. Recommendations are made about the membership and structure of an IEC, and guidance is provided for those serving on an IEC. (4/19)
https://doi.org/10.1542/peds.2019-0659

INSUFFICIENT SLEEP IN ADOLESCENTS AND YOUNG ADULTS: AN UPDATE ON CAUSES AND CONSEQUENCES (TECHNICAL REPORT)

Judith Owens, MD, MPH, FAAP; Adolescent Sleep Working Group; and Committee on Adolescence

ABSTRACT. Chronic sleep loss and associated sleepiness and daytime impairments in adolescence are a serious threat to the academic success, health, and safety of our nation's youth and an important public health issue. Understanding the extent and potential short- and long-term repercussions of sleep restriction, as well as the unhealthy sleep practices and environmental factors that contribute to sleep loss in adolescents, is key in setting public policies to mitigate these effects and in counseling patients and families in the clinical setting. This report reviews the current literature on sleep patterns in adolescents, factors contributing to chronic sleep loss (ie, electronic media use, caffeine consumption), and health-related consequences, such as depression, increased obesity risk, and higher rates of drowsy driving accidents. The report also discusses the potential role of later school start times as a means of reducing adolescent sleepiness. (8/14)
https://doi.org/10.1542/peds.2014-1696

INTEGRATING WEB SERVICES/APPLICATIONS TO IMPROVE PEDIATRIC FUNCTIONALITIES IN ELECTRONIC HEALTH RECORDS

Stuart T. Weinberg, MD, FAAP, FAMIA; Craig Monsen, MD, MS; Christoph U. Lehmann, MD, FAAP, FACMI, FIAHSI; Michael G. Leu, MD, MS, MHS, FAAP, FAMIA; and Council on Clinical Information Technology

ABSTRACT. The past decade has seen a substantial increase in the use of electronic health records (EHRs) by health care providers caring for children. However, gaps in pediatric-specific functionalities continue to exist in some EHR systems, including population-specific growth curves, immunization clinical decision support, weight-based medication dosing with rounding, calculation of pediatric hypertension percentiles, age-specific developmental assessment, newborn bilirubin nomograms, anticipatory guidance reminders, and other functionalities described elsewhere. Implementing pediatric functionalities into EHRs is critical to the provision of safe pediatric care. As an alternative to direct implementation in EHRs, EHR vendor agnostic Web applications, Web services, and application programming interfaces offer an opportunity to provide pediatric

functionalities and eliminate the need for each vendor to develop these functionalities. Successful implementation of Web services and related technologies requires responsible attention from both EHR vendors and developers of Web services, Web applications, and application programming interfaces to the use of data terminology standards, adherence to privacy and security requirements, rigorous testing, change management processes, and robust system support and maintenance. Education of health care providers about opportunities to improve pediatric functionalities in EHRs by using these services can facilitate discussions in EHR user groups in which vendors can be lobbied to implement them. This policy statement emphasizes the need to address pediatric-specific functionalities in EHRs by providing insight and recommendations into the development, maintenance, integration, and support of these novel solutions. (6/21)

See full text on page 787.

https://doi.org/10.1542/peds.2021-052047

INTERFERON-γ RELEASE ASSAYS FOR DIAGNOSIS OF TUBERCULOSIS INFECTION AND DISEASE IN CHILDREN (TECHNICAL REPORT)

Jeffrey R. Starke, MD, FAAP, and Committee on Infectious Diseases

ABSTRACT. Tuberculosis (TB) remains an important problem among children in the United States and throughout the world. Although diagnosis and treatment of infection with *Mycobacterium tuberculosis* (also referred to as latent tuberculosis infection [LTBI] or TB infection) remain the lynchpins of TB prevention, there is no diagnostic reference standard for LTBI. The tuberculin skin test (TST) has many limitations, including difficulty in administration and interpretation, the need for a return visit by the patient, and false-positive results caused by significant cross-reaction with *Mycobacterium bovis*–bacille Calmette-Guérin (BCG) vaccines and many nontuberculous mycobacteria. Interferon-γ release assays (IGRAs) are blood tests that measure ex vivo T-lymphocyte release of interferon-γ after stimulation by antigens specific for *M tuberculosis.* Because these antigens are not found on *M bovis*–BCG or most nontuberculous mycobacteria, IGRAs are more specific tests than the TST, yielding fewer false-positive results. However, IGRAs have little advantage over the TST in sensitivity, and both methods have reduced sensitivity in immunocompromised children, including children with severe TB disease. Both methods have a higher positive predictive value when applied to children with risk factors for LTBI. Unfortunately, neither method distinguishes between TB infection and TB disease. The objective of this technical report is to review what IGRAs are most useful for: (1) increasing test specificity in children who have received a BCG vaccine and may have a false-positive TST result; (2) using with the TST to increase sensitivity for finding LTBI in patients at high risk of developing progression from LTBI to disease; and (3) helping to diagnose TB disease. (11/14, reaffirmed 7/18)

https://doi.org/10.1542/peds.2014-2983

INTERPRETATION OF DO NOT ATTEMPT RESUSCITATION ORDERS FOR CHILDREN REQUIRING ANESTHESIA AND SURGERY (CLINICAL REPORT)

Mary E. Fallat, MD, FAAP; Courtney Hardy, MD, MBA, FAAP; Section on Surgery; Section on Anesthesiology and Pain Medicine; and Committee on Bioethics

ABSTRACT. This clinical report addresses the topic of preexisting do not attempt resuscitation or limited resuscitation orders for children and adolescents undergoing anesthesia and surgery. Pertinent considerations for the clinician include the rights of children, decision-making by parents or legally approved representatives, the process of informed consent, and the roles of surgeon and anesthesiologist. A process of re-evaluation of the do not attempt resuscitation orders, called "required reconsideration," should be incorporated into the process of informed consent for surgery and anesthesia, distinguishing between goal-directed and procedure-directed approaches. The child's individual needs are best served by allowing the parent or legally approved representative and involved clinicians to consider whether full resuscitation, limitations based on procedures, or limitations based on goals is most appropriate. (4/18)

https://doi.org/10.1542/peds.2018-0598

INTIMATE PARTNER VIOLENCE: THE ROLE OF THE PEDIATRICIAN (CLINICAL REPORT)

Jonathan D. Thackeray, MD; Roberta Hibbard, MD; M. Denise Dowd, MD, MPH; Committee on Child Abuse and Neglect; and Committee on Injury, Violence, and Poison Prevention

ABSTRACT. The American Academy of Pediatrics and its members recognize the importance of improving the physician's ability to recognize intimate partner violence (IPV) and understand its effects on child health and development and its role in the continuum of family violence. Pediatricians are in a unique position to identify abused caregivers in pediatric settings and to evaluate and treat children raised in homes in which IPV may occur. Children exposed to IPV are at increased risk of being abused and neglected and are more likely to develop adverse health, behavioral, psychological, and social disorders later in life. Identifying IPV, therefore, may be one of the most effective means of preventing child abuse and identifying caregivers and children who may be in need of treatment and/or therapy. Pediatricians should be aware of the profound effects of exposure to IPV on children. (4/10, reaffirmed 1/14, 3/19)

https://doi.org/10.1542/peds.2010-0451

IODINE DEFICIENCY, POLLUTANT CHEMICALS, AND THE THYROID: NEW INFORMATION ON AN OLD PROBLEM

Council on Environmental Health

ABSTRACT. Many women of reproductive age in the United States are marginally iodine deficient, perhaps because the salt in processed foods is not iodized. Iodine deficiency, per se, can interfere with normal brain development in their offspring; in addition, it increases vulnerability to the effects of certain environmental pollutants, such as nitrate, thiocyanate, and perchlorate. Although pregnant and lactating women should take a supplement containing adequate iodide, only about 15% do so. Such supplements, however, may not contain enough iodide and may not be labeled accurately. The American Thyroid Association recommends that pregnant and lactating women take a supplement with adequate iodide. The American Academy of Pediatrics recommends that pregnant and lactating women also avoid exposure to excess nitrate, which would usually occur from contaminated well water, and thiocyanate, which is in cigarette smoke. Perchlorate is currently a candidate for regulation as a water pollutant. The Environmental Protection Agency should proceed with appropriate regulation, and the Food and Drug Administration should address the mislabeling of the iodine content of prenatal/lactation supplements. (5/14)

https://doi.org/10.1542/peds.2014-0900

LACTOSE INTOLERANCE IN INFANTS, CHILDREN, AND ADOLESCENTS (CLINICAL REPORT)

Melvin B. Heyman, MD, MPH, and Committee on Nutrition

ABSTRACT. The American Academy of Pediatrics Committee on Nutrition presents an updated review of lactose intolerance in infants, children, and adolescents. Differences between primary, secondary, congenital, and developmental lactase deficiency that may result in lactose intolerance are discussed. Children with suspected lactose intolerance can be assessed clinically by dietary lactose elimination or by tests including noninvasive hydrogen breath testing or invasive intestinal biopsy determination of lactase (and other disaccharidase) concentrations. Treatment consists of use of lactase-treated dairy products or oral

lactase supplementation, limitation of lactose-containing foods, or dairy elimination. The American Academy of Pediatrics supports use of dairy foods as an important source of calcium for bone mineral health and of other nutrients that facilitate growth in children and adolescents. If dairy products are eliminated, other dietary sources of calcium or calcium supplements need to be provided. (9/06, reaffirmed 8/12)
https://doi.org/10.1542/peds.2006-1721

"LATE-PRETERM" INFANTS: A POPULATION AT RISK (CLINICAL REPORT)

William A. Engle, MD; Kay M. Tomashek, MD; Carol Wallman, MSN; and Committee on Fetus and Newborn

ABSTRACT. Late-preterm infants, defined by birth at 34$^{6}/_{7}$ through 36$^{6}/_{7}$ weeks' gestation, are less physiologically and metabolically mature than term infants. Thus, they are at higher risk of morbidity and mortality than term infants. The purpose of this report is to define "late preterm," recommend a change in terminology from "near term" to "late preterm," present the characteristics of late-preterm infants that predispose them to a higher risk of morbidity and mortality than term infants, and propose guidelines for the evaluation and management of these infants after birth. (12/07, reaffirmed 5/10, 6/18)
https://doi.org/10.1542/peds.2007-2952

LAWN MOWER-RELATED INJURIES TO CHILDREN

Committee on Injury and Poison Prevention

ABSTRACT. Lawn mower-related injuries to children are relatively common and can result in severe injury or death. Many amputations during childhood are caused by power mowers. Pediatricians have an important role as advocates and educators to promote the prevention of these injuries. (6/01, reaffirmed 10/04, 5/07, 6/10)
https://doi.org/10.1542/peds.107.6.1480

LAWN MOWER-RELATED INJURIES TO CHILDREN (TECHNICAL REPORT)

Committee on Injury and Poison Prevention

ABSTRACT. In the United States, approximately 9400 children younger than 18 years receive emergency treatment annually for lawn mower-related injuries. More than 7% of these children require hospitalization, and power mowers cause a large proportion of the amputations during childhood. Prevention of lawn mower-related injuries can be achieved by design changes of lawn mowers, guidelines for mower operation, and education of parents, child caregivers, and children. Pediatricians have an important role as advocates and educators to promote the prevention of these injuries. (6/01, reaffirmed 10/04, 5/07, 6/10)
https://doi.org/10.1542/peds.107.6.e106

LEARNING DISABILITIES, DYSLEXIA, AND VISION

Section on Ophthalmology and Council on Children With Disabilities (joint with American Academy of Ophthalmology, American Association for Pediatric Ophthalmology and Strabismus, and American Association of Certified Orthoptists)

ABSTRACT. Learning disabilities, including reading disabilities, are commonly diagnosed in children. Their etiologies are multifactorial, reflecting genetic influences and dysfunction of brain systems. Learning disabilities are complex problems that require complex solutions. Early recognition and referral to qualified educational professionals for evidence-based evaluations and treatments seem necessary to achieve the best possible outcome. Most experts believe that dyslexia is a language-based disorder. Vision problems can interfere with the process of learning; however, vision problems are not the cause of primary dyslexia or learning disabilities. Scientific evidence does not support the efficacy of eye exercises, behavioral vision therapy, or special tinted filters or lenses for improving the long-term educational performance in these complex pediatric neurocognitive conditions. Diagnostic and treatment approaches that lack scientific evidence of efficacy, including eye exercises, behavioral vision therapy, or special tinted filters or lenses, are not endorsed and should not be recommended. (7/09, reaffirmed 7/14)
https://doi.org/10.1542/peds.2009-1445

LEARNING DISABILITIES, DYSLEXIA, AND VISION (TECHNICAL REPORT)

Sheryl M. Handler, MD; Walter M. Fierson, MD; Section on Ophthalmology; and Council on Children With Disabilities (joint with American Academy of Ophthalmology, American Association for Pediatric Ophthalmology and Strabismus, and American Association of Certified Orthoptists)

ABSTRACT. Learning disabilities constitute a diverse group of disorders in which children who generally possess at least average intelligence have problems processing information or generating output. Their etiologies are multifactorial and reflect genetic influences and dysfunction of brain systems. Reading disability, or dyslexia, is the most common learning disability. It is a receptive language-based learning disability that is characterized by difficulties with decoding, fluent word recognition, rapid automatic naming, and/or reading-comprehension skills. These difficulties typically result from a deficit in the phonologic component of language that makes it difficult to use the alphabetic code to decode the written word. Early recognition and referral to qualified professionals for evidence-based evaluations and treatments are necessary to achieve the best possible outcome. Because dyslexia is a language-based disorder, treatment should be directed at this etiology. Remedial programs should include specific instruction in decoding, fluency training, vocabulary, and comprehension. Most programs include daily intensive individualized instruction that explicitly teaches phonemic awareness and the application of phonics. Vision problems can interfere with the process of reading, but children with dyslexia or related learning disabilities have the same visual function and ocular health as children without such conditions. Currently, there is inadequate scientific evidence to support the view that subtle eye or visual problems cause or increase the severity of learning disabilities. Because they are difficult for the public to understand and for educators to treat, learning disabilities have spawned a wide variety of scientifically unsupported vision-based diagnostic and treatment procedures. Scientific evidence does not support the claims that visual training, muscle exercises, ocular pursuit-and-tracking exercises, behavioral/perceptual vision therapy, "training" glasses, prisms, and colored lenses and filters are effective direct or indirect treatments for learning disabilities. There is no valid evidence that children who participate in vision therapy are more responsive to educational instruction than children who do not participate. (3/11)
https://doi.org/10.1542/peds.2010-3670

LEUKODYSTROPHIES IN CHILDREN: DIAGNOSIS, CARE, AND TREATMENT (CLINICAL REPORT)

Joshua L. Bonkowsky, MD, PhD, FAAP; Stephanie Keller, MD, FAAP; Section on Neurology; and Council on Genetics

ABSTRACT. Leukodystrophies are a group of genetically determined disorders that affect development or maintenance of central nervous system myelin. Leukodystrophies have an incidence of at least 1 in 4700 live births and significant morbidity and elevated risk of early death. This report includes a discussion of the types of leukodystrophies; their prevalence, clinical presentation, symptoms, and diagnosis; and current and future treatments. Leukodystrophies can present at any age from infancy to adulthood, with variability in disease progression and clinical presentation, ranging from developmental delay to seizures to

spasticity. Diagnosis is based on a combination of history, examination, and radiologic and laboratory findings, including genetic testing. Although there are few cures, there are significant opportunities for care and improvements in patient well-being. Rapid advances in imaging and diagnosis, the emergence of and requirement for timely treatments, and the addition of leukodystrophy screening to newborn screening, make an understanding of the leukodystrophies necessary for pediatricians and other care providers for children. (8/21)

See full text on page 795.

https://doi.org/10.1542/peds.2021-053126

LEVELS OF NEONATAL CARE

Committee on Fetus and Newborn

ABSTRACT. Provision of risk-appropriate care for newborn infants and mothers was first proposed in 1976. This updated policy statement provides a review of data supporting evidence for a tiered provision of care and reaffirms the need for uniform, nationally applicable definitions and consistent standards of service for public health to improve neonatal outcomes. Facilities that provide hospital care for newborn infants should be classified on the basis of functional capabilities, and these facilities should be organized within a regionalized system of perinatal care. (8/12, reaffirmed 9/15)

https://doi.org/10.1542/peds.2012-1999

THE LIFELONG EFFECTS OF EARLY CHILDHOOD ADVERSITY AND TOXIC STRESS (TECHNICAL REPORT)

Jack P. Shonkoff, MD; Andrew S. Garner, MD, PhD; Committee on Psychosocial Aspects of Child and Family Health; Committee on Early Childhood, Adoption, and Dependent Care; and Section on Developmental and Behavioral Pediatrics

ABSTRACT. Advances in fields of inquiry as diverse as neuroscience, molecular biology, genomics, developmental psychology, epidemiology, sociology, and economics are catalyzing an important paradigm shift in our understanding of health and disease across the lifespan. This converging, multidisciplinary science of human development has profound implications for our ability to enhance the life prospects of children and to strengthen the social and economic fabric of society. Drawing on these multiple streams of investigation, this report presents an ecobiodevelopmental framework that illustrates how early experiences and environmental influences can leave a lasting signature on the genetic predispositions that affect emerging brain architecture and long-term health. The report also examines extensive evidence of the disruptive impacts of toxic stress, offering intriguing insights into causal mechanisms that link early adversity to later impairments in learning, behavior, and both physical and mental well-being. The implications of this framework for the practice of medicine, in general, and pediatrics, specifically, are potentially transformational. They suggest that many adult diseases should be viewed as developmental disorders that begin early in life and that persistent health disparities associated with poverty, discrimination, or maltreatment could be reduced by the alleviation of toxic stress in childhood. An ecobiodevelopmental framework also underscores the need for new thinking about the focus and boundaries of pediatric practice. It calls for pediatricians to serve as both front-line guardians of healthy child development and strategically positioned, community leaders to inform new science-based strategies that build strong foundations for educational achievement, economic productivity, responsible citizenship, and lifelong health. (12/11, reaffirmed 7/16)

https://doi.org/10.1542/peds.2011-2663

THE LINK BETWEEN SCHOOL ATTENDANCE AND GOOD HEALTH

Mandy A. Allison, MD, MSPH, FAAP; Elliott Attisha, DO, FAAP; and Council on School Health

ABSTRACT. More than 6.5 million children in the United States, approximately 13% of all students, miss 15 or more days of school each year. The rates of chronic absenteeism vary between states, communities, and schools, with significant disparities based on income, race, and ethnicity. Chronic school absenteeism, starting as early as preschool and kindergarten, puts students at risk for poor school performance and school dropout, which in turn, put them at risk for unhealthy behaviors as adolescents and young adults as well as poor long-term health outcomes. Pediatricians and their colleagues caring for children in the medical setting have opportunities at the individual patient and/or family, practice, and population levels to promote school attendance and reduce chronic absenteeism and resulting health disparities. Although this policy statement is primarily focused on absenteeism related to students' physical and mental health, pediatricians may play a role in addressing absenteeism attributable to a wide range of factors through individual interactions with patients and their parents and through community-, state-, and federal-level advocacy. (1/19)

https://doi.org/10.1542/peds.2018-3648

LITERACY PROMOTION: AN ESSENTIAL COMPONENT OF PRIMARY CARE PEDIATRIC PRACTICE

Council on Early Childhood

ABSTRACT. Reading regularly with young children stimulates optimal patterns of brain development and strengthens parent-child relationships at a critical time in child development, which, in turn, builds language, literacy, and social-emotional skills that last a lifetime. Pediatric providers have a unique opportunity to encourage parents to engage in this important and enjoyable activity with their children beginning in infancy. Research has revealed that parents listen and children learn as a result of literacy promotion by pediatricians, which provides a practical and evidence-based opportunity to support early brain development in primary care practice. The American Academy of Pediatrics (AAP) recommends that pediatric providers promote early literacy development for children beginning in infancy and continuing at least until the age of kindergarten entry by (1) advising all parents that reading aloud with young children can enhance parent-child relationships and prepare young minds to learn language and early literacy skills; (2) counseling all parents about developmentally appropriate shared-reading activities that are enjoyable for children and their parents and offer language-rich exposure to books, pictures, and the written word; (3) providing developmentally appropriate books given at health supervision visits for all high-risk, low-income young children; (4) using a robust spectrum of options to support and promote these efforts; and (5) partnering with other child advocates to influence national messaging and policies that support and promote these key early shared-reading experiences. The AAP supports federal and state funding for children's books to be provided at pediatric health supervision visits to children at high risk living at or near the poverty threshold and the integration of literacy promotion, an essential component of pediatric primary care, into pediatric resident education. This policy statement is supported by the AAP technical report "School Readiness" and supports the AAP policy statement "Early Childhood Adversity, Toxic Stress, and the Role of the Pediatrician: Translating Developmental Science Into Lifelong Health." (7/14, reaffirmed 12/20)

https://doi.org/10.1542/peds.2014-1384

LONG-ACTING REVERSIBLE CONTRACEPTION: SPECIFIC ISSUES FOR ADOLESCENTS (CLINICAL REPORT)

Seema Menon, MD, and Committee on Adolescence

ABSTRACT. Long-acting reversible contraceptives are the most effective methods to prevent pregnancy and also offer noncontraceptive benefits such as reducing menstrual blood flow and dysmenorrhea. The safety and efficacy of long-acting reversible contraception are well established for adolescents, but the rate of use remains low for this population. The pediatrician can play a key role in increasing access to long-acting reversible contraception for adolescents by providing accurate patient-centered contraception counseling and by understanding and addressing the barriers to use. (7/20)

https://doi.org/10.1542/peds.2020-007252

LONG-TERM FOLLOW-UP CARE FOR CHILDHOOD, ADOLESCENT, AND YOUNG ADULT CANCER SURVIVORS (CLINICAL REPORT)

Melissa M. Hudson, MD; Smita Bhatia, MD, MPH; Jacqueline Casillas, MD, MSHS; Wendy Landier, PhD, RN, CPNP; and Section on Hematology/Oncology (joint with Children's Oncology Group and American Society of Pediatric Hematology/Oncology)

ABSTRACT. Progress in therapy has made survival into adulthood a reality for most children, adolescents, and young adults with a cancer diagnosis today. Notably, this growing population remains vulnerable to a variety of long-term therapy-related sequelae. Systematic ongoing follow-up of these patients is, therefore, important to provide for early detection of and intervention for potentially serious late-onset complications. In addition, health counseling and promotion of healthy lifestyles are important aspects of long-term follow-up care to promote risk reduction for physical and emotional health problems that commonly present during adulthood. Both general and subspecialty health care providers are playing an increasingly important role in the ongoing care of childhood cancer survivors, beyond the routine preventive care, health supervision, and anticipatory guidance provided to all patients. This report is based on the guidelines that have been developed by the Children's Oncology Group to facilitate comprehensive long-term follow-up of childhood, adolescent, and young adult cancer survivors (www.survivorshipguidelines.org). (8/21)

See full text on page 813.

https://doi.org/10.1542/peds.2021-053127

MAINTAINING AND IMPROVING THE ORAL HEALTH OF YOUNG CHILDREN

Section on Oral Health

ABSTRACT. Oral health is an integral part of the overall health of children. Dental caries is a common and chronic disease process with significant short- and long-term consequences. The prevalence of dental caries for the youngest of children has not decreased over the past decade, despite improvements for older children. As health care professionals responsible for the overall health of children, pediatricians frequently confront morbidity associated with dental caries. Because the youngest children visit the pediatrician more often than they visit the dentist, it is important that pediatricians be knowledgeable about the disease process of dental caries, prevention of the disease, and interventions available to the pediatrician and the family to maintain and restore health. (11/14, reaffirmed 1/19)

https://doi.org/10.1542/peds.2014-2984

MALE ADOLESCENT SEXUAL AND REPRODUCTIVE HEALTH CARE (CLINICAL REPORT)

Arik V. Marcell, MD, MPH; Charles Wibbelsman, MD; Warren M. Seigel, MD; and Committee on Adolescence

ABSTRACT. Male adolescents' sexual and reproductive health needs often go unmet in the primary care setting. This report discusses specific issues related to male adolescents' sexual and reproductive health care in the context of primary care, including pubertal and sexual development, sexual behavior, consequences of sexual behavior, and methods of preventing sexually transmitted infections (including HIV) and pregnancy. Pediatricians are encouraged to address male adolescent sexual and reproductive health on a regular basis, including taking a sexual history, performing an appropriate examination, providing patient-centered and age-appropriate anticipatory guidance, and delivering appropriate vaccinations. Pediatricians should provide these services to male adolescent patients in a confidential and culturally appropriate manner, promote healthy sexual relationships and responsibility, and involve parents in age-appropriate discussions about sexual health with their sons. (11/11, reaffirmed 5/15)

https://doi.org/10.1542/peds.2011-2384

MALE CIRCUMCISION (TECHNICAL REPORT)

Task Force on Circumcision

ABSTRACT. Male circumcision consists of the surgical removal of some, or all, of the foreskin (or prepuce) from the penis. It is one of the most common procedures in the world. In the United States, the procedure is commonly performed during the newborn period. In 2007, the American Academy of Pediatrics (AAP) convened a multidisciplinary workgroup of AAP members and other stakeholders to evaluate the evidence regarding male circumcision and update the AAP's 1999 recommendations in this area. The Task Force included AAP representatives from specialty areas as well as members of the AAP Board of Directors and liaisons representing the American Academy of Family Physicians, the American College of Obstetricians and Gynecologists, and the Centers for Disease Control and Prevention. The Task Force members identified selected topics relevant to male circumcision and conducted a critical review of peer-reviewed literature by using the American Heart Association's template for evidence evaluation.

Evaluation of current evidence indicates that the health benefits of newborn male circumcision outweigh the risks; furthermore, the benefits of newborn male circumcision justify access to this procedure for families who choose it. Specific benefits from male circumcision were identified for the prevention of urinary tract infections, acquisition of HIV, transmission of some sexually transmitted infections, and penile cancer. Male circumcision does not appear to adversely affect penile sexual function/sensitivity or sexual satisfaction. It is imperative that those providing circumcision are adequately trained and that both sterile techniques and effective pain management are used. Significant acute complications are rare. In general, untrained providers who perform circumcisions have more complications than well-trained providers who perform the procedure, regardless of whether the former are physicians, nurses, or traditional religious providers.

Parents are entitled to factually correct, nonbiased information about circumcision and should receive this information from clinicians before conception or early in pregnancy, which is when parents typically make circumcision decisions. Parents should determine what is in the best interest of their child. Physicians who counsel families about this decision should provide assistance by explaining the potential benefits and risks and ensuring that parents understand that circumcision is an elective procedure. The Task Force strongly recommends the creation, revision, and enhancement of educational materials to assist parents of male infants with the care of circumcised and uncircumcised penises. The Task Force also strongly recommends the development of educational materials for providers to enhance practitioners' competency in discussing circumcision's benefits and risks with parents.

The Task Force made the following recommendations:

- Evaluation of current evidence indicates that the health benefits of newborn male circumcision outweigh the risks, and the benefits of newborn male circumcision justify access to this procedure for those families who choose it.
- Parents are entitled to factually correct, nonbiased information about circumcision that should be provided before conception and early in pregnancy, when parents are most likely to be weighing the option of circumcision of a male child.
- Physicians counseling families about elective male circumcision should assist parents by explaining, in a nonbiased manner, the potential benefits and risks and by ensuring that they understand the elective nature of the procedure.
- Parents should weigh the health benefits and risks in light of their own religious, cultural, and personal preferences, as the medical benefits alone may not outweigh these other considerations for individual families.
- Parents of newborn boys should be instructed in the care of the penis, regardless of whether the newborn has been circumcised or not.
- Elective circumcision should be performed only if the infant's condition is stable and healthy.
- Male circumcision should be performed by trained and competent practitioners, by using sterile techniques and effective pain management.
- Analgesia is safe and effective in reducing the procedural pain associated with newborn circumcision; thus, adequate analgesia should be provided whenever newborn circumcision is performed.
  - — Nonpharmacologic techniques (eg, positioning, sucrose pacifiers) alone are insufficient to prevent procedural and postprocedural pain and are not recommended as the sole method of analgesia. They should be used only as analgesic adjuncts to improve infant comfort during circumcision.
  - — If used, topical creams may cause a higher incidence of skin irritation in low birth weight infants, compared with infants of normal weight; penile nerve block techniques should therefore be chosen for this group of newborns.
- Key professional organizations (AAP, the American Academy of Family Physicians, the American College of Obstetricians and Gynecologists, the American Society of Anesthesiologists, the American College of Nurse Midwives, and other midlevel clinicians such as nurse practitioners) should work collaboratively to:
  - — Develop standards of trainee proficiency in the performance of anesthetic and procedure techniques, including suturing;
  - — Teach the procedure and analgesic techniques during postgraduate training programs;
  - — Develop educational materials for clinicians to enhance their own competency in discussing the benefits and risks of circumcision with parents;
  - — Offer educational materials to assist parents of male infants with the care of both circumcised and uncircumcised penises.
- The preventive and public health benefits associated with newborn male circumcision warrant third-party reimbursement of the procedure.

The American College of Obstetricians and Gynecologists has endorsed this technical report. (8/12)

https://doi.org/10.1542/peds.2012-1990

MALTREATMENT OF CHILDREN WITH DISABILITIES (CLINICAL REPORT)

Lori A. Legano, MD, FAAP; Larry W. Desch, MD, FAAP; Stephen A. Messner, MD, FAAP; Sheila Idzerda, MD, FAAP; Emalee G. Flaherty, MD, FAAP; Council on Child Abuse and Neglect; and Council on Children With Disabilities

ABSTRACT. Over the past decade, there have been widespread efforts to raise awareness about maltreatment of children. Pediatric providers have received education about factors that make a child more vulnerable to being abused and neglected. The purpose of this clinical report is to ensure that children with disabilities are recognized as a population at increased risk for maltreatment. This report updates the 2007 American Academy of Pediatrics clinical report "Maltreatment of Children With Disabilities." Since 2007, new information has expanded our understanding of the incidence of abuse in this vulnerable population. There is now information about which children with disabilities are at greatest risk for maltreatment because not all disabling conditions confer the same risks of abuse or neglect. This updated report will serve as a resource for pediatricians and others who care for children with disabilities and offers guidance on risks for subpopulations of children with disabilities who are at particularly high risk of abuse and neglect. The report will also discuss ways in which the medical home can aid in early identification and intervene when abuse and neglect are suspected. It will also describe community resources and preventive strategies that may reduce the risk of abuse and neglect. (4/21)

See full text on page 833.

https://doi.org/10.1542/peds.2021-050920

MANAGEMENT OF DENTAL TRAUMA IN A PRIMARY CARE SETTING (CLINICAL REPORT)

Martha Ann Keels, DDS, PhD, and Section on Oral Health

ABSTRACT. The American Academy of Pediatrics and its Section on Oral Health have developed this clinical report for pediatricians and primary care physicians regarding the diagnosis, evaluation, and management of dental trauma in children aged 1 to 21 years. This report was developed through a comprehensive search and analysis of the medical and dental literature and expert consensus. Guidelines published and updated by the International Association of Dental Traumatology (www.dentaltraumaguide.com) are an excellent resource for both dental and nondental health care providers. (1/14)

https://doi.org/10.1542/peds.2013-3792

MANAGEMENT OF FOOD ALLERGY IN THE SCHOOL SETTING (CLINICAL REPORT)

Scott H. Sicherer, MD; Todd Mahr, MD; and Section on Allergy and Immunology

ABSTRACT. Food allergy is estimated to affect approximately 1 in 25 school-aged children and is the most common trigger of anaphylaxis in this age group. School food-allergy management requires strategies to reduce the risk of ingestion of the allergen as well as procedures to recognize and treat allergic reactions and anaphylaxis. The role of the pediatrician or pediatric health care provider may include diagnosing and documenting a potentially life-threatening food allergy, prescribing selfinjectable epinephrine, helping the child learn how to store and use the medication in a responsible manner, educating the parents of their responsibility to implement prevention strategies within and outside the home environment, and working with families, schools, and students in developing written plans to reduce the risk of anaphylaxis and to implement emergency treatment in the event of a reaction. This clinical report highlights the role of the pediatrician and pediatric health care provider in managing students with food allergies. (11/10, reaffirmed 10/20)

https://doi.org/10.1542/peds.2010-2575

MANAGEMENT OF INFANTS AT RISK FOR GROUP B STREPTOCOCCAL DISEASE (CLINICAL REPORT)

Karen M. Puopolo, MD, PhD, FAAP; Ruth Lynfield, MD, FAAP; James J. Cummings, MD, MS, FAAP; Committee on Fetus and Newborn; and Committee on Infectious Diseases

ABSTRACT. Group B streptococcal (GBS) infection remains the most common cause of neonatal early-onset sepsis and a significant cause of late-onset sepsis among young infants. Administration of intrapartum antibiotic prophylaxis is the only currently available effective strategy for the prevention of perinatal GBS early-onset disease, and there is no effective approach for the prevention of late-onset disease. The American Academy of Pediatrics joins with the American College of Obstetricians and Gynecologists to reaffirm the use of universal antenatal microbiologic-based testing for the detection of maternal GBS colonization to facilitate appropriate administration of intrapartum antibiotic prophylaxis. The purpose of this clinical report is to provide neonatal clinicians with updated information regarding the epidemiology of GBS disease as well current recommendations for the evaluation of newborn infants at risk for GBS disease and for treatment of those with confirmed GBS infection. This clinical report is endorsed by the American College of Obstetricians and Gynecologists (ACOG), July 2019, and should be construed as ACOG clinical guidance. (7/19)

https://doi.org/10.1542/peds.2019-1881

MANAGEMENT OF NEONATES BORN AT ≥35 0/7 WEEKS' GESTATION WITH SUSPECTED OR PROVEN EARLY-ONSET BACTERIAL SEPSIS (CLINICAL REPORT)

Karen M. Puopolo, MD, PhD, FAAP; William E. Benitz, MD, FAAP; Theoklis E. Zaoutis, MD, MSCE, FAAP; Committee on Fetus and Newborn; and Committee on Infectious Diseases

ABSTRACT. The incidence of neonatal early-onset sepsis (EOS) has declined substantially over the last 2 decades, primarily because of the implementation of evidence-based intrapartum antimicrobial therapy. However, EOS remains a serious and potentially fatal illness. Laboratory tests alone are neither sensitive nor specific enough to guide EOS management decisions. Maternal and infant clinical characteristics can help identify newborn infants who are at risk and guide the administration of empirical antibiotic therapy. The incidence of EOS, the prevalence and implications of established risk factors, the predictive value of commonly used laboratory tests, and the uncertainties in the risk/benefit balance of antibiotic exposures all vary significantly with gestational age at birth. Our purpose in this clinical report is to provide a summary of the current epidemiology of neonatal sepsis among infants born at ≥35 0/7 weeks' gestation and a framework for the development of evidence-based approaches to sepsis risk assessment among these infants. (11/18)

https://doi.org/10.1542/peds.2018-2894

MANAGEMENT OF NEONATES BORN AT ≤34 6/7 WEEKS' GESTATION WITH SUSPECTED OR PROVEN EARLY-ONSET BACTERIAL SEPSIS (CLINICAL REPORT)

Karen M. Puopolo, MD, PhD, FAAP; William E. Benitz, MD, FAAP; Theoklis E. Zaoutis, MD, MSCE, FAAP; Committee on Fetus and Newborn; and Committee on Infectious Diseases

ABSTRACT. Early-onset sepsis (EOS) remains a serious and often fatal illness among infants born preterm, particularly among newborn infants of the lowest gestational age. Currently, most preterm infants with very low birth weight are treated empirically with antibiotics for risk of EOS, often for prolonged periods, in the absence of a culture-confirmed infection. Retrospective studies have revealed that antibiotic exposures after birth are associated with multiple subsequent poor outcomes among preterm infants, making the risk/benefit balance of these antibiotic treatments uncertain. Gestational age is the strongest single predictor of EOS, and the majority of preterm births occur in the setting of other factors associated with risk of EOS, making it difficult to apply risk stratification strategies to preterm infants. Laboratory tests alone have a poor predictive value in preterm EOS. Delivery characteristics of extremely preterm infants present an opportunity to identify those with a lower risk of EOS and may inform decisions to initiate or extend antibiotic therapies. Our purpose for this clinical report is to provide a summary of the current epidemiology of preterm neonatal sepsis and provide guidance for the development of evidence-based approaches to sepsis risk assessment among preterm newborn infants. (11/18)

https://doi.org/10.1542/peds.2018-2896

MANAGEMENT OF PEDIATRIC TRAUMA

Committee on Pediatric Emergency Medicine; Council on Injury, Violence, and Poison Prevention; Section on Critical Care; Section on Orthopaedics; Section on Surgery; and Section on Transport Medicine (joint with Pediatric Trauma Society and Society of Trauma Nurses Pediatric Committee)

ABSTRACT. Injury is still the number 1 killer of children ages 1 to 18 years in the United States (http://www.cdc.gov/nchs/fastats/children.htm). Children who sustain injuries with resulting disabilities incur significant costs not only for their health care but also for productivity lost to the economy. The families of children who survive childhood injury with disability face years of emotional and financial hardship, along with a significant societal burden. The entire process of managing childhood injury is enormously complex and varies by region. Only the comprehensive cooperation of a broadly diverse trauma team will have a significant effect on improving the care of injured children. (7/16)

https://doi.org/10.1542/peds.2016-1569

MANAGEMENT OF TYPE 2 DIABETES MELLITUS IN CHILDREN AND ADOLESCENTS (TECHNICAL REPORT)

Shelley C. Springer, MD, MBA, MSc, JD, FAAP; Janet Silverstein, MD, FAAP; Kenneth Copeland, MD, FAAP; Kelly R. Moore, MD, FAAP; Greg E. Prazar, MD, FAAP; Terry Raymer, MD, CDE; Richard N. Shiffman, MD, FAAP; Vidhu V. Thaker, MD, FAAP; Meaghan Anderson, MS, RD, LD, CDE; Stephen J. Spann, MD, MBA, FAAFP; and Susan K. Flinn, MA

ABSTRACT. *Objective.* Over the last 3 decades, the prevalence of childhood obesity has increased dramatically in North America, ushering in a variety of health problems, including type 2 diabetes mellitus (T2DM), which previously was not typically seen until much later in life. This technical report describes, in detail, the procedures undertaken to develop the recommendations given in the accompanying clinical practice guideline, "Management of Type 2 Diabetes Mellitus in Children and Adolescents," and provides in-depth information about the rationale for the recommendations and the studies used to make the clinical practice guideline's recommendations.

Methods. A primary literature search was conducted relating to the treatment of T2DM in children and adolescents, and a secondary literature search was conducted relating to the screening and treatment of T2DM's comorbidities in children and adolescents. Inclusion criteria were prospectively and unanimously agreed on by members of the committee. An article was eligible for inclusion if it addressed treatment (primary search) or 1 of 4 comorbidities (secondary search) of T2DM, was published in 1990 or later, was written in English, and included an abstract. Only primary research inquiries were considered; review articles were considered if they included primary data or opinion. The research population had to constitute children and/or

adolescents with an existing diagnosis of T2DM; studies of adult patients were considered if at least 10% of the study population was younger than 35 years. All retrieved titles, abstracts, and articles were reviewed by the consulting epidemiologist.

Results. Thousands of articles were retrieved and considered in both searches on the basis of the aforementioned criteria. From those, in the primary search, 199 abstracts were identified for possible inclusion, 58 of which were retained for systematic review. Five of these studies were classified as grade A studies, 1 as grade B, 20 as grade C, and 32 as grade D. Articles regarding treatment of T2DM selected for inclusion were divided into 4 major subcategories on the basis of type of treatment being discussed: (1) medical treatments (32 studies); (2) nonmedical treatments (9 studies); (3) provider behaviors (8 studies); and (4) social issues (9 studies). From the secondary search, an additional 336 abstracts relating to comorbidities were identified for possible inclusion, of which 26 were retained for systematic review. These articles included the following: 1 systematic review of literature regarding comorbidities of T2DM in adolescents; 5 expert opinions presenting global recommendations not based on evidence; 5 cohort studies reporting natural history of disease and comorbidities; 3 with specific attention to comorbidity patterns in specific ethnic groups (case-control, cohort, and clinical report using adult literature); 3 reporting an association between microalbuminuria and retinopathy (2 case-control, 1 cohort); 3 reporting the prevalence of nephropathy (cohort); 1 reporting peripheral vascular disease (case series); 2 discussing retinopathy (1 case-control, 1 position statement); and 3 addressing hyperlipidemia (American Heart Association position statement on cardiovascular risks; American Diabetes Association consensus statement; case series). A breakdown of grade of recommendation shows no grade A studies, 10 grade B studies, 6 grade C studies, and 10 grade D studies. With regard to screening and treatment recommendations for comorbidities, data in children are scarce, and the available literature is conflicting. Therapeutic recommendations for hypertension, dyslipidemia, retinopathy, microalbuminuria, and depression were summarized from expert guideline documents and are presented in detail in the guideline. The references are provided, but the committee did not independently assess the supporting evidence. Screening tools are provided in the Supplemental Information. (1/13)

https://doi.org/10.1542/peds.2012-3496

MANAGEMENT PRINCIPLES FOR ACUTE ILLNESS IN PATIENTS WITH MEDIUM-CHAIN ACYL-COENZYME A DEHYDROGENASE DEFICIENCY (CLINICAL REPORT)

Tracy L. McGregor, MD; Susan A. Berry, MD, FAAP; Katrina M. Dipple, MD, PhD, FAAP; Rizwan Hamid, MD, PhD, FAAP; and Council on Genetics

ABSTRACT. Medium-chain acyl-coenzyme A dehydrogenase deficiency (MCADD) is a fatty acid oxidation disorder in which the patient is unable to break down fats to produce energy. This disorder places children at risk for metabolic decompensation during periods of stress, such as routine childhood illnesses. The intent of this clinical report is to provide pediatricians with additional information regarding the acute clinical care of patients with MCADD. Although each patient with MCADD will still be expected to have a primary metabolic physician, the involvement of the primary care provider is crucial as well. Appropriate treatment of children with MCADD can lead to avoidance of morbidity and mortality. (12/20)

See full text on page 847.

https://doi.org/10.1542/peds.2020-040303

MARIJUANA USE DURING PREGNANCY AND BREASTFEEDING: IMPLICATIONS FOR NEONATAL AND CHILDHOOD OUTCOMES (CLINICAL REPORT)

Sheryl A. Ryan, MD, FAAP; Seth D. Ammerman, MD, FAAP, FSAHM, DABAM; Mary E. O'Connor, MD, MPH, FAAP; Committee on Substance Use and Prevention; and Section on Breastfeeding

ABSTRACT. Marijuana is one of the most widely used substances during pregnancy in the United States. Emerging data on the ability of cannabinoids to cross the placenta and affect the development of the fetus raise concerns about both pregnancy outcomes and long-term consequences for the infant or child. Social media is used to tout the use of marijuana for severe nausea associated with pregnancy. Concerns have also been raised about marijuana use by breastfeeding mothers. With this clinical report, we provide data on the current rates of marijuana use among pregnant and lactating women, discuss what is known about the effects of marijuana on fetal development and later neurodevelopmental and behavioral outcomes, and address implications for education and policy. (8/18)

https://doi.org/10.1542/peds.2018-1889

MATERNAL-FETAL INTERVENTION AND FETAL CARE CENTERS (CLINICAL REPORT)

Committee on Bioethics (joint with American College of Obstetricians and Gynecologists Committee on Ethics)

ABSTRACT. The past 2 decades have yielded profound advances in the fields of prenatal diagnosis and fetal intervention. Although fetal interventions are driven by a beneficence-based motivation to improve fetal and neonatal outcomes, advancement in fetal therapies raises ethical issues surrounding maternal autonomy and decision-making, concepts of innovation versus research, and organizational aspects within institutions in the development of fetal care centers. To safeguard the interests of both the pregnant woman and the fetus, the American College of Obstetricians and Gynecologists and the American Academy of Pediatrics make recommendations regarding informed consent, the role of research subject advocates and other independent advocates, the availability of support services, the multidisciplinary nature of fetal intervention teams, the oversight of centers, and the need to accumulate maternal and fetal outcome data. (7/11, reaffirmed 2/18)

https://doi.org/10.1542/peds.2011-1570

MEDIA AND YOUNG MINDS

Council on Communications and Media

ABSTRACT. Infants, toddlers, and preschoolers are now growing up in environments saturated with a variety of traditional and new technologies, which they are adopting at increasing rates. Although there has been much hope for the educational potential of interactive media for young children, accompanied by fears about their overuse during this crucial period of rapid brain development, research in this area still remains limited. This policy statement reviews the existing literature on television, videos, and mobile/interactive technologies; their potential for educational benefit; and related health concerns for young children (0 to 5 years of age). The statement also highlights areas in which pediatric providers can offer specific guidance to families in managing their young children's media use, not only in terms of content or time limits, but also emphasizing the importance of parent-child shared media use and allowing the child time to take part in other developmentally healthy activities. (10/16)

https://doi.org/10.1542/peds.2016-2591

MEDIA EDUCATION

Committee on Communications and Media

ABSTRACT. The American Academy of Pediatrics recognizes that exposure to mass media (eg, television, movies, video and computer games, the Internet, music lyrics and videos, newspapers, magazines, books, advertising) presents health risks for children and adolescents but can provide benefits as well. Media education has the potential to reduce the harmful effects of media and accentuate the positive effects. By understanding and supporting media education, pediatricians can play an important role in reducing harmful effects of media on children and adolescents. (9/10)

https://doi.org/10.1542/peds.2010-1636

MEDIA USE IN SCHOOL-AGED CHILDREN AND ADOLESCENTS

Council on Communications and Media

ABSTRACT. This policy statement focuses on children and adolescents 5 through 18 years of age. Research suggests both benefits and risks of media use for the health of children and teenagers. Benefits include exposure to new ideas and knowledge acquisition, increased opportunities for social contact and support, and new opportunities to access health-promotion messages and information. Risks include negative health effects on weight and sleep; exposure to inaccurate, inappropriate, or unsafe content and contacts; and compromised privacy and confidentiality. Parents face challenges in monitoring their children's and their own media use and in serving as positive role models. In this new era, evidence regarding healthy media use does not support a one-size-fits-all approach. Parents and pediatricians can work together to develop a Family Media Use Plan (www.healthychildren.org/MediaUsePlan) that considers their children's developmental stages to individualize an appropriate balance for media time and consistent rules about media use, to mentor their children, to set boundaries for accessing content and displaying personal information, and to implement open family communication about media. (10/16)

https://doi.org/10.1542/peds.2016-2592

MEDIATORS AND ADVERSE EFFECTS OF CHILD POVERTY IN THE UNITED STATES (TECHNICAL REPORT)

John M. Pascoe, MD, MPH, FAAP; David L. Wood, MD, MPH, FAAP; James H. Duffee, MD, MPH, FAAP; Alice Kuo, MD, PhD, MEd, FAAP; Committee on Psychosocial Aspects of Child and Family Health; and Council on Community Pediatrics

ABSTRACT. The link between poverty and children's health is well recognized. Even temporary poverty may have an adverse effect on children's health, and data consistently support the observation that poverty in childhood continues to have a negative effect on health into adulthood. In addition to childhood morbidity being related to child poverty, epidemiologic studies have documented a mortality gradient for children aged 1 to 15 years (and adults), with poor children experiencing a higher mortality rate than children from higher-income families. The global great recession is only now very slowly abating for millions of America's children and their families. At this difficult time in the history of our nation's families and immediately after the 50th anniversary year of President Lyndon Johnson's War on Poverty, it is particularly germane for the American Academy of Pediatrics, which is "dedicated to the health of all children," to publish a research-supported technical report that examines the mediators associated with the long-recognized adverse effects of child poverty on children and their families. This technical report draws on research from a number of disciplines, including physiology, sociology, psychology, economics, and epidemiology, to describe the present state of knowledge regarding poverty's negative impact on children's health and development. Children inherit not only their parents' genes but also the family ecology and its social milieu. Thus, parenting skills, housing, neighborhood, schools, and other factors (eg, medical care) all have complex relations to each other and influence how each child's genetic canvas is expressed. Accompanying this technical report is a policy statement that describes specific actions that pediatricians and other child advocates can take to attenuate the negative effects of the mediators identified in this technical report and improve the well-being of our nation's children and their families. (3/16, reaffirmed 4/21)

https://doi.org/10.1542/peds.2016-0340

MEDICAID POLICY STATEMENT

Committee on Child Health Financing

ABSTRACT. Medicaid insures 39% of the children in the United States. This revision of the 2005 Medicaid Policy Statement of the American Academy of Pediatrics reflects opportunities for changes in state Medicaid programs resulting from the 2010 Patient Protection and Affordable Care Act as upheld in 2012 by the Supreme Court. Policy recommendations focus on the areas of benefit coverage, financing and payment, eligibility, outreach and enrollment, managed care, and quality improvement. (4/13, reaffirmed 3/19)

https://doi.org/10.1542/peds.2013-0419

MEDICAL COUNTERMEASURES FOR CHILDREN IN PUBLIC HEALTH EMERGENCIES, DISASTERS, OR TERRORISM

Disaster Preparedness Advisory Council

ABSTRACT. Significant strides have been made over the past 10 to 15 years to develop medical countermeasures (MCMs) to address potential disaster hazards, including chemical, biological, radiologic, and nuclear threats. Significant and effective collaboration between the pediatric health community, including the American Academy of Pediatrics, and federal partners, such as the Office of the Assistant Secretary for Preparedness and Response, Centers for Disease Control and Prevention, Federal Emergency Management Agency, National Institutes of Health, Food and Drug Administration, and other federal agencies, over the past 5 years has resulted in substantial gains in addressing the needs of children related to disaster preparedness in general and MCMs in particular. Yet, major gaps still remain related to MCMs for children, a population highly vulnerable to the effects of exposure to such threats, because many vaccines and pharmaceuticals approved for use by adults as MCMs do not yet have pediatric formulations, dosing information, or safety information. As a result, the nation's stockpiles and other caches (designated supply of MCMs) where pharmacotherapeutic and other MCMs are stored are less prepared to address the needs of children compared with those of adults in the event of a disaster. This policy statement provides recommendations to close the remaining gaps for the development and use of MCMs in children during public health emergencies or disasters. The progress made by federal agencies to date to address the needs of children and the shared commitment of collaboration that characterizes the current relationship between the pediatric health community and the federal agencies responsible for MCMs should encourage all child advocates to invest the necessary energy and resources now to complete the process of remedying the remaining significant gaps in preparedness. (1/16)

https://doi.org/10.1542/peds.2015-4273

MEDICAL EMERGENCIES OCCURRING AT SCHOOL

Council on School Health

ABSTRACT. Children and adults might experience medical emergency situations because of injuries, complications of chronic health conditions, or unexpected major illnesses that occur in schools. In February 2001, the American Academy of Pediatrics issued a policy statement titled "Guidelines for Emergency Medical Care in Schools" (available at: http://aappolicy.

aappublications.org/cgi/content/full/pediatrics;107/2/435). Since the release of that statement, the spectrum of potential individual student emergencies has changed significantly. The increase in the number of children with special health care needs and chronic medical conditions attending schools and the challenges associated with ensuring that schools have access to on-site licensed health care professionals on an ongoing basis have added to increasing the risks of medical emergencies in schools. The goal of this statement is to increase pediatricians' awareness of schools' roles in preparing for individual student emergencies and to provide recommendations for primary care and school physicians on how to assist and support school personnel. (10/08, reaffirmed 9/11, 4/17)
https://doi.org/10.1542/peds.2008-2171

MEDICAL STAFF APPOINTMENT AND DELINEATION OF PEDIATRIC PRIVILEGES IN HOSPITALS (CLINICAL REPORT)

Daniel A. Rauch, MD; Committee on Hospital Care; and Section on Hospital Medicine

ABSTRACT. The review and verification of credentials and the granting of clinical privileges are required of every hospital to ensure that members of the medical staff are competent and qualified to provide specified levels of patient care. The credentialing process involves the following: (1) assessment of the professional and personal background of each practitioner seeking privileges; (2) assignment of privileges appropriate for the clinician's training and experience; (3) ongoing monitoring of the professional activities of each staff member; and (4) periodic reappointment to the medical staff on the basis of objectively measured performance. We examine the essential elements of a credentials review for initial and renewed medical staff appointments along with suggested criteria for the delineation of clinical privileges. Sample forms for the delineation of privileges can be found on the American Academy of Pediatrics Committee on Hospital Care Web site (http://www.aap.org/visit/cmte19.htm). Because of differences among individual hospitals, no 1 method for credentialing is universally applicable. The medical staff of each hospital must, therefore, establish its own process based on the general principles reviewed in this report. The issues of medical staff membership and credentialing have become very complex, and institutions and medical staffs are vulnerable to legal action. Consequently, it is advisable for hospitals and medical staffs to obtain expert legal advice when medical staff bylaws are constructed or revised. (3/12, reaffirmed 2/16)
https://doi.org/10.1542/peds.2011-3866

MEDICAL VERSUS NONMEDICAL IMMUNIZATION EXEMPTIONS FOR CHILD CARE AND SCHOOL ATTENDANCE

Committee on Practice and Ambulatory Medicine, Committee on Infectious Diseases, Committee on State Government Affairs, Council on School Health, and Section on Administration and Practice Management

ABSTRACT. Routine childhood immunizations against infectious diseases are an integral part of our public health infrastructure. They provide direct protection to the immunized individual and indirect protection to children and adults unable to be immunized via the effect of community immunity. All 50 states, the District of Columbia, and Puerto Rico have regulations requiring proof of immunization for child care and school attendance as a public health strategy to protect children in these settings and to secondarily serve as a mechanism to promote timely immunization of children by their caregivers. Although all states and the District of Columbia have mechanisms to exempt school attendees from specific immunization requirements for medical reasons, the majority also have a heterogeneous collection of regulations and laws that allow nonmedical exemptions from childhood immunizations otherwise required for child care and school attendance. The American Academy of Pediatrics (AAP) supports regulations and laws requiring certification of immunization to attend child care and school as a sound means of providing a safe environment for attendees and employees of these settings. The AAP also supports medically indicated exemptions to specific immunizations as determined for each individual child. The AAP views nonmedical exemptions to school-required immunizations as inappropriate for individual, public health, and ethical reasons and advocates for their elimination. (8/16)
https://doi.org/10.1542/peds.2016-2145

MEDICATION-ASSISTED TREATMENT OF ADOLESCENTS WITH OPIOID USE DISORDERS

Committee on Substance Use and Prevention

ABSTRACT. Opioid use disorder is a leading cause of morbidity and mortality among US youth. Effective treatments, both medications and substance use disorder counseling, are available but underused, and access to developmentally appropriate treatment is severely restricted for adolescents and young adults. Resources to disseminate available therapies and to develop new treatments specifically for this age group are needed to save and improve lives of youth with opioid addiction. (8/16)
https://doi.org/10.1542/peds.2016-1893

MENSTRUAL MANAGEMENT FOR ADOLESCENTS WITH DISABILITIES (CLINICAL REPORT)

Elisabeth H. Quint, MD; Rebecca F. O'Brien, MD; and Committee on Adolescence (joint with North American Society for Pediatric and Adolescent Gynecology)

ABSTRACT. The onset of menses for adolescents with physical or intellectual disabilities can affect their independence and add additional concerns for families at home, in schools, and in other settings. The pediatrician is the primary health care provider to explore and assist with the pubertal transition and menstrual management. Menstrual management of both normal and abnormal cycles may be requested to minimize hygiene issues, premenstrual symptoms, dysmenorrhea, heavy or irregular bleeding, contraception, and conditions exacerbated by the menstrual cycle. Several options are available for menstrual management, depending on the outcome that is desired, ranging from cycle regulation to complete amenorrhea. The use of medications or the request for surgeries to help with the menstrual cycles in teenagers with disabilities has medical, social, legal, and ethical implications. This clinical report is designed to help guide pediatricians in assisting adolescent females with intellectual and/or physical disabilities and their families in making decisions related to successfully navigating menarche and subsequent menstrual cycles. (6/16)
https://doi.org/10.1542/peds.2016-0295

MENTAL HEALTH COMPETENCIES FOR PEDIATRIC PRACTICE

Jane Meschan Foy, MD, FAAP; Cori M. Green, MD, MS, FAAP; Marian F. Earls, MD, MTS, FAAP; Committee on Psychosocial Aspects of Child and Family Health; and Mental Health Leadership Work Group

ABSTRACT. Pediatricians have unique opportunities and an increasing sense of responsibility to promote healthy social-emotional development of children and to prevent and address their mental health and substance use conditions. In this report, the American Academy of Pediatrics updates its 2009 policy statement, which proposed competencies for providing mental health care to children in primary care settings and recommended steps toward achieving them. This 2019 policy statement affirms the 2009 statement and expands competencies in response to science and policy that have emerged since: the impact of adverse childhood experiences and social determinants on mental health, trauma-informed practice, and team-based care. Importantly, it

also recognizes ways in which the competencies are pertinent to pediatric subspecialty practice. Proposed mental health competencies include foundational communication skills, capacity to incorporate mental health content and tools into health promotion and primary and secondary preventive care, skills in the psychosocial assessment and care of children with mental health conditions, knowledge and skills of evidence-based psychosocial therapy and psychopharmacologic therapy, skills to function as a team member and comanager with mental health specialists, and commitment to embrace mental health practice as integral to pediatric care. Achievement of these competencies will necessarily be incremental, requiring partnership with fellow advocates, system changes, new payment mechanisms, practice enhancements, and decision support for pediatricians in their expanded scope of practice. (10/19)
https://doi.org/10.1542/peds.2019-2757

METABOLIC AND BARIATRIC SURGERY FOR PEDIATRIC PATIENTS WITH SEVERE OBESITY (TECHNICAL REPORT)

Christopher F. Bolling, MD, FAAP; Sarah C. Armstrong, MD, FAAP; Kirk W. Reichard, MD, MBA, FAAP; Marc P. Michalsky, MD, FACS, FAAP, FASMBS; Section on Obesity; and Section on Surgery

ABSTRACT. Severe obesity affects the health and well-being of millions of children and adolescents in the United States and is widely considered to be an "epidemic within an epidemic" that poses a major public health crisis. Currently, few effective treatments for severe obesity exist. Metabolic and bariatric surgery are existing but underuse treatment options for pediatric patients with severe obesity. Roux-en-Y gastric bypass and vertical sleeve gastrectomy are the most commonly performed metabolic and bariatric procedures in the United States and have been shown to result in sustained short-, mid-, and long-term weight loss, with associated resolution of multiple obesity-related comorbid diseases. Substantial evidence supports the safety and effectiveness of surgical weight loss for children and adolescents, and robust best practice guidelines for these procedures exist. (11/19)
https://doi.org/10.1542/peds.2019-3224

THE METABOLIC SYNDROME IN CHILDREN AND ADOLESCENTS: SHIFTING THE FOCUS TO CARDIOMETABOLIC RISK FACTOR CLUSTERING (CLINICAL REPORT)

Sheela N. Magge, MD, MSCE, FAAP; Elizabeth Goodman, MD, MBA, FAAP; Sarah C. Armstrong, MD, FAAP; Committee on Nutrition; Section on Endocrinology; and Section on Obesity

ABSTRACT. Metabolic syndrome (MetS) was developed by the National Cholesterol Education Program Adult Treatment Panel III, identifying adults with at least 3 of 5 cardiometabolic risk factors (hyperglycemia, increased central adiposity, elevated triglycerides, decreased high-density lipoprotein cholesterol, and elevated blood pressure) who are at increased risk of diabetes and cardiovascular disease. The constellation of MetS component risk factors has a shared pathophysiology and many common treatment approaches grounded in lifestyle modification. Several attempts have been made to define MetS in the pediatric population. However, in children, the construct is difficult to define and has unclear implications for clinical care. In this Clinical Report, we focus on the importance of screening for and treating the individual risk factor components of MetS. Focusing attention on children with cardiometabolic risk factor clustering is emphasized over the need to define a pediatric MetS. (7/17)
https://doi.org/10.1542/peds.2017-1603

METRIC UNITS AND THE PREFERRED DOSING OF ORALLY ADMINISTERED LIQUID MEDICATIONS

Committee on Drugs

ABSTRACT. Medication overdoses are a common, but preventable, problem among children. Volumetric dosing errors and the use of incorrect dosing delivery devices are 2 common sources of these preventable errors for orally administered liquid medications. To reduce errors and increase precision of drug administration, milliliter-based dosing should be used exclusively when prescribing and administering liquid medications. Teaspoon- and tablespoon-based dosing should not be used. Devices that allow for precise dose administration (preferably syringes with metric markings) should be used instead of household spoons and should be distributed with the medication. (3/15)
https://doi.org/10.1542/peds.2015-0072

MIND-BODY THERAPIES IN CHILDREN AND YOUTH (CLINICAL REPORT)

Section on Integrative Medicine

ABSTRACT. Mind-body therapies are popular and are ranked among the top 10 complementary and integrative medicine practices reportedly used by adults and children in the 2007–2012 National Health Interview Survey. A growing body of evidence supports the effectiveness and safety of mind-body therapies in pediatrics. This clinical report outlines popular mind-body therapies for children and youth and examines the best-available evidence for a variety of mind-body therapies and practices, including biofeedback, clinical hypnosis, guided imagery, meditation, and yoga. The report is intended to help health care professionals guide their patients to nonpharmacologic approaches to improve concentration, help decrease pain, control discomfort, or ease anxiety. (8/16)
https://doi.org/10.1542/peds.2016-1896

MINORS AS LIVING SOLID-ORGAN DONORS (CLINICAL REPORT)

Lainie Friedman Ross, MD, PhD; J. Richard Thistlethwaite Jr, MD, PhD; and Committee on Bioethics

ABSTRACT. In the past half-century, solid-organ transplantation has become standard treatment for a variety of diseases in children and adults. The major limitation for all transplantation is the availability of donors, and the gap between demand and supply continues to grow despite the increase in living donors. Although rare, children do serve as living donors, and these donations raise serious ethical issues. This clinical report includes a discussion of the ethical considerations regarding minors serving as living donors, using the traditional benefit/burden calculus from the perspectives of both the donor and the recipient. The report also includes an examination of the circumstances under which a minor may morally participate as a living donor, how to minimize risks, and what the informed-consent process should entail. The American Academy of Pediatrics holds that minors can morally serve as living organ donors but only in exceptional circumstances when specific criteria are fulfilled. (8/08, reaffirmed 5/11)
https://doi.org/10.1542/peds.2008-1525

MODEL CONTRACTUAL LANGUAGE FOR MEDICAL NECESSITY FOR CHILDREN

Committee on Child Health Financing

ABSTRACT. The term "medical necessity" is used by Medicare and Medicaid and in insurance contracts to refer to medical services that are generally recognized as appropriate for the diagnosis, prevention, or treatment of disease and injury. There is no consensus on how to define and apply the term and the accompanying rules and regulations, and as a result there has been substantial variation in medical-necessity definitions and interpretations. With this policy statement, the American Academy of Pediatrics hopes to encourage insurers to adopt more consistent medical-necessity definitions that take into account the needs of children. (7/05, reaffirmed 10/11)
https://doi.org/10.1542/peds.2005-0880

MOTOR DELAYS: EARLY IDENTIFICATION AND EVALUATION (CLINICAL REPORT)

Garey H. Noritz, MD; Nancy A. Murphy, MD; and Neuromotor Screening Expert Panel

ABSTRACT. Pediatricians often encounter children with delays of motor development in their clinical practices. Earlier identification of motor delays allows for timely referral for developmental interventions as well as diagnostic evaluations and treatment planning. A multidisciplinary expert panel developed an algorithm for the surveillance and screening of children for motor delays within the medical home, offering guidance for the initial workup and referral of the child with possible delays in motor development. Highlights of this clinical report include suggestions for formal developmental screening at the 9-, 18-, 30-, and 48-month well-child visits; approaches to the neurologic examination, with emphasis on the assessment of muscle tone; and initial diagnostic approaches for medical home providers. Use of diagnostic tests to evaluate children with motor delays are described, including brain MRI for children with high muscle tone, and measuring serum creatine kinase concentration of those with decreased muscle tone. The importance of pursuing diagnostic tests while concurrently referring patients to early intervention programs is emphasized. (5/13, reaffirmed 5/17)

https://doi.org/10.1542/peds.2013-1056

THE NEED TO OPTIMIZE ADOLESCENT IMMUNIZATION (CLINICAL REPORT)

Henry H. Bernstein, DO, MHCM, FAAP; Joseph A. Bocchini Jr, MD, FAAP; and Committee on Infectious Diseases

ABSTRACT. The adolescent period heralds the pediatric patient's transition into adulthood. It is a time of dynamic development during which effective preventive care measures can promote safe behaviors and the development of lifelong health habits. One of the foundations of preventive adolescent health care is timely vaccination, and every visit can be viewed as an opportunity to update and complete an adolescent's immunizations.

In the past decade, the adolescent immunization schedule has expanded to include 2 doses of quadrivalent meningococcal conjugate vaccine; 1 dose of tetanus, diphtheria, acellular pertussis, absorbed vaccine; 2 or 3 doses of human papillomavirus vaccine, depending on the child's age; and an annual influenza vaccine. In addition, during adolescent visits, health care providers can determine whether catch-up vaccination is needed to meet early childhood recommendations for hepatitis B; hepatitis A; measles, mumps, rubella; poliovirus; and varicella vaccines. New serogroup B meningococcal vaccines are now available for those at increased risk for meningococcal disease; in addition, these serogroup B meningococcal vaccines received a Category B recommendation for healthy adolescents, where individual counseling and risk–benefit evaluation based on health care provider judgements and patient preferences are indicated. This clinical report focuses on the epidemiology of adolescent vaccine-preventable diseases by reviewing the rationale for the annual universally recommended adolescent immunization schedule of the American Academy of Pediatrics, the American Academy of Family Physicians, the Centers for Disease Control and Prevention, and the American Congress of Obstetricians and Gynecologists. In addition, the barriers that negatively influence adherence to this current adolescent immunization schedule will be highlighted. (2/17)

https://doi.org/10.1542/peds.2016-4186

NEEDS OF KINSHIP CARE FAMILIES AND PEDIATRIC PRACTICE

David Rubin, MD, FAAP; Sarah H. Springer, MD, FAAP; Sarah Zlotnik, MSW, MSPH; Christina D. Kang-Yi, PhD; and Council on Foster Care, Adoption, and Kinship Care

ABSTRACT. As many as 3% of children in the United States live in kinship care arrangements with caregivers who are relatives but not the biological parents of the child. A growing body of evidence suggests that children who cannot live with their biological parents fare better, overall, when living with extended family than with nonrelated foster parents. Acknowledging this, federal laws and public policies increasingly favor kinship care over nonrelative foster care when children are unable to live with their biological parents. Despite overall better outcomes, families providing kinship care experience many hardships, and the children experience many of the same adversities of children in traditional foster care. This policy statement reviews both the strengths and vulnerabilities of kinship families and suggests strategies for pediatricians to use to address the needs of individual patients and families. Strategies are also outlined for community, state, and federal advocacy on behalf of these children and their families. (3/17)

https://doi.org/10.1542/peds.2017-0099

NEONATAL DRUG WITHDRAWAL (CLINICAL REPORT)

Mark L. Hudak, MD; Rosemarie C. Tan, MD, PhD; Committee on Drugs; and Committee on Fetus and Newborn

ABSTRACT. Maternal use of certain drugs during pregnancy can result in transient neonatal signs consistent with withdrawal or acute toxicity or cause sustained signs consistent with a lasting drug effect. In addition, hospitalized infants who are treated with opioids or benzodiazepines to provide analgesia or sedation may be at risk for manifesting signs of withdrawal. This statement updates information about the clinical presentation of infants exposed to intrauterine drugs and the therapeutic options for treatment of withdrawal and is expanded to include evidence-based approaches to the management of the hospitalized infant who requires weaning from analgesics or sedatives. (1/12, reaffirmed 2/16)

https://doi.org/10.1542/peds.2011-3212

NEONATAL OPIOID WITHDRAWAL SYNDROME (CLINICAL REPORT)

Stephen W. Patrick, MD, MPH, MS, FAAP; Wanda D. Barfield, MD, MPH, FAAP; Brenda B. Poindexter, MD, MS, FAAP; Committee on Fetus and Newborn; and Committee on Substance Use and Prevention

ABSTRACT. The opioid crisis has grown to affect pregnant women and infants across the United States, as evidenced by rising rates of opioid use disorder among pregnant women and neonatal opioid withdrawal syndrome among infants. Across the country, pregnant women lack access to evidence-based therapies, including medications for opioid use disorder, and infants with opioid exposure frequently receive variable care. In addition, public systems, such as child welfare and early intervention, are increasingly stretched by increasing numbers of children affected by the crisis. Systematic, enduring, coordinated, and holistic approaches are needed to improve care for the mother-infant dyad. In this statement, we provide an overview of the effect of the opioid crisis on the mother-infant dyad and provide recommendations for management of the infant with opioid exposure, including clinical presentation, assessment, treatment, and discharge. (10/20)

https://doi.org/10.1542/peds.2020-029074

NEONATAL PROVIDER WORKFORCE (TECHNICAL REPORT)

Erin L. Keels, DNP, APRN-CNP, NNP-BC; Jay P. Goldsmith, MD, FAAP; and Committee on Fetus and Newborn

ABSTRACT. This technical report reviews education, training, competency requirements, and scopes of practice of the different neonatal care providers who work to meet the special needs of neonatal patients and their families in the NICU. Additionally, this report examines the current workforce issues of NICU

providers, offers suggestions for establishing and monitoring quality and safety of care, and suggests potential solutions to the NICU provider workforce shortages now and in the future. (11/19)
https://doi.org/10.1542/peds.2019-3147

A NEW ERA IN QUALITY MEASUREMENT: THE DEVELOPMENT AND APPLICATION OF QUALITY MEASURES

Terry Adirim, MD, MPH, FAAP; Kelley Meade, MD, FAAP; Kamila Mistry, PhD, MPH; Council on Quality Improvement and Patient Safety; and Committee on Practice and Ambulatory Medicine

ABSTRACT. Quality measures are used for a variety of purposes in health care, including clinical care improvement, regulation, accreditation, public reporting, surveillance, and maintenance of certification. Most quality measures are 1 of 3 types: structure, process, or outcome. Health care quality measures should address the domains of quality across the continuum of care and reflect patient and family experience. Measure development for pediatric health care has a number of important challenges, including gaps in the evidence base; the fact that measures for most conditions must be age-specific; the long, resourceintensive development process; and the national focus on measure development for adult conditions. Numerous national organizations focus on the development and application of quality measures, including the Pediatric Quality Measures Program, which is focused solely on the development and implementation of pediatric-specific measures. Once a quality measure is developed for use in national measurement programs, the organization that develops and/or "stewards" the measure may submit the measure or set of measures for endorsement, which is recognition of the scientific soundness, usability, and relevance of the measure. Quality measures must then be disseminated and applied to improve care. Although pediatric health care providers and child health care institutions alike must continually balance time and resources needed to address multiple reporting requirements, quality measurement is an important tool for advancing high-quality and safe health care for children. This policy statement provides an overview of quality measurement and describes the opportunities for pediatric health care providers to apply quality measures to improve clinical quality and performance in the delivery of pediatric health care services. (12/16)
https://doi.org/10.1542/peds.2016-3442

NEWBORN SCREENING EXPANDS: RECOMMENDATIONS FOR PEDIATRICIANS AND MEDICAL HOMES—IMPLICATIONS FOR THE SYSTEM (CLINICAL REPORT)

Newborn Screening Authoring Committee

ABSTRACT. Advances in newborn screening technology, coupled with recent advances in the diagnosis and treatment of rare but serious congenital conditions that affect newborn infants, provide increased opportunities for positively affecting the lives of children and their families. These advantages also pose new challenges to primary care pediatricians, both educationally and in response to the management of affected infants. Primary care pediatricians require immediate access to clinical and diagnostic information and guidance and have a proactive role to play in supporting the performance of the newborn screening system. Primary care pediatricians must develop office policies and procedures to ensure that newborn screening is conducted and that results are transmitted to them in a timely fashion; they must also develop strategies to use should these systems fail. In addition, collaboration with local, state, and national partners is essential for promoting actions and policies that will optimize the function of the newborn screening systems and ensure that families receive the full benefit of them. (1/08, reaffirmed 9/16)
https://doi.org/10.1542/peds.2007-3021

NEWBORN SCREENING FOR BILIARY ATRESIA (TECHNICAL REPORT)

Kasper S. Wang, MD, FAAP, FACS; Section on Surgery; and Committee on Fetus and Newborn (joint with Childhood Liver Disease Research Network)

ABSTRACT. Biliary atresia is the most common cause of pediatric end-stage liver disease and the leading indication for pediatric liver transplantation. Affected infants exhibit evidence of biliary obstruction within the first few weeks after birth. Early diagnosis and successful surgical drainage of bile are associated with greater survival with the child's native liver. Unfortunately, because noncholestatic jaundice is extremely common in early infancy, it is difficult to identify the rare infant with cholestatic jaundice who has biliary atresia. Hence, the need for timely diagnosis of this disease warrants a discussion of the feasibility of screening for biliary atresia to improve outcomes. Herein, newborn screening for biliary atresia in the United States is assessed by using criteria established by the Discretionary Advisory Committee on Heritable Disorders in Newborns and Children. Published analyses indicate that newborn screening for biliary atresia by using serum bilirubin concentrations or stool color cards is potentially life-saving and cost-effective. Further studies are necessary to evaluate the feasibility, effectiveness, and costs of potential screening strategies for early identification of biliary atresia in the United States. (11/15)
https://doi.org/10.1542/peds.2015-3570

NICKEL ALLERGIC CONTACT DERMATITIS: IDENTIFICATION, TREATMENT, AND PREVENTION

Nanette B. Silverberg, MD, FAAP, FAAD; Janice L. Pelletier, MD, FAAP; Sharon E. Jacob, MD, FAAP, FAAD; Lynda C. Schneider, MD, FAAP; Section on Dermatology; and Section on Allergy and Immunology

ABSTRACT. Nickel is a ubiquitous metal added to jewelry and metallic substances for its hardening properties and because it is inexpensive. Estimates suggest that at least 1.1 million children in the United States are sensitized to nickel. Nickel allergic contact dermatitis (Ni-ACD) is the most common cutaneous delayed-type hypersensitivity reaction worldwide. The incidence among children tested has almost quadrupled over the past 3 decades. The associated morbidities include itch, discomfort, school absence, and reduced quality of life. In adulthood, individuals with Ni-ACD may have severe disabling hand eczema. The increasing rate of Ni-ACD in children has been postulated to result from early and frequent exposure to metals with high amounts of nickel release (eg, as occurs with ear piercing or with products used daily in childhood such as toys, belt buckles, and electronics).

To reduce exposure to metal sources with high nickel release by prolonged and direct contact with human skin, Denmark and the European Union legislated a directive several decades ago with the goal of reducing high nickel release and the incidence of Ni-ACD. Since then, there has been a global reduction in incidence of Ni-ACD in population-based studies of adults and studies of children and young adults being tested for allergic contact dermatitis. These data point to nickel exposure as a trigger for elicitation of Ni-ACD and, further, provide evidence that legislation can have a favorable effect on the economic and medical health of a population.

This policy statement reviews the epidemiology, history, and appearances of Ni-ACD. Examples of sources of high nickel release are discussed to highlight how difficult it is to avoid this metal in modern daily lives. Treatments are outlined, and

avoidance strategies are presented. Long-term epidemiological interventions are addressed. Advocacy for smarter nickel use is reviewed. The American Academy of Pediatrics supports US legislation that advances safety standards (as modeled by the European Union) that protect children from early and prolonged skin exposure to high–nickel-releasing items. Our final aim for this article is to aid the pediatric community in developing nickel-avoidance strategies on both individual and global levels. (4/20)
https://doi.org/10.1542/peds.2020-0628

NICOTINE AND TOBACCO AS SUBSTANCES OF ABUSE IN CHILDREN AND ADOLESCENTS (TECHNICAL REPORT)

Lorena M. Siqueira, MD, MSPH, FAAP, FSAHM, and Committee on Substance Use and Prevention

ABSTRACT. Nicotine is the primary pharmacologic component of tobacco, and users of tobacco products seek out its effects. The highly addictive nature of nicotine is responsible for its widespread use and difficulty with quitting. This technical report focuses on nicotine and discusses the stages of use in progression to dependence on nicotine-containing products; the physiologic characteristics, neurobiology, metabolism, pharmacogenetics, and health effects of nicotine; and acute nicotine toxicity. Finally, some newer approaches to cessation are noted. (12/16)
https://doi.org/10.1542/peds.2016-3436

NONDISCRIMINATION IN PEDIATRIC HEALTH CARE

Committee on Pediatric Workforce

ABSTRACT. This policy statement is a revision of a 2001 statement and articulates the positions of the American Academy of Pediatrics on nondiscrimination in pediatric health care. It addresses both pediatricians who provide health care and the infants, children, adolescents, and young adults whom they serve. (10/07, reaffirmed 6/11, 1/15, 5/21)
https://doi.org/10.1542/peds.2007-2334

NONEMERGENCY ACUTE CARE: WHEN IT'S NOT THE MEDICAL HOME

Gregory P. Conners, MD, MPH, MBA, FAAP; Susan J. Kressly, MD, FAAP; James M. Perrin, MD, FAAP; Julia E. Richerson, MD, FAAP; Usha M. Sankrithi, MBBS, MPH, FAAP; Committee on Practice and Ambulatory Medicine; Committee on Pediatric Emergency Medicine; Section on Telehealth Care; Section on Emergency Medicine; Subcommittee on Urgent Care; and Task Force on Pediatric Practice Change

ABSTRACT. The American Academy of Pediatrics (AAP) affirms that the optimal location for children to receive care for acute, nonemergency health concerns is the medical home. The medical home is characterized by the AAP as a care model that "must be accessible, family centered, continuous, comprehensive, coordinated, compassionate, and culturally effective." However, some children and families use acute care services outside the medical home because there is a perceived or real benefit related to accessibility, convenience, or cost of care. Examples of such acute care entities include urgent care facilities, retail-based clinics, and commercial telemedicine services. Children deserve high-quality, appropriate, and safe acute care services wherever they access the health care system, with timely and complete communication with the medical home, to ensure coordinated and continuous care. Treatment of children under established, new, and evolving practice arrangements in acute care entities should adhere to the core principles of continuity of care and communication, best practices within a defined scope of services, pediatric-trained staff, safe transitions of care, and continuous improvement. In support of the medical home, the AAP urges stakeholders, including payers, to avoid any incentives (eg, reduced copays) that encourage visits to external entities for acute issues as a preference over the medical home. (4/17)
https://doi.org/10.1542/peds.2017-0629

NONINITIATION OR WITHDRAWAL OF INTENSIVE CARE FOR HIGH-RISK NEWBORNS

Committee on Fetus and Newborn

ABSTRACT. Advances in medical technology have led to dilemmas in initiation and withdrawal of intensive care of newborn infants with a very poor prognosis. Physicians and parents together must make difficult decisions guided by their understanding of the child's best interest. The foundation for these decisions consists of several key elements: (1) direct and open communication between the health care team and the parents of the child with regard to the medical status, prognosis, and treatment options; (2) inclusion of the parents as active participants in the decision process; (3) continuation of comfort care even when intensive care is not being provided; and (4) treatment decisions that are guided primarily by the best interest of the child. (2/07, reaffirmed 5/10, 6/15)
https://doi.org/10.1542/peds.2006-3180

NONINVASIVE RESPIRATORY SUPPORT (CLINICAL REPORT)

James J. Cummings, MD, FAAP; Richard A. Polin, MD, FAAP; and Committee on Fetus and Newborn

ABSTRACT. Mechanical ventilation is associated with increased survival of preterm infants but is also associated with an increased incidence of chronic lung disease (bronchopulmonary dysplasia) in survivors. Nasal continuous positive airway pressure (nCPAP) is a form of noninvasive ventilation that reduces the need for mechanical ventilation and decreases the combined outcome of death or bronchopulmonary dysplasia. Other modes of noninvasive ventilation, including nasal intermittent positive pressure ventilation, biphasic positive airway pressure, and high-flow nasal cannula, have recently been introduced into the NICU setting as potential alternatives to mechanical ventilation or nCPAP. Randomized controlled trials suggest that these newer modalities may be effective alternatives to nCPAP and may offer some advantages over nCPAP, but efficacy and safety data are limited. (12/15)
https://doi.org/10.1542/peds.2015-3758

NONORAL FEEDING FOR CHILDREN AND YOUTH WITH DEVELOPMENTAL OR ACQUIRED DISABILITIES (CLINICAL REPORT)

Richard C. Adams, MD, FAAP; Ellen Roy Elias, MD, FAAP; and Council on Children With Disabilities

ABSTRACT. The decision to initiate enteral feedings is multifaceted, involving medical, financial, cultural, and emotional considerations. Children who have developmental or acquired disabilities are at risk for having primary and secondary conditions that affect growth and nutritional well-being. This clinical report provides (1) an overview of clinical issues in children who have developmental or acquired disabilities that may prompt a need to consider nonoral feedings, (2) a systematic way to support the child and family in clinical decisions related to initiating nonoral feeding, (3) information on surgical options that the family may need to consider in that decision-making process, and (4) pediatric guidance for ongoing care after initiation of nonoral feeding intervention, including care of the gastrostomy tube and skin site. Ongoing medical and psychosocial support is needed after initiation of nonoral feedings and is best provided through the collaborative efforts of the family and a team of professionals that may include the pediatrician, dietitian, social worker, and/or therapists. (11/14, reaffirmed 6/19)
https://doi.org/10.1542/peds.2014-2829

NONTHERAPEUTIC USE OF ANTIMICROBIAL AGENTS IN ANIMAL AGRICULTURE: IMPLICATIONS FOR PEDIATRICS (TECHNICAL REPORT)

Jerome A. Paulson, MD, FAAP; Theoklis E. Zaoutis, MD, MSCE, FAAP; Council on Environmental Health; and Committee on Infectious Diseases

ABSTRACT. Antimicrobial resistance is one of the most serious threats to public health globally and threatens our ability to treat infectious diseases. Antimicrobial-resistant infections are associated with increased morbidity, mortality, and health care costs. Infants and children are affected by transmission of susceptible and resistant food zoonotic pathogens through the food supply, direct contact with animals, and environmental pathways. The overuse and misuse of antimicrobial agents in veterinary and human medicine is, in large part, responsible for the emergence of antibiotic resistance. Approximately 80% of the overall tonnage of antimicrobial agents sold in the United States in 2012 was for animal use, and approximately 60% of those agents are considered important for human medicine. Most of the use involves the addition of low doses of antimicrobial agents to the feed of healthy animals over prolonged periods to promote growth and increase feed efficiency or at a range of doses to prevent disease. These nontherapeutic uses contribute to resistance and create new health dangers for humans. This report describes how antimicrobial agents are used in animal agriculture, reviews the mechanisms of how such use contributes to development of resistance, and discusses US and global initiatives to curb the use of antimicrobial agents in agriculture. (11/15, reaffirmed 6/21)

https://doi.org/10.1542/peds.2015-3630

OFFICE-BASED CARE FOR LESBIAN, GAY, BISEXUAL, TRANSGENDER, AND QUESTIONING YOUTH

Committee on Adolescence

ABSTRACT. The American Academy of Pediatrics issued its last statement on homosexuality and adolescents in 2004. Although most lesbian, gay, bisexual, transgender, and questioning (LGBTQ) youth are quite resilient and emerge from adolescence as healthy adults, the effects of homophobia and heterosexism can contribute to health disparities in mental health with higher rates of depression and suicidal ideation, higher rates of substance abuse, and more sexually transmitted and HIV infections. Pediatricians should have offices that are teen-friendly and welcoming to sexual minority youth. Obtaining a comprehensive, confidential, developmentally appropriate adolescent psychosocial history allows for the discovery of strengths and assets as well as risks. Referrals for mental health or substance abuse may be warranted. Sexually active LGBTQ youth should have sexually transmitted infection/HIV testing according to recommendations of the Sexually Transmitted Diseases Treatment Guidelines of the Centers for Disease Control and Prevention based on sexual behaviors. With appropriate assistance and care, sexual minority youth should live healthy, productive lives while transitioning through adolescence and young adulthood. (6/13, reaffirmed 4/21)

https://doi.org/10.1542/peds.2013-1282

OFFICE-BASED CARE FOR LESBIAN, GAY, BISEXUAL, TRANSGENDER, AND QUESTIONING YOUTH (TECHNICAL REPORT)

David A. Levine, MD, and Committee on Adolescence

ABSTRACT. The American Academy of Pediatrics issued its last statement on homosexuality and adolescents in 2004. This technical report reflects the rapidly expanding medical and psychosocial literature about sexual minority youth. Pediatricians should be aware that some youth in their care may have concerns or questions about their sexual orientation or that of siblings, friends, parents, relatives, or others and should provide factual, current, nonjudgmental information in a confidential manner. Although most lesbian, gay, bisexual, transgender, and questioning (LGBTQ) youth are quite resilient and emerge from adolescence as healthy adults, the effects of homophobia and heterosexism can contribute to increased mental health issues for sexual minority youth. LGBTQ and MSM/WSW (men having sex with men and women having sex with women) adolescents, in comparison with heterosexual adolescents, have higher rates of depression and suicidal ideation, higher rates of substance abuse, and more risky sexual behaviors. Obtaining a comprehensive, confidential, developmentally appropriate adolescent psychosocial history allows for the discovery of strengths and assets as well as risks. Pediatricians should have offices that are teen-friendly and welcoming to sexual minority youth. This includes having supportive, engaging office staff members who ensure that there are no barriers to care. For transgender youth, pediatricians should provide the opportunity to acknowledge and affirm their feelings of gender dysphoria and desires to transition to the opposite gender. Referral of transgender youth to a qualified mental health professional is critical to assist with the dysphoria, to educate them, and to assess their readiness for transition. With appropriate assistance and care, sexual minority youth should live healthy, productive lives while transitioning through adolescence and young adulthood. (6/13, reaffirmed 4/21)

https://doi.org/10.1542/peds.2013-1283

OFFICE-BASED COUNSELING FOR UNINTENTIONAL INJURY PREVENTION (CLINICAL REPORT)

H. Garry Gardner, MD, and Committee on Injury, Violence, and Poison Prevention

ABSTRACT. Unintentional injuries are the leading cause of death for children older than 1 year. Pediatricians should include unintentional injury prevention as a major component of anticipatory guidance for infants, children, and adolescents. The content of injury-prevention counseling varies for infants, preschool-aged children, school-aged children, and adolescents. This report provides guidance on the content of unintentional injury-prevention counseling for each of those age groups. (1/07)

https://doi.org/10.1542/peds.2006-2899

OFF-LABEL USE OF DRUGS IN CHILDREN

Committee on Drugs

ABSTRACT. The passage of the Best Pharmaceuticals for Children Act and the Pediatric Research Equity Act has collectively resulted in an improvement in rational prescribing for children, including more than 500 labeling changes. However, off-label drug use remains an important public health issue for infants, children, and adolescents, because an overwhelming number of drugs still have no information in the labeling for use in pediatrics. The purpose of off-label use is to benefit the individual patient. Practitioners use their professional judgment to determine these uses. As such, the term "off-label" does not imply an improper, illegal, contraindicated, or investigational use. Therapeutic decision-making must always rely on the best available evidence and the importance of the benefit for the individual patient. (2/14, reaffirmed 11/20)

https://doi.org/10.1542/peds.2013-4060

OFF-LABEL USE OF MEDICAL DEVICES IN CHILDREN

Section on Cardiology and Cardiac Surgery and Section on Orthopaedics

ABSTRACT. Despite widespread therapeutic needs, the majority of medical and surgical devices used in children do not have approval or clearance from the Food and Drug Administration (FDA) for use in pediatric populations. The clinical need for devices to diagnose and treat diseases or conditions occurring

in children has led to the widespread and necessary practice in pediatric medicine and surgery of using approved devices for "off-label" or "physician-directed" applications that are not included in FDA-approved labeling. This practice is common and often appropriate, even with the highest-risk (class III) devices. The legal and regulatory framework used by the FDA for devices is complex, and economic or market barriers to medical and surgical device development for children are significant. Given the need for pediatric medical and surgical devices and the challenges to pediatric device development, off-label use is a necessary and appropriate part of care. In addition, because of the relatively uncommon nature of pediatric conditions, FDA clearance or approval often requires other regulatory pathways (eg, Humanitarian Device Exemption), which can cause confusion among pediatricians and payers about whether a specific use, even of an approved device, is considered experimental. This policy statement describes the appropriateness of off-label use of devices in children; the use of devices approved or cleared through the FDA regulatory processes, including through the Humanitarian Device Exemption; and the important need to increase pediatric device labeling information for all devices and especially those that pose the highest risk to children. (12/16)
https://doi.org/10.1542/peds.2016-3439

ONGOING PEDIATRIC HEALTH CARE FOR THE CHILD WHO HAS BEEN MALTREATED (CLINICAL REPORT)

Emalee Flaherty, MD, FAAP; Lori Legano, MD, FAAP; Sheila Idzerda, MD, FAAP; and Council on Child Abuse and Neglect

ABSTRACT. Pediatricians provide continuous medical care and anticipatory guidance for children who have been reported to state child protection agencies, including tribal child protection agencies, because of suspected child maltreatment. Because families may continue their relationships with their pediatricians after these reports, these primary care providers are in a unique position to recognize and manage the physical, developmental, academic, and emotional consequences of maltreatment and exposure to childhood adversity. Substantial information is available to optimize follow-up medical care of maltreated children. This new clinical report will provide guidance to pediatricians about how they can best oversee and foster the optimal physical health, growth, and development of children who have been maltreated and remain in the care of their biological family or are returned to their care by Child Protective Services agencies. The report describes the pediatrician's role in helping to strengthen families' and caregivers' capabilities and competencies and in promoting and maximizing high-quality services for their families in their community. Pediatricians should refer to other reports and policies from the American Academy of Pediatrics for more information about the emotional and behavioral consequences of child maltreatment and the treatment of these consequences. (3/19)
https://doi.org/10.1542/peds.2019-0284

OPHTHALMOLOGIC EXAMINATIONS IN CHILDREN WITH JUVENILE RHEUMATOID ARTHRITIS (CLINICAL REPORT)

James Cassidy, MD; Jane Kivlin, MD; Carol Lindsley, MD; James Nocton, MD; Section on Rheumatology; and Section on Ophthalmology

ABSTRACT. Unlike the joints, ocular involvement with juvenile rheumatoid arthritis is most often asymptomatic; yet, the inflammation can cause serious morbidity with loss of vision. Scheduled slit-lamp examinations by an ophthalmologist at specific intervals can detect ocular disease early, and prompt treatment can prevent vision loss. (5/06, reaffirmed 10/12, 7/18)
https://doi.org/10.1542/peds.2006-0421

OPTIMIZING BONE HEALTH IN CHILDREN AND ADOLESCENTS (CLINICAL REPORT)

Neville H. Golden, MD; Steven A. Abrams, MD; and Committee on Nutrition

ABSTRACT. The pediatrician plays a major role in helping optimize bone health in children and adolescents. This clinical report reviews normal bone acquisition in infants, children, and adolescents and discusses factors affecting bone health in this age group. Previous recommended daily allowances for calcium and vitamin D are updated, and clinical guidance is provided regarding weight-bearing activities and recommendations for calcium and vitamin D intake and supplementation. Routine calcium supplementation is not recommended for healthy children and adolescents, but increased dietary intake to meet daily requirements is encouraged. The American Academy of Pediatrics endorses the higher recommended dietary allowances for vitamin D advised by the Institute of Medicine and supports testing for vitamin D deficiency in children and adolescents with conditions associated with increased bone fragility. Universal screening for vitamin D deficiency is not routinely recommended in healthy children or in children with dark skin or obesity because there is insufficient evidence of the cost–benefit of such a practice in reducing fracture risk. The preferred test to assess bone health is dual-energy x-ray absorptiometry, but caution is advised when interpreting results in children and adolescents who may not yet have achieved peak bone mass. For analyses, *z* scores should be used instead of T scores, and corrections should be made for size. Office-based strategies for the pediatrician to optimize bone health are provided. This clinical report has been endorsed by American Bone Health. (9/14)
https://doi.org/10.1542/peds.2014-2173

OPTIMIZING RESOURCES IN CHILDREN'S SURGICAL CARE: AN UPDATE ON THE AMERICAN COLLEGE OF SURGEONS' VERIFICATION PROGRAM (TECHNICAL REPORT)

Kasper S. Wang, MD, FAAP; James Cummings, MD, FAAP; Ann Stark, MD, FAAP; Constance Houck, MD, MPH, FAAP; Keith Oldham, MD, FAAP; Catherine Grant, BSN, RN; Mary Fallat, MD, FAAP; Section on Surgery; Committee on Fetus and Newborn; and Section on Anesthesiology and Pain Medicine

ABSTRACT. Surgical procedures are performed in the United States in a wide variety of clinical settings and with variation in clinical outcomes. In May 2012, the Task Force for Children's Surgical Care, an ad hoc multidisciplinary group comprising physicians representing specialties relevant to pediatric perioperative care, was convened to generate recommendations to optimize the delivery of children's surgical care. This group generated a white paper detailing the consensus opinions of the involved experts. Following these initial recommendations, the American College of Surgeons (ACS), Children's Hospital Association, and Task Force for Children's Surgical Care, with input from all related perioperative specialties, developed and published specific and detailed resource and quality standards designed to improve children's surgical care (https://www.facs.org/quality-programs/childrens-surgery/childrens-surgery-verification). In 2015, with the endorsement of the American Academy of Pediatrics (https://pediatrics.aappublications.org/content/135/6/e1538), the ACS established a pilot verification program. In January 2017, after completion of the pilot program, the ACS Children's Surgery Verification Quality Improvement Program was officially launched. Verified sites are listed on the program Web site at https://www.facs.org/quality-programs/childrens-surgery/childrens-surgery-verification/centers, and more than 150 are interested in verification. This report provides an update on the ACS Children's Surgery Verification Quality Improvement Program as it continues to evolve. (4/20)
https://doi.org/10.1542/peds.2020-0708

OPTIONS COUNSELING FOR THE PREGNANT ADOLESCENT PATIENT

Laurie L. Hornberger, MD, MPH, FAAP, and Committee on Adolescence

ABSTRACT. Each year, more than 500 000 girls and young women younger than 20 years become pregnant. It is important for pediatricians to have the ability and the resources in their offices to make a timely pregnancy diagnosis in their adolescent patients and provide them with nonjudgmental pregnancy options counseling. Counseling includes an unbiased discussion of the adolescent's legal options to either continue or terminate her pregnancy, supporting the adolescent in the decision-making process, and referring the adolescent to appropriate resources and services. Pediatricians who choose not to provide such discussions should promptly refer pregnant adolescent patients to a health care professional who will offer developmentally appropriate pregnancy options counseling. This approach to pregnancy options counseling has not changed since the original 1989 American Academy of Pediatrics statement on this issue. (8/17)

https://doi.org/10.1542/peds.2017-2274

ORAL AND DENTAL ASPECTS OF CHILD ABUSE AND NEGLECT (CLINICAL REPORT)

Susan A. Fisher-Owens, MD, MPH, FAAP; James L. Lukefahr, MD, FAAP; Anupama Rao Tate, DMD, MPH; Section on Oral Health; and Committee on Child Abuse and Neglect (joint with American Academy of Pediatric Dentistry Council on Clinical Affairs, Council on Scientific Affairs, and Ad Hoc Work Group on Child Abuse and Neglect)

ABSTRACT. In all 50 states, health care providers (including dentists) are mandated to report suspected cases of abuse and neglect to social service or law enforcement agencies. The purpose of this report is to review the oral and dental aspects of physical and sexual abuse and dental neglect in children and the role of pediatric care providers and dental providers in evaluating such conditions. This report addresses the evaluation of bite marks as well as perioral and intraoral injuries, infections, and diseases that may raise suspicion for child abuse or neglect. Oral health issues can also be associated with bullying and are commonly seen in human trafficking victims. Some medical providers may receive less education pertaining to oral health and dental injury and disease and may not detect the mouth and gum findings that are related to abuse or neglect as readily as they detect those involving other areas of the body. Therefore, pediatric care providers and dental providers are encouraged to collaborate to increase the prevention, detection, and treatment of these conditions in children. (7/17)

https://doi.org/10.1542/peds.2017-1487

ORAL HEALTH CARE FOR CHILDREN WITH DEVELOPMENTAL DISABILITIES (CLINICAL REPORT)

Kenneth W. Norwood Jr, MD; Rebecca L. Slayton, DDS, PhD; Council on Children With Disabilities; and Section on Oral Health

ABSTRACT. Children with developmental disabilities often have unmet complex health care needs as well as significant physical and cognitive limitations. Children with more severe conditions and from low-income families are particularly at risk with high dental needs and poor access to care. In addition, children with developmental disabilities are living longer, requiring continued oral health care. This clinical report describes the effect that poor oral health has on children with developmental disabilities as well as the importance of partnerships between the pediatric medical and dental homes. Basic knowledge of the oral health risk factors affecting children with developmental disabilities is provided. Pediatricians may use the report to guide their incorporation of oral health assessments and education into their well-child examinations for children with developmental disabilities. This report has medical, legal, educational, and operational implications for practicing pediatricians. (2/13, reaffirmed 6/18)

https://doi.org/10.1542/peds.2012-3650

ORGANIC FOODS: HEALTH AND ENVIRONMENTAL ADVANTAGES AND DISADVANTAGES (CLINICAL REPORT)

Joel Forman, MD; Janet Silverstein, MD; Committee on Nutrition; and Council on Environmental Health

ABSTRACT. The US market for organic foods has grown from $3.5 billion in 1996 to $28.6 billion in 2010, according to the Organic Trade Association. Organic products are now sold in specialty stores and conventional supermarkets. Organic products contain numerous marketing claims and terms, only some of which are standardized and regulated.

In terms of health advantages, organic diets have been convincingly demonstrated to expose consumers to fewer pesticides associated with human disease. Organic farming has been demonstrated to have less environmental impact than conventional approaches. However, current evidence does not support any meaningful nutritional benefits or deficits from eating organic compared with conventionally grown foods, and there are no well-powered human studies that directly demonstrate health benefits or disease protection as a result of consuming an organic diet. Studies also have not demonstrated any detrimental or disease-promoting effects from an organic diet. Although organic foods regularly command a significant price premium, well-designed farming studies demonstrate that costs can be competitive and yields comparable to those of conventional farming techniques. Pediatricians should incorporate this evidence when discussing the health and environmental impact of organic foods and organic farming while continuing to encourage all patients and their families to attain optimal nutrition and dietary variety consistent with the US Department of Agriculture's MyPlate recommendations.

This clinical report reviews the health and environmental issues related to organic food production and consumption. It defines the term "organic," reviews organic food-labeling standards, describes organic and conventional farming practices, and explores the cost and environmental implications of organic production techniques. It examines the evidence available on nutritional quality and production contaminants in conventionally produced and organic foods. Finally, this report provides guidance for pediatricians to assist them in advising their patients regarding organic and conventionally produced food choices. (10/12)

https://doi.org/10.1542/peds.2012-2579

ORGANIZED SPORTS FOR CHILDREN, PREADOLESCENTS, AND ADOLESCENTS (CLINICAL REPORT)

Kelsey Logan, MD, MPH, FAAP; Steven Cuff, MD, FAAP; and Council on Sports Medicine and Fitness

ABSTRACT. Interest and participation in organized sports for children, preadolescents, and adolescents continue to grow. Because of increased participation, and younger entry age, in organized sports, appropriate practice, game schedules, and content become more important, taking into account athlete developmental stage and skills. Parental support for organized sports in general, with focus on development and fun instead of winning, has emerged as a key factor in the athlete's enjoyment of sports. Schools and community sports organizations who support multiple levels of sport (eg, recreational, competitive, elite) can include more youth who want to play sports and combat sport dropout. This report reviews the benefits and risks of organized sports as well as the roles of schools, community organizations, parents, and coaches in organized sports. It is designed to complement the American Academy of Pediatrics clinical reports "Physical Activity Assessment and Counseling

in Pediatric Clinical Settings" and "Sports Specialization and Intensive Training in Young Athletes" by reviewing relevant literature on healthy organized sports for youth and providing guidance on organized sport readiness and entry. The report also provides guidance for pediatricians on counseling parents and advocating for healthy organized sports participation. (5/19)
https://doi.org/10.1542/peds.2019-0997

OUT-OF-HOME PLACEMENT FOR CHILDREN AND ADOLESCENTS WITH DISABILITIES (CLINICAL REPORT)

Sandra L. Friedman, MD, MPH, FAAP; Miriam A. Kalichman, MD, FAAP; and Council on Children With Disabilities

ABSTRACT. The vast majority of children and youth with chronic and complex health conditions who also have intellectual and developmental disabilities are cared for in their homes. Social, legal, policy, and medical changes through the years have allowed for an increase in needed support within the community. However, there continues to be a relatively small group of children who live in various types of congregate care settings. This clinical report describes these settings and the care and services that are provided in them. The report also discusses reasons families choose out-of-home placement for their children, barriers to placement, and potential effects of this decision on family members. We examine the pediatrician's role in caring for children with severe intellectual and developmental disabilities and complex medical problems in the context of responding to parental inquiries about out-of-home placement and understanding factors affecting these types of decisions. Common medical problems and care issues for children residing outside the family home are reviewed. Variations in state and federal regulations, challenges in understanding local systems, and access to services are also discussed. (9/14, reaffirmed 2/19)
https://doi.org/10.1542/peds.2014-2279

OUT-OF-HOME PLACEMENT FOR CHILDREN AND ADOLESCENTS WITH DISABILITIES—ADDENDUM: CARE OPTIONS FOR CHILDREN AND ADOLESCENTS WITH DISABILITIES AND MEDICAL COMPLEXITY (CLINICAL REPORT)

Sandra L. Friedman, MD, MPH, FAAP; Kenneth W. Norwood Jr, MD, FAAP; and Council on Children With Disabilities

ABSTRACT. Children and adolescents with significant intellectual and developmental disabilities and complex medical problems require safe and comprehensive care to meet their medical and psychosocial needs. Ideally, such children and youth should be cared for by their families in their home environments. When this type of arrangement is not possible, there should be exploration of appropriate, alternative noncongregate community-based settings, especially alternative family homes. Government funding sources exist to support care in the community, although there is variability among states with regard to the availability of community programs and resources. It is important that families are supported in learning about options of care. Pediatricians can serve as advocates for their patients and their families to access community-based services and to increase the availability of resources to ensure that the option to live in a family home is available to all children with complex medical needs. (11/16, reaffirmed 2/19)
https://doi.org/10.1542/peds.2016-3216

OUT-OF-SCHOOL SUSPENSION AND EXPULSION

Council on School Health

ABSTRACT. The primary mission of any school system is to educate students. To achieve this goal, the school district must maintain a culture and environment where all students feel safe, nurtured, and valued and where order and civility are expected standards of behavior. Schools cannot allow unacceptable behavior to interfere with the school district's primary mission. To this end, school districts adopt codes of conduct for expected behaviors and policies to address unacceptable behavior. In developing these policies, school boards must weigh the severity of the offense and the consequences of the punishment and the balance between individual and institutional rights and responsibilities. Out-of-school suspension and expulsion are the most severe consequences that a school district can impose for unacceptable behavior. Traditionally, these consequences have been reserved for offenses deemed especially severe or dangerous and/or for recalcitrant offenders. However, the implications and consequences of out-of-school suspension and expulsion and "zero-tolerance" are of such severity that their application and appropriateness for a developing child require periodic review. The indications and effectiveness of exclusionary discipline policies that demand automatic or rigorous application are increasingly questionable. The impact of these policies on offenders, other children, school districts, and communities is broad. Periodic scrutiny of policies should be placed not only on the need for a better understanding of the educational, emotional, and social impact of out-of-school suspension and expulsion on the individual student but also on the greater societal costs of such rigid policies. Pediatricians should be prepared to assist students and families affected by out-of-school suspension and expulsion and should be willing to guide school districts in their communities to find more effective and appropriate alternatives to exclusionary discipline policies for the developing child. A discussion of preventive strategies and alternatives to out-of-school suspension and expulsion, as well as recommendations for the role of the physician in matters of out-of-school suspension and expulsion are included. School-wide positive behavior support/positive behavior intervention and support is discussed as an effective alternative. (2/13)
https://doi.org/10.1542/peds.2012-3932

OVERCROWDING CRISIS IN OUR NATION'S EMERGENCY DEPARTMENTS: IS OUR SAFETY NET UNRAVELING?

Committee on Pediatric Emergency Medicine

ABSTRACT. Emergency departments (EDs) are a vital component in our health care safety net, available 24 hours a day, 7 days a week, for all who require care. There has been a steady increase in the volume and acuity of patient visits to EDs, now with well over 100 million Americans (30 million children) receiving emergency care annually. This rise in ED utilization has effectively saturated the capacity of EDs and emergency medical services in many communities. The resulting phenomenon, commonly referred to as ED overcrowding, now threatens access to emergency services for those who need them the most. As managers of the pediatric medical home and advocates for children and optimal pediatric health care, there is a very important role for pediatricians and the American Academy of Pediatrics in guiding health policy decision-makers toward effective solutions that promote the medical home and timely access to emergency care. (9/04, reaffirmed 5/07, 6/11, 7/16)
https://doi.org/10.1542/peds.2004-1287

OVERUSE INJURIES, OVERTRAINING, AND BURNOUT IN CHILD AND ADOLESCENT ATHLETES (CLINICAL REPORT)

Joel S. Brenner, MD, MPH, and Council on Sports Medicine and Fitness

ABSTRACT. Overuse is one of the most common etiologic factors that lead to injuries in the pediatric and adolescent athlete. As more children are becoming involved in organized and recreational athletics, the incidence of overuse injuries is increasing. Many children are participating in sports year-round and sometimes on multiple teams simultaneously. This overtraining can lead to burnout, which may have a detrimental effect on the child participating in sports as a lifelong healthy activity. One contributing factor to overtraining may be parental pressure to

compete and succeed. The purpose of this clinical report is to assist pediatricians in identifying and counseling at-risk children and their families. This report supports the American Academy of Pediatrics policy statement on intensive training and sport specialization. (6/07, reaffirmed 3/11, 6/14, 2/21)
https://doi.org/10.1542/peds.2007-0887

OXYGEN TARGETING IN EXTREMELY LOW BIRTH WEIGHT INFANTS (CLINICAL REPORT)

James J. Cummings, MD, FAAP; Richard A. Polin, MD, FAAP; and Committee on Fetus and Newborn

ABSTRACT. The use of supplemental oxygen plays a vital role in the care of the critically ill preterm infant, but the unrestricted use of oxygen can lead to unintended harms, such as chronic lung disease and retinopathy of prematurity. An overly restricted use of supplemental oxygen may have adverse effects as well. Ideally, continuous monitoring of tissue and cellular oxygen delivery would allow clinicians to better titrate the use of supplemental oxygen, but such monitoring is not currently feasible in the clinical setting. The introduction of pulse oximetry has greatly aided the clinician by providing a relatively easy and continuous estimate of arterial oxygen saturation, but pulse oximetry has several practical, technical, and physiologic limitations. Recent randomized clinical trials comparing different pulse oximetry targets have been conducted to better inform the practice of supplemental oxygen use. This clinical report discusses the benefits and limitations of pulse oximetry for assessing oxygenation, summarizes randomized clinical trials of oxygen saturation targeting, and addresses implications for practice. (7/16)
https://doi.org/10.1542/peds.2016-1576

PAIN ASSESSMENT AND TREATMENT IN CHILDREN WITH SIGNIFICANT IMPAIRMENT OF THE CENTRAL NERVOUS SYSTEM (CLINICAL REPORT)

Julie Hauer, MD, FAAP; Amy J. Houtrow, MD, PhD, MPH, FAAP; Section on Hospice and Palliative Medicine; and Council on Children With Disabilities

ABSTRACT. Pain is a frequent and significant problem for children with impairment of the central nervous system, with the highest frequency and severity occurring in children with the greatest impairment. Despite the significance of the problem, this population remains vulnerable to underrecognition and undertreatment of pain. Barriers to treatment may include uncertainty in identifying pain along with limited experience and fear with the use of medications for pain treatment. Behavioral pain-assessment tools are reviewed in this clinical report, along with other strategies for monitoring pain after an intervention. Sources of pain in this population include acute-onset pain attributable to tissue injury or inflammation resulting in nociceptive pain, with pain then expected to resolve after treatment directed at the source. Other sources can result in chronic intermittent pain that, for many, occurs on a weekly to daily basis, commonly attributed to gastroesophageal reflux, spasticity, and hip subluxation. Most challenging are pain sources attributable to the impaired central nervous system, requiring empirical medication trials directed at causes that cannot be identified by diagnostic tests, such as central neuropathic pain. Interventions reviewed include integrative therapies and medications, such as gabapentinoids, tricyclic antidepressants, α-agonists, and opioids. This clinical report aims to address, with evidence-based guidance, the inherent challenges with the goal to improve comfort throughout life in this vulnerable group of children. (5/17)
https://doi.org/10.1542/peds.2017-1002

PARENTAL LEAVE FOR RESIDENTS AND PEDIATRIC TRAINING PROGRAMS

Section on Medical Students, Residents, and Fellowship Trainees and Committee on Early Childhood

ABSTRACT. The American Academy of Pediatrics (AAP) is committed to the development of rational, equitable, and effective parental leave policies that are sensitive to the needs of pediatric residents, families, and developing infants and that enable parents to spend adequate and good-quality time with their young children. It is important for each residency program to have a policy for parental leave that is written, that is accessible to residents, and that clearly delineates program practices regarding parental leave. At a minimum, a parental leave policy for residents and fellows should conform legally with the Family Medical Leave Act as well as with respective state laws and should meet institutional requirements of the Accreditation Council for Graduate Medical Education for accredited programs. Policies should be well formulated and communicated in a culturally sensitive manner. The AAP advocates for extension of benefits consistent with the Family Medical Leave Act to all residents and interns beginning at the time that pediatric residency training begins. The AAP recommends that regardless of gender, residents who become parents should be guaranteed 6 to 8 weeks, at a minimum, of parental leave with pay after the infant's birth. In addition, in conformance with federal law, the resident should be allowed to extend the leave time when necessary by using paid vacation time or leave without pay. Coparenting, adopting, or fostering of a child should entitle the resident, regardless of gender, to the same amount of paid leave (6–8 weeks) as a person who takes maternity/paternity leave. Flexibility, creativity, and advanced planning are necessary to arrange schedules that optimize resident education and experience, cultivate equity in sharing workloads, and protect pregnant residents from overly strenuous work experiences at critical times of their pregnancies. (1/13, reaffirmed 4/19)
https://doi.org/10.1542/peds.2012-3542

PARENTAL PRESENCE DURING TREATMENT OF EBOLA OR OTHER HIGHLY CONSEQUENTIAL INFECTION (CLINICAL REPORT)

H. Dele Davies, MD, MS, MHCM, FAAP; Carrie L. Byington, MD, FAAP; and Committee on Infectious Diseases

ABSTRACT. This clinical report offers guidance to health care providers and hospitals on options to consider regarding parental presence at the bedside while caring for a child with suspected or proven Ebola virus disease (Ebola) or other highly consequential infection. Options are presented to help meet the needs of the patient and the family while also posing the least risk to providers and health care organizations. The optimal way to minimize risk is to limit contact between the person under investigation or treatment and family members/caregivers whenever possible while working to meet the emotional support needs of both patient and family. At times, caregiver presence may be deemed to be in the best interest of the patient, and in such situations, a strong effort should be made to limit potential risks of exposure to the caregiver, health care providers, and the community. The decision to allow parental/caregiver presence should be made in consultation with a team including an infectious diseases expert and state and/or local public health authorities and should involve consideration of many factors, depending on the stage of investigation and management, including (1) a careful history, physical examination, and investigations to elucidate the likelihood of the diagnosis of Ebola or other highly consequential infection; (2) ability of the facility to offer appropriate isolation for the person under investigation and family members and to manage Ebola; (3) ability to recognize and exclude people at increased risk of worse outcomes (eg, pregnant women); and

(4) ability of parent/caregiver to follow instructions, including appropriate donning and doffing of personal protective equipment. (8/16, reaffirmed 3/21)
https://doi.org/10.1542/peds.2016-1891

PARTICIPATION OF CHILDREN AND ADOLESCENTS IN LIVE CRISIS DRILLS AND EXERCISES

David J. Schonfeld, MD, FAAP; Marlene Melzer-Lange, MD, FAAP; Andrew N. Hashikawa, MD, MS, FAAP; Peter A. Gorski, MD, MPA, FAAP; Council on Children and Disasters; Council on Injury, Violence, and Poison Prevention; and Council on School Health

ABSTRACT. Children and adolescents should be included in exercises and drills to the extent that their involvement advances readiness to meet their unique needs in the event of a crisis and/or furthers their own preparedness or resiliency. However, there is also a need to be cautious about the potential psychological risks and other unintended consequences of directly involving children in live exercises and drills. These risks and consequences are especially a concern when children are deceived and led to believe there is an actual attack and not a drill and/or for high-intensity active shooter drills. High-intensity active shooter drills may involve the use of real weapons, gunfire or blanks, theatrical makeup to give a realistic image of blood or gunshot wounds, predatory and aggressive acting by the individual posing to be the shooter, or other means to simulate an actual attack, even when participants are aware that it is a drill. This policy statement outlines some of the considerations regarding the prevalent practice of live active shooter drills in schools, including the recommendations to eliminate children's involvement in high-intensity drills and exercises (with the possible exception of adolescent volunteers), prohibit deception in drills and exercises, and ensure appropriate accommodations during drills and exercises based on children's unique vulnerabilities. (8/20)
https://doi.org/10.1542/peds.2020-015503

PATENT DUCTUS ARTERIOSUS IN PRETERM INFANTS (CLINICAL REPORT)

William E. Benitz, MD, FAAP, and Committee on Fetus and Newborn

ABSTRACT. Despite a large body of basic science and clinical research and clinical experience with thousands of infants over nearly 6 decades, there is still uncertainty and controversy about the significance, evaluation, and management of patent ductus arteriosus in preterm infants, resulting in substantial heterogeneity in clinical practice. The purpose of this clinical report is to summarize the evidence available to guide evaluation and treatment of preterm infants with prolonged ductal patency in the first few weeks after birth. (12/15)
https://doi.org/10.1542/peds.2015-3730

PATIENT- AND FAMILY-CENTERED CARE AND THE PEDIATRICIAN'S ROLE

Committee on Hospital Care and Institute for Patient- and Family-Centered Care

ABSTRACT. Drawing on several decades of work with families, pediatricians, other health care professionals, and policy makers, the American Academy of Pediatrics provides a definition of patient- and family-centered care. In pediatrics, patient- and family-centered care is based on the understanding that the family is the child's primary source of strength and support. Further, this approach to care recognizes that the perspectives and information provided by families, children, and young adults are essential components of high-quality clinical decision-making, and that patients and family are integral partners with the health care team. This policy statement outlines the core principles of patient- and family-centered care, summarizes some of the recent literature linking patient- and family-centered care to improved health outcomes, and lists various other benefits to be expected when engaging in patient- and family-centered pediatric practice. The statement concludes with specific recommendations for how pediatricians can integrate patient- and family-centered care in hospitals, clinics, and community settings, and in broader systems of care, as well. (1/12, reaffirmed 2/18)
https://doi.org/10.1542/peds.2011-3084

PATIENT- AND FAMILY-CENTERED CARE AND THE ROLE OF THE EMERGENCY PHYSICIAN PROVIDING CARE TO A CHILD IN THE EMERGENCY DEPARTMENT

Committee on Pediatric Emergency Medicine (joint with American College of Emergency Physicians)

ABSTRACT. Patient- and family-centered care is an approach to health care that recognizes the role of the family in providing medical care; encourages collaboration between the patient, family, and health care professionals; and honors individual and family strengths, cultures, traditions, and expertise. Although there are many opportunities for providing patient- and family-centered care in the emergency department, there are also challenges to doing so. The American Academy of Pediatrics and the American College of Emergency Physicians support promoting patient dignity, comfort, and autonomy; recognizing the patient and family as key decision-makers in the patient's medical care; recognizing the patient's experience and perspective in a culturally sensitive manner; acknowledging the interdependence of child and parent as well as the pediatric patient's evolving independence; encouraging family-member presence; providing information to the family during interventions; encouraging collaboration with other health care professionals; acknowledging the importance of the patient's medical home; and encouraging institutional policies for patient- and family-centered care. (11/06, reaffirmed 6/09, 10/11, 9/15, 10/19)
https://doi.org/10.1542/peds.2006-2588

PATIENT- AND FAMILY-CENTERED CARE COORDINATION: A FRAMEWORK FOR INTEGRATING CARE FOR CHILDREN AND YOUTH ACROSS MULTIPLE SYSTEMS

Council on Children With Disabilities and Medical Home Implementation Project Advisory Committee

ABSTRACT. Understanding a care coordination framework, its functions, and its effects on children and families is critical for patients and families themselves, as well as for pediatricians, pediatric medical subspecialists/surgical specialists, and anyone providing services to children and families. Care coordination is an essential element of a transformed American health care delivery system that emphasizes optimal quality and cost outcomes, addresses family-centered care, and calls for partnership across various settings and communities. High-quality, cost-effective health care requires that the delivery system include elements for the provision of services supporting the coordination of care across settings and professionals. This requirement of supporting coordination of care is generally true for health systems providing care for all children and youth but especially for those with special health care needs. At the foundation of an efficient and effective system of care delivery is the patient-/family-centered medical home. From its inception, the medical home has had care coordination as a core element. In general, optimal outcomes for children and youth, especially those with special health care needs, require interfacing among multiple care systems and individuals, including the following: medical, social, and behavioral professionals; the educational system; payers; medical equipment providers; home care agencies; advocacy groups; needed supportive therapies/services; and families. Coordination of care across settings permits an integration of services that is centered on the comprehensive needs of

the patient and family, leading to decreased health care costs, reduction in fragmented care, and improvement in the patient/family experience of care. (4/14, reaffirmed 4/18)
https://doi.org/10.1542/peds.2014-0318

PATIENT- AND FAMILY-CENTERED CARE OF CHILDREN IN THE EMERGENCY DEPARTMENT (TECHNICAL REPORT)

Nanette Dudley, MD, FAAP; Alice Ackerman, MD, MBA, FAAP; Kathleen M. Brown, MD, FACEP; Sally K. Snow, BSN, RN, CPEN, FAEN; and Committee on Pediatric Emergency Medicine (joint with American College of Emergency Physicians Pediatric Emergency Medicine Committee and Emergency Nurses Association Pediatric Committee)

ABSTRACT. Patient- and family-centered care is an approach to the planning, delivery, and evaluation of health care that is grounded in a mutually beneficial partnership among patients, families, and health care professionals. Providing patient- and family-centered care to children in the emergency department setting presents many opportunities and challenges. This revised technical report draws on previously published policy statements and reports, reviews the current literature, and describes the present state of practice and research regarding patient- and family-centered care for children in the emergency department setting as well as some of the complexities of providing such care. (12/14, reaffirmed 10/19)
https://doi.org/10.1542/peds.2014-3424

PATIENT SAFETY IN THE PEDIATRIC EMERGENCY CARE SETTING

Committee on Pediatric Emergency Medicine

ABSTRACT. Patient safety is a priority for all health care professionals, including those who work in emergency care. Unique aspects of pediatric care may increase the risk of medical error and harm to patients, especially in the emergency care setting. Although errors can happen despite the best human efforts, given the right set of circumstances, health care professionals must work proactively to improve safety in the pediatric emergency care system. Specific recommendations to improve pediatric patient safety in the emergency department are provided in this policy statement. (12/07, reaffirmed 6/11, 7/14, 8/18)
https://doi.org/10.1542/peds.2007-2902

PEDESTRIAN SAFETY

Committee on Injury, Violence, and Poison Prevention

ABSTRACT. Each year, approximately 900 pediatric pedestrians younger than 19 years are killed. In addition, 51000 children are injured as pedestrians, and 5300 of them are hospitalized because of their injuries. Parents should be warned that young children often do not have the cognitive, perceptual, and behavioral abilities to negotiate traffic independently. Parents should also be informed about the danger of vehicle back-over injuries to toddlers playing in driveways. Because posttraumatic stress syndrome commonly follows even minor pedestrian injury, pediatricians should screen and refer for this condition as necessary. The American Academy of Pediatrics supports community- and school-based strategies that minimize a child's exposure to traffic, especially to high-speed, high-volume traffic. Furthermore, the American Academy of Pediatrics supports governmental and industry action that would lead to improvements in vehicle design, driver manuals, driver education, and data collection for the purpose of reducing pediatric pedestrian injury. (7/09, reaffirmed 8/13, 5/19)
https://doi.org/10.1542/peds.2009-1143

PEDIATRIC AND ADOLESCENT MENTAL HEALTH EMERGENCIES IN THE EMERGENCY MEDICAL SERVICES SYSTEM (TECHNICAL REPORT)

Margaret A. Dolan, MD; Joel A. Fein, MD, MPH; and Committee on Pediatric Emergency Medicine

ABSTRACT. Emergency department (ED) health care professionals often care for patients with previously diagnosed psychiatric illnesses who are ill, injured, or having a behavioral crisis. In addition, ED personnel encounter children with psychiatric illnesses who may not present to the ED with overt mental health symptoms. Staff education and training regarding identification and management of pediatric mental health illness can help EDs overcome the perceived limitations of the setting that influence timely and comprehensive evaluation. In addition, ED physicians can inform and advocate for policy changes at local, state, and national levels that are needed to ensure comprehensive care of children with mental health illnesses. This report addresses the roles that the ED and ED health care professionals play in emergency mental health care of children and adolescents in the United States, which includes the stabilization and management of patients in mental health crisis, the discovery of mental illnesses and suicidal ideation in ED patients, and approaches to advocating for improved recognition and treatment of mental illnesses in children. The report also addresses special issues related to mental illness in the ED, such as minority populations, children with special health care needs, and children's mental health during and after disasters and trauma. (4/11, reaffirmed 7/14, 4/20)
https://doi.org/10.1542/peds.2011-0522

PEDIATRIC ANTHRAX CLINICAL MANAGEMENT (CLINICAL REPORT)

John S. Bradley, MD, FAAP, FIDSA, FPIDS; Georgina Peacock, MD, MPH, FAAP; Steven E. Krug, MD, FAAP; William A. Bower, MD, FIDSA; Amanda C. Cohn, MD; Dana Meaney-Delman, MD, MPH, FACOG; Andrew T. Pavia, MD, FAAP, FIDSA; Committee on Infectious Diseases; and Disaster Preparedness Advisory Council

ABSTRACT. Anthrax is a zoonotic disease caused by *Bacillus anthracis,* which has multiple routes of infection in humans, manifesting in different initial presentations of disease. Because *B anthracis* has the potential to be used as a biological weapon and can rapidly progress to systemic anthrax with high mortality in those who are exposed and untreated, clinical guidance that can be quickly implemented must be in place before any intentional release of the agent. This document provides clinical guidance for the prophylaxis and treatment of neonates, infants, children, adolescents, and young adults up to the age of 21 (referred to as "children") in the event of a deliberate *B anthracis* release and offers guidance in areas where the unique characteristics of children dictate a different clinical recommendation from adults. (4/14)
https://doi.org/10.1542/peds.2014-0563

PEDIATRIC ANTHRAX CLINICAL MANAGEMENT: EXECUTIVE SUMMARY

John S. Bradley, MD, FAAP, FIDSA, FPIDS; Georgina Peacock, MD, MPH, FAAP; Steven E. Krug, MD, FAAP; William A. Bower, MD, FIDSA; Amanda C. Cohn, MD; Dana Meaney-Delman, MD, MPH, FACOG; Andrew T. Pavia, MD, FAAP, FIDSA; Committee on Infectious Diseases; and Disaster Preparedness Advisory Council

ABSTRACT. The use of *Bacillus anthracis* as a biological weapon is considered a potential national security threat by the US government. *B anthracis* has the ability to be used as a biological weapon and to cause anthrax, which can rapidly progress to systemic disease with high mortality in those who are untreated. Therefore, clear plans for managing children after a *B anthracis*

bioterror exposure event must be in place before any intentional release of the agent. This document provides a summary of the guidance contained in the clinical report (appendices cited in this executive summary refer to those in the clinical report) for diagnosis and management of anthrax, including antimicrobial treatment and postexposure prophylaxis (PEP), use of antitoxin, and recommendations for use of anthrax vaccine in neonates, infants, children, adolescents, and young adults up to the age of 21 years (referred to as "children"). (4/14)
https://doi.org/10.1542/peds.2014-0564

PEDIATRIC APPLICATION OF CODING AND VALUATION SYSTEMS

David M. Kanter, MD, MBA, FAAP; Richard Lander, MD, FAAP, CIC; Richard A. Molteni, MD, FAAP; Committee on Coding and Nomenclature; and Private Payer Advocacy Advisory Committee

ABSTRACT. The American Academy of Pediatrics provides this revised policy statement to address health care changes that impact procedural and visit coding and valuation as well as the incorporation of coding principles into innovative, newer payment models. This policy statement focuses solely on recommendations, and an accompanying technical report provides supplemental coding and valuation background. (9/19)
https://doi.org/10.1542/peds.2019-2496

PEDIATRIC APPLICATION OF CODING AND VALUATION SYSTEMS (TECHNICAL REPORT)

David M. Kanter, MD, MBA, FAAP; Richard A. Molteni, MD, FAAP; and Committee on Coding and Nomenclature

ABSTRACT. The American Academy of Pediatrics provides this technical report as supplemental background to the accompanying coding and valuation system policy statement. The rapid evolution in health care payment modeling requires that clinicians have a current appreciation of the mechanics of service representation and valuation. The accompanying policy statement provides recommendations relevant to this area, and this technical report provides a format to outline important concepts that allow for effective translation of bedside clinical events into physician payment. (9/19)
https://doi.org/10.1542/peds.2019-2498

PEDIATRIC ASPECTS OF INPATIENT HEALTH INFORMATION TECHNOLOGY SYSTEMS (TECHNICAL REPORT)

Christoph U. Lehmann, MD, FAAP, FACMI, and Council on Clinical Information Technology

ABSTRACT. In the past 3 years, the Health Information Technology for Economic and Clinical Health Act accelerated the adoption of electronic health records (EHRs) with providers and hospitals, who can claim incentive monies related to meaningful use. Despite the increase in adoption of commercial EHRs in pediatric settings, there has been little support for EHR tools and functionalities that promote pediatric quality improvement and patient safety, and children remain at higher risk than adults for medical errors in inpatient environments. Health information technology (HIT) tailored to the needs of pediatric health care providers can improve care by reducing the likelihood of errors through information assurance and minimizing the harm that results from errors. This technical report outlines pediatric-specific concepts, child health needs and their data elements, and required functionalities in inpatient clinical information systems that may be missing in adult-oriented HIT systems with negative consequences for pediatric inpatient care. It is imperative that inpatient (and outpatient) HIT systems be adapted to improve their ability to properly support safe health care delivery for children. (2/15)
https://doi.org/10.1542/peds.2014-4148

PEDIATRIC CONSIDERATIONS BEFORE, DURING, AND AFTER RADIOLOGICAL OR NUCLEAR EMERGENCIES

Jerome A. Paulson, MD, FAAP, and Council on Environmental Health

ABSTRACT. Infants, children, and adolescents can be exposed unexpectedly to ionizing radiation from nuclear power plant events, improvised nuclear or radiologic dispersal device explosions, or inappropriate disposal of radiotherapy equipment. Children are likely to experience higher external and internal radiation exposure levels than adults because of their smaller body and organ size and other physiologic characteristics, by picking up contaminated items, and through consumption of contaminated milk or foodstuffs. This policy statement and accompanying technical report update the 2003 American Academy of Pediatrics policy statement on pediatric radiation emergencies by summarizing newer scientific knowledge from studies of the Chernobyl and Fukushima Daiichi nuclear power plant events, use of improvised radiologic dispersal devices, exposures from inappropriate disposal of radiotherapy equipment, and potential health effects from residential proximity to nuclear plants. Policy recommendations are made for providers and governments to improve future responses to these types of events. (11/18)
https://doi.org/10.1542/peds.2018-3000

PEDIATRIC CONSIDERATIONS BEFORE, DURING, AND AFTER RADIOLOGICAL OR NUCLEAR EMERGENCIES (TECHNICAL REPORT)

Martha S. Linet, MD, MPH; Ziad Kazzi, MD; Jerome A. Paulson, MD, FAAP; and Council on Environmental Health

ABSTRACT. Infants, children, and adolescents can be exposed unexpectedly to ionizing radiation from nuclear power plant events, improvised nuclear or radiologic dispersal device explosions, or inappropriate disposal of radiotherapy equipment. Children are likely to experience higher external and internal radiation exposure levels than adults because of their smaller body and organ size and other physiologic characteristics as well as their tendency to pick up contaminated items and consume contaminated milk or foodstuffs. This technical report accompanies the revision of the 2003 American Academy of Pediatrics policy statement on pediatric radiation emergencies by summarizing newer scientific data from studies of the Chernobyl and the Fukushima Daiichi nuclear power plant events, use of improvised radiologic dispersal devices, exposures from inappropriate disposal of radiotherapy equipment, and potential health effects from residential proximity to nuclear plants. Also included are recommendations from epidemiological studies and biokinetic models to address mitigation efforts. The report includes major emphases on acute radiation syndrome, acute and long-term psychological effects, cancer risks, and other late tissue reactions after low-to-high levels of radiation exposure. Results, along with public health and clinical implications, are described from studies of the Japanese atomic bomb survivors, nuclear plant accidents (eg, Three Mile Island, Chernobyl, and Fukushima), improper disposal of radiotherapy equipment in Goiania, Brazil, and residence in proximity to nuclear plants. Measures to reduce radiation exposure in the immediate aftermath of a radiologic or nuclear disaster are described, including the diagnosis and management of external and internal contamination, use of potassium iodide, and actions in relation to breastfeeding. (11/18)
https://doi.org/10.1542/peds.2018-3001

PEDIATRIC INTEGRATIVE MEDICINE (CLINICAL REPORT)

Hilary McClafferty, MD, FAAP; Sunita Vohra, MD, FAAP; Michelle Bailey, MD, FAAP; Melanie Brown, MD, MSE, FAAP; Anna Esparham, MD, FAAP; Dana Gerstbacher, MD, FAAP; Brenda Golianu, MD, FAAP; Anna-Kaisa Niemi, MD, PhD, FAAP, FACMG; Erica Sibinga, MD, FAAP; Joy Weydert, MD, FAAP; Ann Ming Yeh, MD; and Section on Integrative Medicine

ABSTRACT. The American Academy of Pediatrics is dedicated to optimizing the well-being of children and advancing family-centered health care. Related to this mission, the American Academy of Pediatrics recognizes the increasing use of complementary and integrative therapies for children and the subsequent need to provide reliable information and high-quality clinical resources to support pediatricians. This Clinical Report serves as an update to the original 2008 statement on complementary medicine. The range of complementary therapies is both extensive and diverse. Therefore, in-depth discussion of each therapy or product is beyond the scope of this report. Instead, our intentions are to define terms; describe epidemiology of use; outline common types of complementary therapies; review medicolegal, ethical, and research implications; review education and training for select providers of complementary therapies; provide educational resources; and suggest communication strategies for discussing complementary therapies with patients and families. (8/17)

https://doi.org/10.1542/peds.2017-1961

PEDIATRIC MEDICATION SAFETY IN THE EMERGENCY DEPARTMENT

Lee Benjamin, MD, FAAP, FACEP; Karen Frush, MD, FAAP; Kathy Shaw, MD, MSCE, FAAP; Joan E. Shook, MD, MBA, FAAP; Sally K. Snow, BSN, RN, CPEN, FAEN; and Committee on Pediatric Emergency Medicine (joint with American College of Emergency Physicians Pediatric Emergency Medicine Committee and Emergency Nurses Association Pediatric Emergency Medicine Committee)

ABSTRACT. Pediatric patients cared for in emergency departments (EDs) are at high risk of medication errors for a variety of reasons. A multidisciplinary panel was convened by the Emergency Medical Services for Children program and the American Academy of Pediatrics Committee on Pediatric Emergency Medicine to initiate a discussion on medication safety in the ED. Top opportunities identified to improve medication safety include using kilogram-only weight-based dosing, optimizing computerized physician order entry by using clinical decision support, developing a standard formulary for pediatric patients while limiting variability of medication concentrations, using pharmacist support within EDs, enhancing training of medical professionals, systematizing the dispensing and administration of medications within the ED, and addressing challenges for home medication administration before discharge. (2/18)

https://doi.org/10.1542/peds.2017-4066

PEDIATRIC MENTAL HEALTH EMERGENCIES IN THE EMERGENCY MEDICAL SERVICES SYSTEM

Committee on Pediatric Emergency Medicine (joint with American College of Emergency Physicians)

ABSTRACT. Emergency departments are vital in the management of pediatric patients with mental health emergencies. Pediatric mental health emergencies are an increasing part of emergency medical practice because emergency departments have become the safety net for a fragmented mental health infrastructure that is experiencing critical shortages in services in all sectors. Emergency departments must safely, humanely, and in a culturally and developmentally appropriate manner manage pediatric patients with undiagnosed and known mental illnesses, including those with mental retardation, autistic spectrum disorders, and attention-deficit/hyperactivity disorder and those experiencing a behavioral crisis. Emergency departments also manage patients with suicidal ideation, depression, escalating aggression, substance abuse, posttraumatic stress disorder, and maltreatment and those exposed to violence and unexpected deaths. Emergency departments must address not only the physical but also the mental health needs of patients during and after mass-casualty incidents and disasters. The American Academy of Pediatrics and the American College of Emergency Physicians support advocacy for increased mental health resources, including improved pediatric mental health tools for the emergency department, increased mental health insurance coverage, and adequate reimbursement at all levels; acknowledgment of the importance of the child's medical home; and promotion of education and research for mental health emergencies. (10/06, reaffirmed 6/09, 4/13, 4/20)

https://doi.org/10.1542/peds.2006-1925

PEDIATRIC METABOLIC AND BARIATRIC SURGERY: EVIDENCE, BARRIERS, AND BEST PRACTICES

Sarah C. Armstrong, MD, FAAP; Christopher F. Bolling, MD, FAAP; Marc P. Michalsky, MD, FACS, FAAP, FASMBS; Kirk W. Reichard, MD, MBA, FAAP, FACS; Section on Obesity; and Section on Surgery

ABSTRACT. Severe obesity among youth is an "epidemic within an epidemic" and portends a shortened life expectancy for today's children compared with those of their parents' generation. Severe obesity has outpaced less severe forms of childhood obesity in prevalence, and it disproportionately affects adolescents. Emerging evidence has linked severe obesity to the development and progression of multiple comorbid states, including increased cardiometabolic risk resulting in end-organ damage in adulthood. Lifestyle modification treatment has achieved moderate short-term success among young children and those with less severe forms of obesity, but no studies to date demonstrate significant and durable weight loss among youth with severe obesity. Metabolic and bariatric surgery has emerged as an important treatment for adults with severe obesity and, more recently, has been shown to be a safe and effective strategy for groups of youth with severe obesity. However, current data suggest that youth with severe obesity may not have adequate access to metabolic and bariatric surgery, especially among underserved populations. This report outlines the current evidence regarding adolescent bariatric surgery, provides recommendations for practitioners and policy makers, and serves as a companion to an accompanying technical report, "Metabolic and Bariatric Surgery for Pediatric Patients With Severe Obesity," which provides details and supporting evidence. (11/19)

https://doi.org/10.1542/peds.2019-3223

PEDIATRIC OBSERVATION UNITS (CLINICAL REPORT)

Gregory P. Conners, MD, MPH, MBA; Sanford M. Melzer, MD, MBA; Committee on Hospital Care; and Committee on Pediatric Emergency Medicine

ABSTRACT. Pediatric observation units (OUs) are hospital areas used to provide medical evaluation and/or management for health-related conditions in children, typically for a well-defined, brief period. Pediatric OUs represent an emerging alternative site of care for selected groups of children who historically may have received their treatment in an ambulatory setting, emergency department, or hospital-based inpatient unit. This clinical report provides an overview of pediatric OUs, including the definitions and operating characteristics of different types of OUs, quality considerations and coding for observation services, and the effect of OUs on inpatient hospital utilization. (6/12, reaffirmed 9/15)

https://doi.org/10.1542/peds.2012-1358

PEDIATRIC ORGAN DONATION AND TRANSPLANTATION

Committee on Hospital Care, Section on Surgery, and Section on Critical Care

ABSTRACT. Pediatric organ donation and organ transplantation can have a significant life-extending benefit to the young recipients of these organs and a high emotional impact on donor and recipient families. Pediatricians, pediatric medical specialists, and pediatric transplant surgeons need to be better acquainted with evolving national strategies that involve organ procurement and organ transplantation to help acquaint families with the benefits and risks of organ donation and transplantation. Efforts of pediatric professionals are needed to shape public policies to provide a system in which procurement, distribution, and cost are fair and equitable to children and adults. Major issues of concern are availability of and access to donor organs; oversight and control of the process; pediatric medical and surgical consultation and continued care throughout the organ-donation and transplantation process; ethical, social, financial, and follow-up issues; insurance-coverage issues; and public awareness of the need for organ donors of all ages. (3/10, reaffirmed 3/14, 4/19)

https://doi.org/10.1542/peds.2010-0081

PEDIATRIC PALLIATIVE CARE AND HOSPICE CARE COMMITMENTS, GUIDELINES, AND RECOMMENDATIONS

Section on Hospice and Palliative Medicine and Committee on Hospital Care

ABSTRACT. Pediatric palliative care and pediatric hospice care (PPC-PHC) are often essential aspects of medical care for patients who have life-threatening conditions or need end-of-life care. PPC-PHC aims to relieve suffering, improve quality of life, facilitate informed decision-making, and assist in care coordination between clinicians and across sites of care. Core commitments of PPC-PHC include being patient centered and family engaged; respecting and partnering with patients and families; pursuing care that is high quality, readily accessible, and equitable; providing care across the age spectrum and life span, integrated into the continuum of care; ensuring that all clinicians can provide basic palliative care and consult PPC-PHC specialists in a timely manner; and improving care through research and quality improvement efforts. PPC-PHC guidelines and recommendations include ensuring that all large health care organizations serving children with life-threatening conditions have dedicated interdisciplinary PPC-PHC teams, which should develop collaborative relationships between hospital- and community-based teams; that PPC-PHC be provided as integrated multimodal care and practiced as a cornerstone of patient safety and quality for patients with life-threatening conditions; that PPC-PHC teams should facilitate clear, compassionate, and forthright discussions about medical issues and the goals of care and support families, siblings, and health care staff; that PPC-PHC be part of all pediatric education and training curricula, be an active area of research and quality improvement, and exemplify the highest ethical standards; and that PPC-PHC services be supported by financial and regulatory arrangements to ensure access to high-quality PPC-PHC by all patients with life-threatening and life-shortening diseases. (10/13, reaffirmed 4/19)

https://doi.org/10.1542/peds.2013-2731

PEDIATRIC PRIMARY HEALTH CARE

Committee on Pediatric Workforce

ABSTRACT. Primary health care is described as accessible and affordable, first contact, continuous and comprehensive, and coordinated to meet the health needs of the individual and the family being served.

Pediatric primary health care encompasses health supervision and anticipatory guidance; monitoring physical and psychosocial growth and development; age-appropriate screening; diagnosis and treatment of acute and chronic disorders; management of serious and life-threatening illness and, when appropriate, referral of more complex conditions; and provision of first contact care as well as coordinated management of health problems requiring multiple professional services.

Pediatric primary health care for children and adolescents is family centered and incorporates community resources and strengths, needs and risk factors, and sociocultural sensitivities into strategies for care delivery and clinical practice. Pediatric primary health care is best delivered within the context of a "medical home," where comprehensive, continuously accessible and affordable care is available and delivered or supervised by qualified child health specialists.

The pediatrician, because of training (which includes 4 years of medical school education, plus an additional 3 or more years of intensive training devoted solely to all aspects of medical care for children and adolescents), coupled with the demonstrated interest in and total professional commitment to the health care of infants, children, adolescents, and young adults, is the most appropriate provider of pediatric primary health care. (1/11, reaffirmed 10/13, 5/17, 4/20)

https://doi.org/10.1542/peds.2010-3416

PEDIATRIC READINESS IN EMERGENCY MEDICAL SERVICES SYSTEMS

Brian Moore, MD, FAAP; Manish I. Shah, MD, MS, FAAP; Sylvia Owusu-Ansah, MD, MPH, FAAP; Toni Gross, MD, MPH, FAAP; Kathleen Brown, MD, FAAP; Marianne Gausche-Hill, MD, FACEP, FAAP, FAEMS; Katherine Remick, MD, FACEP, FAAP, FAEMS; Kathleen Adelgais, MD, MPH, FAAP; John Lyng, MD, FAEMS, FACEP, NRP; Lara Rappaport, MD, MPH, FAAP; Sally Snow, RN, BSN, CPEN, FAEN; Cynthia Wright-Johnson, MSN, RNC; Julie C. Leonard, MD, MPH, FAAP; Committee on Pediatric Emergency Medicine; Section on Emergency Medicine; and EMS Subcommittee (joint with American College of Emergency Physicians Emergency Medical Services Committee; Emergency Nurses Association Pediatric Committee; National Association of Emergency Medical Services Physicians Standards and Clinical Practice Committee; and National Association of Emergency Medical Technicians Medical Technicians Emergency Pediatric Care Committee)

ABSTRACT. Prehospital emergency care typically involves emergency medical technicians, paramedics, and other licensed medical providers who work in emergency medical services (EMS) systems in ground ambulances and fixed- or rotor-wing aircraft that are dispatched to an emergency when either a bystander calls 9-1-1 or when a patient requires interfacility transport for a medical illness or traumatic injury. Because prehospital emergency care of children plays a critical role in the continuum of health care, which also involves primary prevention, hospital-based acute care, rehabilitation, and return to the medical home, the unique needs of children must be addressed by EMS systems. Pediatric readiness encompasses the presence of equipment and medications, usage of guidelines and policies, availability of education and training, incorporation of performance-improvement practices, and integration of EMS physician medical oversight to equip EMS systems to deliver optimal care to children. It has been shown that emergency departments are more prepared to care for children when a pediatric emergency care coordinator is responsible for championing and making recommendations for policies, training, and resources pertinent to the emergency care of children. The specialty of EMS medicine has the potential to derive similar benefits when members of the EMS community are personally invested in pediatric patient care. Although a critical aspect of pediatric readiness in EMS involves strong EMS physician oversight of these investments, a discussion of physician oversight of pediatric care in EMS is outside the scope of this article. This topic is, however, well addressed in the National

Association of Emergency Medical Services Physicians position statement "Physician Oversight of Pediatric Care in Emergency Medical Services." This policy statement is accompanied by a technical report published simultaneously in this issue of *Pediatrics*. (12/19)
https://doi.org/10.1542/peds.2019-3307

PEDIATRIC READINESS IN EMERGENCY MEDICAL SERVICES SYSTEMS (TECHNICAL REPORT)

Sylvia Owusu-Ansah, MD, MPH, FAAP; Brian Moore, MD, FAAP; Manish I. Shah, MD, MS, FAAP; Toni Gross, MD, MPH, FAAP; Kathleen Brown, MD, FAAP; Marianne Gausche-Hill, MD, FACEP, FAAP, FAEMS; Katherine Remick, MD, FACEP, FAAP, FAEMS; Kathleen Adelgais, MD, MPH, FAAP; Lara Rappaport, MD, MPH, FAAP; Sally Snow, RN, BSN, CPEN, FAEN; Cynthia Wright-Johnson, MSN, RNC; Julie C. Leonard, MD, MPH, FAAP; John Lyng, MD, FAEMS, FACEP, NRP; Mary Fallat, MD, FACS, FAAP; Committee on Pediatric Emergency Medicine; Section on Emergency Medicine; EMS Subcommittee; and Section on Surgery

ABSTRACT. Ill and injured children have unique needs that can be magnified when the child's ailment is serious or life-threatening. This is especially true in the out-of-hospital environment. Providing high-quality out-of-hospital care to children requires an emergency medical services (EMS) system infrastructure designed to support the care of pediatric patients. As in the emergency department setting, it is important that all EMS agencies have the appropriate resources, including physician oversight, trained and competent staff, education, policies, medications, equipment, and supplies, to provide effective emergency care for children. Resource availability across EMS agencies is variable, making it essential that EMS medical directors, administrators, and personnel collaborate with outpatient and hospital-based pediatric experts, especially those in emergency departments, to optimize prehospital emergency care for children. The principles in the policy statement "Pediatric Readiness in Emergency Medical Services Systems" and this accompanying technical report establish a foundation on which to build optimal pediatric care within EMS systems and serve as a resource for clinical and administrative EMS leaders. (12/19)
https://doi.org/10.1542/peds.2019-3308

PEDIATRIC READINESS IN THE EMERGENCY DEPARTMENT

Katherine Remick, MD, FAAP, FACEP, FAEMS; Marianne Gausche-Hill, MD, FAAP, FACEP, FAEMS; Madeline M. Joseph, MD, FAAP, FACEP; Kathleen Brown, MD, FAAP, FACEP; Sally K. Snow, BSN, RN, CPEN, FAEN; Joseph L. Wright, MD, MPH, FAAP; Committee on Pediatric Emergency Medicine; and Section on Surgery (joint with American College of Emergency Physicians Pediatric Emergency Medicine Committee and Emergency Nurses Association Pediatric Committee)

ABSTRACT. This is a revision of the previous joint Policy Statement titled "Guidelines for Care of Children in the Emergency Department." Children have unique physical and psychosocial needs that are heightened in the setting of serious or life-threatening emergencies. The majority of children who are ill and injured are brought to community hospital emergency departments (EDs) by virtue of proximity. It is therefore imperative that all EDs have the appropriate resources (medications, equipment, policies, and education) and capable staff to provide effective emergency care for children. In this Policy Statement, we outline the resources necessary for EDs to stand ready to care for children of all ages. These recommendations are consistent with the recommendations of the Institute of Medicine (now called the National Academy of Medicine) in its report "The Future of Emergency Care in the US Health System." Although resources within emergency and trauma care systems vary locally, regionally, and nationally, it is essential that ED staff, administrators, and medical directors seek to meet or exceed these recommendations to ensure that high-quality emergency care is available for all children. These updated recommendations are intended to serve as a resource for clinical and administrative leadership in EDs as they strive to improve their readiness for children of all ages. (10/18)
https://doi.org/10.1542/peds.2018-2459

PEDIATRIC SUDDEN CARDIAC ARREST

Section on Cardiology and Cardiac Surgery

ABSTRACT. Pediatric sudden cardiac arrest (SCA), which can cause sudden cardiac death if not treated within minutes, has a profound effect on everyone: children, parents, family members, communities, and health care providers. Preventing the tragedy of pediatric SCA, defined as the abrupt and unexpected loss of heart function, remains a concern to all. The goal of this statement is to increase the knowledge of pediatricians (including primary care providers and specialists) of the incidence of pediatric SCA, the spectrum of causes of pediatric SCA, disease-specific presentations, the role of patient and family screening, the rapidly evolving role of genetic testing, and finally, important aspects of secondary SCA prevention. This statement is not intended to address sudden infant death syndrome or sudden unexplained death syndrome, nor will specific treatment of individual cardiac conditions be discussed. This statement has been endorsed by the American College of Cardiology, the American Heart Association, and the Heart Rhythm Society. (3/12)
https://doi.org/10.1542/peds.2012-0144

PEDIATRICIAN GUIDANCE IN SUPPORTING FAMILIES OF CHILDREN WHO ARE ADOPTED, FOSTERED, OR IN KINSHIP CARE (CLINICAL REPORT)

Veronnie F. Jones, MD, MSPH, FAAP; Elaine E. Schulte, MD, MPH, FAAP; Douglas Waite, MD, FAAP; and Council on Foster Care, Adoption, and Kinship Care

ABSTRACT. The child welfare system strives to provide children and adolescents in foster care with a safe, nurturing environment through kinship and nonkinship foster care placement with the goal of either reunification with birth parents or adoption. Pediatricians can support families who care for children and adolescents who are fostered and adopted while attending to children's medical needs and helping each child attain their developmental potential. Although this report primarily focuses on children in the US child welfare system, private and internationally adopted children often have similar needs. (11/20)
https://doi.org/10.1542/peds.2020-034629

PEDIATRICIAN WORKFORCE POLICY STATEMENT

Committee on Pediatric Workforce

ABSTRACT. This policy statement reviews important trends and other factors that affect the pediatrician workforce and the provision of pediatric health care, including changes in the pediatric patient population, pediatrician workforce, and nature of pediatric practice. The effect of these changes on pediatricians and the demand for pediatric care are discussed. The American Academy of Pediatrics (AAP) concludes that there is currently a shortage of pediatric medical subspecialists in many fields, as well as a shortage of pediatric surgical specialists. In addition, the AAP believes that the current distribution of primary care pediatricians is inadequate to meet the needs of children living in rural and other underserved areas, and more primary care pediatricians will be needed in the future because of the increasing number of children who have significant chronic health problems, changes in physician work hours, and implementation of current health reform efforts that seek to improve access to comprehensive patient- and family-centered care for all children in a medical home. The AAP is committed to being an active

participant in physician workforce policy development with both professional organizations and governmental bodies to ensure a pediatric perspective on health care workforce issues. The overall purpose of this statement is to summarize policy recommendations and serve as a resource for the AAP and other stakeholders as they address pediatrician workforce issues that ultimately influence the quality of pediatric health care provided to children in the United States. (7/13)
https://doi.org/10.1542/peds.2013-1517

PEDIATRICIAN-FAMILY-PATIENT RELATIONSHIPS: MANAGING THE BOUNDARIES

Committee on Bioethics

ABSTRACT. All professionals are concerned about maintaining the appropriate limits in their relationships with those they serve. Pediatricians should be aware that, under normal circumstances, caring for one's own children presents significant ethical issues. Pediatricians also must strive to maintain appropriate professional boundaries in their relationships with the family members of their patients. Pediatricians should avoid behavior that patients and parents might misunderstand as having sexual or inappropriate social meaning. Romantic and sexual involvement between physicians and patients is unacceptable. The acceptance of gifts or nonmonetary compensation for medical services has the potential to affect the professional relationship adversely. (11/09, reaffirmed 1/14, 10/20)
https://doi.org/10.1542/peds.2009-2147

THE PEDIATRICIAN'S ROLE IN CHILD MALTREATMENT PREVENTION (CLINICAL REPORT)

Emalee G. Flaherty, MD; John Stirling Jr, MD; and Committee on Child Abuse and Neglect

ABSTRACT. It is the pediatrician's role to promote the child's well-being and to help parents raise healthy, well-adjusted children. Pediatricians, therefore, can play an important role in the prevention of child maltreatment. Previous clinical reports and policy statements from the American Academy of Pediatrics have focused on improving the identification and management of child maltreatment. This clinical report outlines how the pediatrician can help to strengthen families and promote safe, stable, nurturing relationships with the aim of preventing maltreatment. After describing some of the triggers and factors that place children at risk for maltreatment, the report describes how pediatricians can identify family strengths, recognize risk factors, provide helpful guidance, and refer families to programs and other resources with the goal of strengthening families, preventing child maltreatment, and enhancing child development. (9/10, reaffirmed 1/14, 7/20)
https://doi.org/10.1542/peds.2010-2087

THE PEDIATRICIAN'S ROLE IN FAMILY SUPPORT AND FAMILY SUPPORT PROGRAMS

Committee on Early Childhood, Adoption, and Dependent Care

ABSTRACT. Children's social, emotional, and physical health; their developmental trajectory; and the neurocircuits that are being created and reinforced in their developing brains are all directly influenced by their relationships during early childhood. The stresses associated with contemporary American life can challenge families' abilities to promote successful developmental outcomes and emotional health for their children. Pediatricians are positioned to serve as partners with families and other community providers in supporting the well-being of children and their families. The structure and support of families involve forces that are often outside the agenda of the usual pediatric health supervision visits. Pediatricians must ensure that their medical home efforts promote a holistically healthy family environment for all children. This statement recommends opportunities for pediatricians to develop their expertise in assessing the strengths and stresses in families, in counseling families about strategies and resources, and in collaborating with others in their communities to support family relationships. (11/11, reaffirmed 12/16)
https://doi.org/10.1542/peds.2011-2664

THE PEDIATRICIAN'S ROLE IN OPTIMIZING SCHOOL READINESS

Council on Early Childhood and Council on School Health

ABSTRACT. School readiness includes not only the early academic skills of children but also their physical health, language skills, social and emotional development, motivation to learn, creativity, and general knowledge. Families and communities play a critical role in ensuring children's growth in all of these areas and thus their readiness for school. Schools must be prepared to teach all children when they reach the age of school entry, regardless of their degree of readiness. Research on early brain development emphasizes the effects of early experiences, relationships, and emotions on creating and reinforcing the neural connections that are the basis for learning. Pediatricians, by the nature of their relationships with families and children, may significantly influence school readiness. Pediatricians have a primary role in ensuring children's physical health through the provision of preventive care, treatment of illness, screening for sensory deficits, and monitoring nutrition and growth. They can promote and monitor the social-emotional development of children by providing anticipatory guidance on development and behavior, by encouraging positive parenting practices, by modeling reciprocal and respectful communication with adults and children, by identifying and addressing psychosocial risk factors, and by providing community-based resources and referrals when warranted. Cognitive and language skills are fostered through timely identification of developmental problems and appropriate referrals for services, including early intervention and special education services; guidance regarding safe and stimulating early education and child care programs; and promotion of early literacy by encouraging language-rich activities such as reading together, telling stories, and playing games. Pediatricians are also well positioned to advocate not only for children's access to health care but also for high-quality early childhood education and evidence-based family supports such as home visits, which help provide a foundation for optimal learning. (8/16)
https://doi.org/10.1542/peds.2016-2293

THE PEDIATRICIAN'S ROLE IN SUPPORTING ADOPTIVE FAMILIES (CLINICAL REPORT)

Veronnie F. Jones, MD, PhD, MSPH; Elaine E. Schulte, MD, MPH; Committee on Early Childhood; and Council on Foster Care, Adoption, and Kinship Care

ABSTRACT. Each year, more children join families through adoption. Pediatricians have an important role in assisting adoptive families in the various challenges they may face with respect to adoption. The acceptance of the differences between families formed through birth and those formed through adoption is essential in promoting positive emotional growth within the family. It is important for pediatricians to be aware of the adoptive parents' need to be supported in their communication with their adopted children. (9/12, reaffirmed 12/16)
https://doi.org/10.1542/peds.2012-2261

THE PEDIATRICIAN'S ROLE IN THE EVALUATION AND PREPARATION OF PEDIATRIC PATIENTS UNDERGOING ANESTHESIA

Section on Anesthesiology and Pain Medicine

ABSTRACT. Pediatricians play a key role in helping prepare patients and families for anesthesia and surgery. The questions to be answered by the pediatrician fall into 2 categories. The first

involves preparation: is the patient in optimal medical condition for surgery, and are the patient and family emotionally and cognitively ready for surgery? The second category concerns logistics: what communication and organizational needs are necessary to enable safe passage through the perioperative process? This revised statement updates the recommendations for the pediatrician's role in the preoperative preparation of patients. (8/14, reaffirmed 2/21)
https://doi.org/10.1542/peds.2014-1840

PEDIATRICIANS AND PUBLIC HEALTH: OPTIMIZING THE HEALTH AND WELL-BEING OF THE NATION'S CHILDREN

Alice A. Kuo, MD, PhD, FAAP; Pauline A. Thomas, MD, FAAP; Lance A. Chilton, MD, FAAP; Laurene Mascola, MD, MPH; Council on Community Pediatrics; and Section on Epidemiology, Public Health, and Evidence

ABSTRACT. Ensuring optimal health for children requires a population-based approach and collaboration between pediatrics and public health. The prevention of major threats to children's health (such as behavioral health issues) and the control and management of chronic diseases, obesity, injury, communicable diseases, and other problems cannot be managed solely in the pediatric office. The integration of clinical practice with public health actions is necessary for multiple levels of disease prevention that involve the child, family, and community. Although pediatricians and public health professionals interact frequently to the benefit of children and their families, increased integration of the 2 disciplines is critical to improving child health at the individual and population levels. Effective collaboration is necessary to ensure that population health activities include children and that the child health priorities of the American Academy of Pediatrics (AAP), such as poverty and child health, early brain and child development, obesity, and mental health, can engage federal, state, and local public health initiatives. In this policy statement, we build on the 2013 AAP Policy Statement on community pediatrics by identifying specific opportunities for collaboration between pediatricians and public health professionals that are likely to improve the health of children in communities. In the statement, we provide recommendations for pediatricians, public health professionals, and the AAP and its chapters. (1/18)
https://doi.org/10.1542/peds.2017-3848

PERSONAL WATERCRAFT USE BY CHILDREN AND ADOLESCENTS

Committee on Injury and Poison Prevention

ABSTRACT. The use of personal watercraft (PWC) has increased dramatically during the past decade as have the speed and mobility of the watercraft. A similar dramatic increase in PWC-related injury and death has occurred simultaneously. No one younger than 16 years should operate a PWC. The operator and all passengers must wear US Coast Guard-approved personal flotation devices. Other safety recommendations are suggested for parents and pediatricians. (2/00, reaffirmed 5/04, 1/07, 6/10)
https://doi.org/10.1542/peds.105.2.452

PESTICIDE EXPOSURE IN CHILDREN

Council on Environmental Health

ABSTRACT. This statement presents the position of the American Academy of Pediatrics on pesticides. Pesticides are a collective term for chemicals intended to kill unwanted insects, plants, molds, and rodents. Children encounter pesticides daily and have unique susceptibilities to their potential toxicity. Acute poisoning risks are clear, and understanding of chronic health implications from both acute and chronic exposure are emerging. Epidemiologic evidence demonstrates associations between early life exposure to pesticides and pediatric cancers, decreased cognitive function, and behavioral problems. Related animal toxicology studies provide supportive biological plausibility for these findings. Recognizing and reducing problematic exposures will require attention to current inadequacies in medical training, public health tracking, and regulatory action on pesticides. Ongoing research describing toxicologic vulnerabilities and exposure factors across the life span are needed to inform regulatory needs and appropriate interventions. Policies that promote integrated pest management, comprehensive pesticide labeling, and marketing practices that incorporate child health considerations will enhance safe use. (11/12)
https://doi.org/10.1542/peds.2012-2757

PESTICIDE EXPOSURE IN CHILDREN (TECHNICAL REPORT)

James R. Roberts, MD, MPH; Catherine J. Karr, MD, PhD; and Council on Environmental Health

ABSTRACT. Pesticides are a collective term for a wide array of chemicals intended to kill unwanted insects, plants, molds, and rodents. Food, water, and treatment in the home, yard, and school are all potential sources of children's exposure. Exposures to pesticides may be overt or subacute, and effects range from acute to chronic toxicity. In 2008, pesticides were the ninth most common substance reported to poison control centers, and approximately 45% of all reports of pesticide poisoning were for children. Organophosphate and carbamate poisoning are perhaps the most widely known acute poisoning syndromes, can be diagnosed by depressed red blood cell cholinesterase levels, and have available antidotal therapy. However, numerous other pesticides that may cause acute toxicity, such as pyrethroid and neonicotinoid insecticides, herbicides, fungicides, and rodenticides, also have specific toxic effects; recognition of these effects may help identify acute exposures. Evidence is increasingly emerging about chronic health implications from both acute and chronic exposure. A growing body of epidemiological evidence demonstrates associations between parental use of pesticides, particularly insecticides, with acute lymphocytic leukemia and brain tumors. Prenatal, household, and occupational exposures (maternal and paternal) appear to be the largest risks. Prospective cohort studies link early-life exposure to organophosphates and organochlorine pesticides (primarily DDT) with adverse effects on neurodevelopment and behavior. Among the findings associated with increased pesticide levels are poorer mental development by using the Bayley index and increased scores on measures assessing pervasive developmental disorder, inattention, and attention-deficit/hyperactivity disorder. Related animal toxicology studies provide supportive biological plausibility for these findings. Additional data suggest that there may also be an association between parental pesticide use and adverse birth outcomes including physical birth defects, low birth weight, and fetal death, although the data are less robust than for cancer and neurodevelopmental effects. Children's exposures to pesticides should be limited as much as possible. (11/12)
https://doi.org/10.1542/peds.2012-2758

PHOTOTHERAPY TO PREVENT SEVERE NEONATAL HYPERBILIRUBINEMIA IN THE NEWBORN INFANT 35 OR MORE WEEKS OF GESTATION (TECHNICAL REPORT)

Vinod K. Bhutani, MD, and Committee on Fetus and Newborn

ABSTRACT. *Objective.* To standardize the use of phototherapy consistent with the American Academy of Pediatrics clinical practice guideline for the management of hyperbilirubinemia in the newborn infant 35 or more weeks of gestation.

Methods. Relevant literature was reviewed. Phototherapy devices currently marketed in the United States that incorporate fluorescent, halogen, fiber-optic, or blue light-emitting diode light sources were assessed in the laboratory.

Results. The efficacy of phototherapy units varies widely because of differences in light source and configuration. The fol-

lowing characteristics of a device contribute to its effectiveness: (1) emission of light in the blue-to-green range that overlaps the in vivo plasma bilirubin absorption spectrum (~460–490 nm); (2) irradiance of at least 30 μW·cm–2·nm–1 (confirmed with an appropriate irradiance meter calibrated over the appropriate wavelength range); (3) illumination of maximal body surface; and (4) demonstration of a decrease in total bilirubin concentrations during the first 4 to 6 hours of exposure.

Recommendations. The intensity and spectral output of phototherapy devices is useful in predicting potential effectiveness in treating hyperbilirubinemia (group B recommendation). Clinical effectiveness should be evaluated before and monitored during use (group B recommendation). Blocking the light source or reducing exposed body surface should be avoided (group B recommendation). Standardization of irradiance meters, improvements in device design, and lower-upper limits of light intensity for phototherapy units merit further study. Comparing the in vivo performance of devices is not practical, in general, and alternative procedures need to be explored. (9/11, reaffirmed 7/14)

https://doi.org/10.1542/peds.2011-1494

PHYSICAL ACTIVITY ASSESSMENT AND COUNSELING IN PEDIATRIC CLINICAL SETTINGS (CLINICAL REPORT)

Felipe Lobelo, MD, PhD; Natalie D. Muth, MD, MPH, FAAP, FACSM; Sara Hanson, PhD; Blaise A. Nemeth, MD, FAAP; Council on Sports Medicine and Fitness; and Section on Obesity

ABSTRACT. Physical activity plays an important role in children's cardiovascular health, musculoskeletal health, mental and behavioral health, and physical, social, and cognitive development. Despite the importance in children's lives, pediatricians are unfamiliar with assessment and guidance regarding physical activity in children. With the release of the 2018 Physical Activity Guidelines by the US Department of Health and Human Services, pediatricians play a critical role in encouraging physical activity in children through assessing physical activity and physical literacy; providing guidance toward meeting recommendations by children and their families; advocating for opportunities for physical activity for all children in schools, communities, and hospitals; setting an example and remaining physically active personally; advocating for the use of assessment tools and insurance coverage of physical activity and physical literacy screening; and incorporating physical activity assessment and prescription in medical school curricula. (2/20)

https://doi.org/10.1542/peds.2019-3992

PHYSICIAN HEALTH AND WELLNESS (CLINICAL REPORT)

Hilary McClafferty, MD, FAAP; Oscar W. Brown, MD, FAAP; Section on Integrative Medicine; and Committee on Practice and Ambulatory Medicine

ABSTRACT. Physician health and wellness is a critical issue gaining national attention because of the high prevalence of physician burnout. Pediatricians and pediatric trainees experience burnout at levels equivalent to other medical specialties, highlighting a need for more effective efforts to promote health and well-being in the pediatric community. This report will provide an overview of physician burnout, an update on work in the field of preventive physician health and wellness, and a discussion of emerging initiatives that have potential to promote health at all levels of pediatric training.

Pediatricians are uniquely positioned to lead this movement nationally, in part because of the emphasis placed on wellness in the Pediatric Milestone Project, a joint collaboration between the Accreditation Council for Graduate Medical Education and the American Board of Pediatrics. Updated core competencies calling for a balanced approach to health, including focus on nutrition, exercise, mindfulness, and effective stress management, signal a paradigm shift and send the message that it is time for pediatricians to cultivate a culture of wellness better aligned with their responsibilities as role models and congruent with advances in pediatric training.

Rather than reviewing programs in place to address substance abuse and other serious conditions in distressed physicians, this article focuses on forward progress in the field, with an emphasis on the need for prevention and anticipation of predictable stressors related to burnout in medical training and practice. Examples of positive progress and several programs designed to promote physician health and wellness are reviewed. Areas where more research is needed are highlighted. (9/14)

https://doi.org/10.1542/peds.2014-2278

PHYSICIAN REFUSAL TO PROVIDE INFORMATION OR TREATMENT ON THE BASIS OF CLAIMS OF CONSCIENCE

Committee on Bioethics

ABSTRACT. Health care professionals may have moral objections to particular medical interventions. They may refuse to provide or cooperate in the provision of these interventions. Such objections are referred to as conscientious objections. Although it may be difficult to characterize or validate claims of conscience, respecting the individual physician's moral integrity is important. Conflicts arise when claims of conscience impede a patient's access to medical information or care. A physician's conscientious objection to certain interventions or treatments may be constrained in some situations. Physicians have a duty to disclose to prospective patients treatments they refuse to perform. As part of informed consent, physicians also have a duty to inform their patients of all relevant and legally available treatment options, including options to which they object. They have a moral obligation to refer patients to other health care professionals who are willing to provide those services when failing to do so would cause harm to the patient, and they have a duty to treat patients in emergencies when referral would significantly increase the probability of mortality or serious morbidity. Conversely, the health care system should make reasonable accommodations for physicians with conscientious objections. (11/09, reaffirmed 1/14, 6/18)

https://doi.org/10.1542/peds.2009-2222

PHYSICIAN'S ROLE IN COORDINATING CARE OF HOSPITALIZED CHILDREN (CLINICAL REPORT)

Daniel A. Rauch, MD, FAAP; Committee on Hospital Care; and Section on Hospital Medicine

ABSTRACT. The hospitalization of a child is a stressful event for the child and family. The physician responsible for the admission has an important role in directing the care of the child, communicating with the child's providers (medical and primary caregivers), and advocating for the safety of the child during the hospitalization and transition out of the hospital. These challenges remain constant across the varied facilities in which children are hospitalized. The purpose of this revised clinical report is to update pediatricians about principles to improve the coordination of care and review expectations and practice. (7/18)

https://doi.org/10.1542/peds.2018-1503

PLANNED HOME BIRTH

Committee on Fetus and Newborn

ABSTRACT. The American Academy of Pediatrics concurs with the recent statement of the American College of Obstetricians and Gynecologists affirming that hospitals and birthing centers are the safest settings for birth in the United States while respecting the right of women to make a medically informed decision about delivery. This statement is intended to help pediatricians provide supportive, informed counsel to women considering home birth while retaining their role as child advocates and to summarize the standards of care for newborn infants born at home, which are consistent with standards for infants born in

a medical care facility. Regardless of the circumstances of his or her birth, including location, every newborn infant deserves health care that adheres to the standards highlighted in this statement, more completely described in other publications from the American Academy of Pediatrics, including *Guidelines for Perinatal Care.* The goal of providing high-quality care to all newborn infants can best be achieved through continuing efforts by all participating health care providers and institutions to develop and sustain communications and understanding on the basis of professional interaction and mutual respect throughout the health care system. (4/13, reaffirmed 12/16)
https://doi.org/10.1542/peds.2013-0575

POINT-OF-CARE ULTRASONOGRAPHY BY PEDIATRIC EMERGENCY MEDICINE PHYSICIANS

Committee on Pediatric Emergency Medicine (joint with Society for Academic Emergency Medicine Academy of Emergency Ultrasound, American College of Emergency Physicians Pediatric Emergency Medicine Committee, and World Interactive Network Focused on Critical Ultrasound)

ABSTRACT. Point-of-care ultrasonography is increasingly being used to facilitate accurate and timely diagnoses and to guide procedures. It is important for pediatric emergency medicine (PEM) physicians caring for patients in the emergency department to receive adequate and continued point-of-care ultrasonography training for those indications used in their practice setting. Emergency departments should have credentialing and quality assurance programs. PEM fellowships should provide appropriate training to physician trainees. Hospitals should provide privileges to physicians who demonstrate competency in point-of-care ultrasonography. Ongoing research will provide the necessary measures to define the optimal training and competency assessment standards. Requirements for credentialing and hospital privileges will vary and will be specific to individual departments and hospitals. As more physicians are trained and more research is completed, there should be one national standard for credentialing and privileging in point-of-care ultrasonography for PEM physicians. (3/15, reaffirmed 9/19)
https://doi.org/10.1542/peds.2015-0342

POINT-OF-CARE ULTRASONOGRAPHY BY PEDIATRIC EMERGENCY MEDICINE PHYSICIANS (TECHNICAL REPORT)

Jennifer R. Marin, MD, MSc; Resa E. Lewiss, MD; and Committee on Pediatric Emergency Medicine (joint with Society for Academic Emergency Medicine Academy of Emergency Ultrasound, American College of Emergency Physicians Pediatric Emergency Medicine Committee, and World Interactive Network Focused on Critical Ultrasound)

ABSTRACT. Emergency physicians have used point-of-care ultrasonography since the 1990s. Pediatric emergency medicine physicians have more recently adopted this technology. Point-of-care ultrasonography is used for various scenarios, particularly the evaluation of soft tissue infections or blunt abdominal trauma and procedural guidance. To date, there are no published statements from national organizations specifically for pediatric emergency physicians describing the incorporation of point-of-care ultrasonography into their practice. This document outlines how pediatric emergency departments may establish a formal point-of-care ultrasonography program. This task includes appointing leaders with expertise in point-of-care ultrasonography, effectively training and credentialing physicians in the department, and providing ongoing quality assurance reviews.

Point-of-care ultrasonography (US) is a bedside technology that enables clinicians to integrate clinical examination findings with real-time sonographic imaging. General emergency physicians and other specialists have used point-of-care US for many years, and more recently, pediatric emergency medicine (PEM) physicians have adopted point-of-care US as a diagnostic and procedural adjunct. This technical report and accompanying policy statement provide a framework for point-of-care US training and point-of-care US integration into pediatric care by PEM physicians. (3/15, reaffirmed 9/19)
https://doi.org/10.1542/peds.2015-0343

POSTDISCHARGE FOLLOW-UP OF INFANTS WITH CONGENITAL DIAPHRAGMATIC HERNIA (CLINICAL REPORT)

Section on Surgery and Committee on Fetus and Newborn

ABSTRACT. Infants with congenital diaphragmatic hernia often require intensive treatment after birth, have prolonged hospitalizations, and have other congenital anomalies. After discharge from the hospital, they may have long-term sequelae such as respiratory insufficiency, gastroesophageal reflux, poor growth, neurodevelopmental delay, behavior problems, hearing loss, hernia recurrence, and orthopedic deformities. Structured follow-up for these patients facilitates early recognition and treatment of these complications. In this report, follow-up of infants with congenital diaphragmatic hernia is outlined. (3/08, reaffirmed 5/11)
https://doi.org/10.1542/peds.2007-3282

POSTNATAL CORTICOSTEROIDS TO PREVENT OR TREAT BRONCHOPULMONARY DYSPLASIA

Kristi L. Watterberg, MD, and Committee on Fetus and Newborn

ABSTRACT. The purpose of this revised statement is to review current information on the use of postnatal glucocorticoids to prevent or treat bronchopulmonary dysplasia in the preterm infant and to make updated recommendations regarding their use. High-dose dexamethasone (0.5 mg/kg per day) does not seem to confer additional therapeutic benefit over lower doses and is not recommended. Evidence is insufficient to make a recommendation regarding other glucocorticoid doses and preparations. The clinician must use clinical judgment when attempting to balance the potential adverse effects of glucocorticoid treatment with those of bronchopulmonary dysplasia. (9/10, reaffirmed 1/14, 9/20)
https://doi.org/10.1542/peds.2010-1534

POSTNATAL GLUCOSE HOMEOSTASIS IN LATE-PRETERM AND TERM INFANTS (CLINICAL REPORT)

David H. Adamkin, MD, and Committee on Fetus and Newborn

ABSTRACT. This report provides a practical guide and algorithm for the screening and subsequent management of neonatal hypoglycemia. Current evidence does not support a specific concentration of glucose that can discriminate normal from abnormal or can potentially result in acute or chronic irreversible neurologic damage. Early identification of the at-risk infant and institution of prophylactic measures to prevent neonatal hypoglycemia are recommended as a pragmatic approach despite the absence of a consistent definition of hypoglycemia in the literature. (3/11, reaffirmed 6/15)
https://doi.org/10.1542/peds.2010-3851

POVERTY AND CHILD HEALTH IN THE UNITED STATES

Council on Community Pediatrics

ABSTRACT. Almost half of young children in the United States live in poverty or near poverty. The American Academy of Pediatrics is committed to reducing and ultimately eliminating child poverty in the United States. Poverty and related social determinants of health can lead to adverse health outcomes in childhood and across the life course, negatively affecting physical health, socioemotional development, and educational achievement. The American Academy of Pediatrics advocates for programs and policies that have been shown to improve the quality of life and health outcomes for children and families living in poverty. With an awareness and understanding of the

effects of poverty on children, pediatricians and other pediatric health practitioners in a family-centered medical home can assess the financial stability of families, link families to resources, and coordinate care with community partners. Further research, advocacy, and continuing education will improve the ability of pediatricians to address the social determinants of health when caring for children who live in poverty. Accompanying this policy statement is a technical report that describes current knowledge on child poverty and the mechanisms by which poverty influences the health and well-being of children. (3/16, reaffirmed 4/21)
https://doi.org/10.1542/peds.2016-0339

THE POWER OF PLAY: A PEDIATRIC ROLE IN ENHANCING DEVELOPMENT IN YOUNG CHILDREN (CLINICAL REPORT)

Michael Yogman, MD, FAAP; Andrew Garner, MD, PhD, FAAP; Jeffrey Hutchinson, MD, FAAP; Kathy Hirsh-Pasek, PhD; Roberta Michnick Golinkoff, PhD; Committee on Psychosocial Aspects of Child and Family Health; and Council on Communications and Media

ABSTRACT. Children need to develop a variety of skill sets to optimize their development and manage toxic stress. Research demonstrates that developmentally appropriate play with parents and peers is a singular opportunity to promote the social-emotional, cognitive, language, and self-regulation skills that build executive function and a prosocial brain. Furthermore, play supports the formation of the safe, stable, and nurturing relationships with all caregivers that children need to thrive.

Play is not frivolous: it enhances brain structure and function and promotes executive function (ie, the process of learning, rather than the content), which allow us to pursue goals and ignore distractions.

When play and safe, stable, nurturing relationships are missing in a child's life, toxic stress can disrupt the development of executive function and the learning of prosocial behavior; in the presence of childhood adversity, play becomes even more important. The mutual joy and shared communication and attunement (harmonious serve and return interactions) that parents and children can experience during play regulate the body's stress response. This clinical report provides pediatric providers with the information they need to promote the benefits of play and to write a prescription for play at well visits to complement reach out and read. At a time when early childhood programs are pressured to add more didactic components and less playful learning, pediatricians can play an important role in emphasizing the role of a balanced curriculum that includes the importance of playful learning for the promotion of healthy child development. (8/18)
https://doi.org/10.1542/peds.2018-2058

PRACTICAL APPROACHES TO OPTIMIZE ADOLESCENT IMMUNIZATION (CLINICAL REPORT)

Henry H. Bernstein, DO, MHCM, FAAP; Joseph A. Bocchini Jr, MD, FAAP; and Committee on Infectious Diseases

ABSTRACT. With the expansion of the adolescent immunization schedule during the past decade, immunization rates notably vary by vaccine and by state. Addressing barriers to improving adolescent vaccination rates is a priority. Every visit can be viewed as an opportunity to update and complete an adolescent's immunizations. It is essential to continue to focus and refine the appropriate techniques in approaching the adolescent patient and parent in the office setting. Health care providers must continuously strive to educate their patients and develop skills that can help parents and adolescents overcome vaccine hesitancy. Research on strategies to achieve higher vaccination rates is ongoing, and it is important to increase the knowledge and implementation of these strategies. This clinical report focuses on increasing adherence to the universally recommended vaccines in the annual adolescent immunization schedule of the American Academy of Pediatrics, the American Academy of Family Physicians, the Centers for Disease Control and Prevention, and the American Congress of Obstetricians and Gynecologists. This will be accomplished by (1) examining strategies that heighten confidence in immunizations and address patient and parental concerns to promote adolescent immunization and (2) exploring how best to approach the adolescent and family to improve immunization rates. (2/17)
https://doi.org/10.1542/peds.2016-4187

PREMEDICATION FOR NONEMERGENCY ENDOTRACHEAL INTUBATION IN THE NEONATE (CLINICAL REPORT)

Praveen Kumar, MD; Susan E. Denson, MD; Thomas J. Mancuso, MD; Committee on Fetus and Newborn; and Section on Anesthesiology and Pain Medicine

ABSTRACT. Endotracheal intubation is a common procedure in newborn care. The purpose of this clinical report is to review currently available evidence on use of premedication for intubation, identify gaps in knowledge, and provide guidance for making decisions about the use of premedication. (2/10, reaffirmed 8/13, 5/18)
https://doi.org/10.1542/peds.2009-2863

THE PRENATAL VISIT (CLINICAL REPORT)

Michael Yogman, MD, FAAP; Arthur Lavin, MD, FAAP; George Cohen, MD, FAAP; and Committee on Psychosocial Aspects of Child and Family Health

ABSTRACT. A pediatric prenatal visit during the third trimester is recommended for all expectant families as an important first step in establishing a child's medical home, as recommended by *Bright Futures: Guidelines for Health Supervision of Infants, Children, and Adolescents, Fourth Edition*. As advocates for children and their families, pediatricians can support and guide expectant parents in the prenatal period. Prenatal visits allow general pediatricians to establish a supportive and trusting relationship with both parents, gather basic information from expectant parents, offer information and advice regarding the infant, and may identify psychosocial risks early and high-risk conditions that may require special care. There are several possible formats for this first visit. The one used depends on the experience and preference of the parents, the style of the pediatrician's practice, and pragmatic issues of payment. (6/18)
https://doi.org/10.1542/peds.2018-1218

PREPARATION FOR EMERGENCIES IN THE OFFICES OF PEDIATRICIANS AND PEDIATRIC PRIMARY CARE PROVIDERS

Committee on Pediatric Emergency Medicine

ABSTRACT. High-quality pediatric emergency care can be provided only through the collaborative efforts of many health care professionals and child advocates working together throughout a continuum of care that extends from prevention and the medical home to prehospital care, to emergency department stabilization, to critical care and rehabilitation, and finally to a return to care in the medical home. At times, the office of the pediatric primary care provider will serve as the entry site into the emergency care system, which comprises out-of-hospital emergency medical services personnel, emergency department nurses and physicians, and other emergency and critical care providers. Recognizing the important role of pediatric primary care providers in the emergency care system for children and understanding the capabilities and limitations of that system are essential if pediatric primary care providers are to offer the best chance at intact survival for every child who is brought to the office with an emergency. Optimizing pediatric primary care provider office readiness for emergencies requires consideration of the unique aspects of each office practice, the types of patients and

emergencies that might be seen, the resources on site, and the resources of the larger emergency care system of which the pediatric primary care provider's office is a part. Parent education regarding prevention, recognition, and response to emergencies, patient triage, early recognition and stabilization of pediatric emergencies in the office, and timely transfer to an appropriate facility for definitive care are important responsibilities of every pediatric primary care provider. In addition, pediatric primary care providers can collaborate with out-of-hospital and hospital-based providers and advocate for the best-quality emergency care for their patients. (7/07, reaffirmed 6/11, 11/18)
https://doi.org/10.1542/peds.2007-1109

PRESCRIBING ASSISTIVE-TECHNOLOGY SYSTEMS: FOCUS ON CHILDREN WITH IMPAIRED COMMUNICATION (CLINICAL REPORT)

Larry W. Desch, MD; Deborah Gaebler-Spira, MD; and Council on Children With Disabilities

ABSTRACT. This clinical report defines common terms of use and provides information on current practice, research, and limitations of assistive technology that can be used in systems for communication. The assessment process to determine the best devices for use with a particular child (ie, the best fit of a device) is also reviewed. The primary care pediatrician, as part of the medical home, plays an important role in the interdisciplinary effort to provide appropriate assistive technology and may be asked to make a referral for assessment or prescribe a particular device. This report provides resources to assist pediatricians in this role and reviews the interdisciplinary team functional evaluation using standardized assessments; the multiple funding opportunities available for obtaining devices and ways in which pediatricians can assist families with obtaining them; the training necessary to use these systems once the devices are procured; the follow-up evaluation to ensure that the systems are meeting their goals; and the leadership skills needed to advocate for this technology. The American Academy of Pediatrics acknowledges the need for key resources to be identified in the community and recognizes that these resources are a shared medical, educational, therapeutic, and family responsibility. Although this report primarily deals with assistive technology specific for communication impairments, many of the details in this report also can aid in the acquisition and use of other types of assistive technology. (6/08, reaffirmed 1/12, 6/18)
https://doi.org/10.1542/peds.2008-0695

PRESCRIBING PHYSICAL, OCCUPATIONAL, AND SPEECH THERAPY SERVICES FOR CHILDREN WITH DISABILITIES (CLINICAL REPORT)

Amy Houtrow, MD, PhD, MPH, FAAP, FAAPMR; Nancy Murphy, MD, FAAP, FAAPMR; and Council on Children With Disabilities

ABSTRACT. Pediatric health care providers are frequently responsible for prescribing physical, occupational, and speech therapies and monitoring therapeutic progress for children with temporary or permanent disabilities in their practices. This clinical report will provide pediatricians and other pediatric health care providers with information about how best to manage the therapeutic needs of their patients in the medical home by reviewing the International Classification of Functioning, Disability and Health; describing the general goals of habilitative and rehabilitative therapies; delineating the types, locations, and benefits of therapy services; and detailing how to write a therapy prescription and include therapists in the medical home neighborhood. (3/19)
https://doi.org/10.1542/peds.2019-0285

PREVENTING CHILDHOOD TOXIC STRESS: PARTNERING WITH FAMILIES AND COMMUNITIES TO PROMOTE RELATIONAL HEALTH

Andrew Garner, MD, PhD, FAAP; Michael Yogman, MD, FAAP; Committee on Psychosocial Aspects of Child and Family Health; Section on Developmental and Behavioral Pediatrics; and Council on Early Childhood

ABSTRACT. By focusing on the safe, stable, and nurturing relationships (SSNRs) that buffer adversity and build resilience, pediatric care is on the cusp of a paradigm shift that could reprioritize clinical activities, rewrite research agendas, and realign our collective advocacy. Driving this transformation are advances in developmental sciences as they inform a deeper understanding of how early life experiences, both nurturing and adverse, are biologically embedded and influence outcomes in health, education, and economic stability across the life span. This revised policy statement on childhood toxic stress acknowledges a spectrum of potential adversities and reaffirms the benefits of an ecobiodevelopmental model for understanding the childhood origins of adult-manifested disease and wellness. It also endorses a paradigm shift toward relational health because SSNRs not only buffer childhood adversity when it occurs but also promote the capacities needed to be resilient in the future. To translate this relational health framework into clinical practice, generative research, and public policy, the entire pediatric community needs to adopt a public health approach that builds relational health by partnering with families and communities. This public health approach to relational health needs to be integrated both vertically (by including primary, secondary, and tertiary preventions) and horizontally (by including public service sectors beyond health care). The American Academy of Pediatrics asserts that SSNRs are biological necessities for all children because they mitigate childhood toxic stress responses and proactively build resilience by fostering the adaptive skills needed to cope with future adversity in a healthy manner. (7/21)
See full text on page 855.
https://doi.org/10.1542/peds.2021-052582

PREVENTING HOME MEDICATION ADMINISTRATION ERRORS

H. Shonna Yin, MD, MSc, FAAP; Daniel R. Neuspiel, MD, MPH, FAAP; Ian M. Paul, MD, MSc, FAAP; Council on Quality Improvement and Patient Safety; and Committee on Drugs

ABSTRACT. Medication administration errors that take place in the home are common, especially when liquid preparations are used and complex medication schedules with multiple medications are involved; children with chronic conditions are disproportionately affected. Parents and other caregivers with low health literacy and/or limited English proficiency are at higher risk for making errors in administering medications to children in their care. Recommended strategies to reduce home medication errors relate to provider prescribing practices; health literacy–informed verbal counseling strategies (eg, teachback and showback) and written patient education materials (eg, pictographic information) for patients and/or caregivers across settings (inpatient, outpatient, emergency care, pharmacy); dosing-tool provision for liquid medication measurement; review of medication lists with patients and/or caregivers (medication reconciliation) that includes prescription and over-the-counter medications, as well as vitamins and supplements; leveraging the medical home; engaging adolescents and their adult caregivers; training of providers; safe disposal of medications; regulations related to medication dosing tools, labeling, packaging, and informational materials; use of electronic health records and other technologies; and research to identify novel ways to support safe home medication administration. (11/21)
See full text on page 881.
https://doi.org/10.1542/peds.2021-054666

PREVENTING OBESITY AND EATING DISORDERS IN ADOLESCENTS (CLINICAL REPORT)

Neville H. Golden, MD, FAAP; Marcie Schneider, MD, FAAP; Christine Wood, MD, FAAP; Committee on Nutrition; Committee on Adolescence; and Section on Obesity

ABSTRACT. Obesity and eating disorders (EDs) are both prevalent in adolescents. There are concerns that obesity prevention efforts may lead to the development of an ED. Most adolescents who develop an ED did not have obesity previously, but some teenagers, in an attempt to lose weight, may develop an ED. This clinical report addresses the interaction between obesity prevention and EDs in teenagers, provides the pediatrician with evidence-informed tools to identify behaviors that predispose to both obesity and EDs, and provides guidance about obesity and ED prevention messages. The focus should be on a healthy lifestyle rather than on weight. Evidence suggests that obesity prevention and treatment, if conducted correctly, do not predispose to EDs. (8/16)

https://doi.org/10.1542/peds.2016-1649

PREVENTION AND MANAGEMENT OF PROCEDURAL PAIN IN THE NEONATE: AN UPDATE

Committee on Fetus and Newborn and Section on Anesthesiology and Pain Medicine

ABSTRACT. The prevention of pain in neonates should be the goal of all pediatricians and health care professionals who work with neonates, not only because it is ethical but also because repeated painful exposures have the potential for deleterious consequences. Neonates at greatest risk of neurodevelopmental impairment as a result of preterm birth (ie, the smallest and sickest) are also those most likely to be exposed to the greatest number of painful stimuli in the NICU. Although there are major gaps in knowledge regarding the most effective way to prevent and relieve pain in neonates, proven and safe therapies are currently underused for routine minor, yet painful procedures. Therefore, every health care facility caring for neonates should implement (1) a pain-prevention program that includes strategies for minimizing the number of painful procedures performed and (2) a pain assessment and management plan that includes routine assessment of pain, pharmacologic and nonpharmacologic therapies for the prevention of pain associated with routine minor procedures, and measures for minimizing pain associated with surgery and other major procedures. (1/16, reaffirmed 7/20)

https://doi.org/10.1542/peds.2015-4271

PREVENTION OF AGRICULTURAL INJURIES AMONG CHILDREN AND ADOLESCENTS

Committee on Injury and Poison Prevention and Committee on Community Health Services

ABSTRACT. Although the annual number of farm deaths to children and adolescents has decreased since publication of the 1988 American Academy of Pediatrics statement, "Rural Injuries," the rate of nonfatal farm injuries has increased. Approximately 100 unintentional injury deaths occur annually to children and adolescents on US farms, and an additional 22 000 injuries to children younger than 20 years occur on farms. Relatively few adolescents are employed on farms compared with other types of industry, yet the proportion of fatalities in agriculture is higher than that for any other type of adolescent employment. The high mortality and severe morbidity associated with farm injuries require continuing and improved injury-control strategies. This statement provides recommendations for pediatricians regarding patient and community education as well as public advocacy related to agricultural injury prevention in childhood and adolescence. (10/01, reaffirmed 1/07, 11/11)

https://doi.org/10.1542/peds.108.4.1016

PREVENTION OF CHILDHOOD LEAD TOXICITY

Council on Environmental Health

ABSTRACT. Blood lead concentrations have decreased dramatically in US children over the past 4 decades, but too many children still live in housing with deteriorated lead-based paint and are at risk for lead exposure with resulting lead-associated cognitive impairment and behavioral problems. Evidence continues to accrue that commonly encountered blood lead concentrations, even those below 5 μg/dL (50 ppb), impair cognition; there is no identified threshold or safe level of lead in blood. From 2007 to 2010, approximately 2.6% of preschool children in the United States had a blood lead concentration ≥5 μg/dL (≥50 ppb), which represents about 535 000 US children 1 to 5 years of age. Evidence-based guidance is available for managing increased lead exposure in children, and reducing sources of lead in the environment, including lead in housing, soil, water, and consumer products, has been shown to be cost-beneficial. Primary prevention should be the focus of policy on childhood lead toxicity. (6/16, reaffirmed 4/21)

https://doi.org/10.1542/peds.2016-1493

PREVENTION OF CHOKING AMONG CHILDREN

Committee on Injury, Violence, and Poison Prevention

ABSTRACT. Choking is a leading cause of morbidity and mortality among children, especially those aged 3 years or younger. Food, coins, and toys are the primary causes of choking-related injury and death. Certain characteristics, including shape, size, and consistency, of certain toys and foods increase their potential to cause choking among children. Childhood choking hazards should be addressed through comprehensive and coordinated prevention activities. The US Consumer Product Safety Commission (CPSC) should increase efforts to ensure that toys that are sold in retail store bins, vending machines, or on the Internet have appropriate choking-hazard warnings; work with manufacturers to improve the effectiveness of recalls of products that pose a choking risk to children; and increase efforts to prevent the resale of these recalled products via online auction sites. Current gaps in choking-prevention standards for children's toys should be reevaluated and addressed, as appropriate, via revisions to the standards established under the Child Safety Protection Act, the Consumer Product Safety Improvement Act, or regulation by the CPSC. Prevention of food-related choking among children in the United States has been inadequately addressed at the federal level. The US Food and Drug Administration should establish a systematic, institutionalized process for examining and addressing the hazards of food-related choking. This process should include the establishment of the necessary surveillance, hazard evaluation, enforcement, and public education activities to prevent food-related choking among children. While maintaining its highly cooperative arrangements with the CPSC and the US Department of Agriculture, the Food and Drug Administration should have the authority to address choking-related risks of all food products, including meat products that fall under the jurisdiction of the US Department of Agriculture. The existing National Electronic Injury Surveillance System–All Injury Program of the CPSC should be modified to conduct more-detailed surveillance of choking on food among children. Food manufacturers should design new foods and redesign existing foods to avoid shapes, sizes, textures, and other characteristics that increase choking risk to children, to the extent possible. Pediatricians, dentists, and other infant and child health care providers should provide choking-prevention counseling to parents as an integral part of anticipatory guidance activities. (2/10, reaffirmed 10/19)

https://doi.org/10.1542/peds.2009-2862

PREVENTION OF DROWNING (TECHNICAL REPORT)

Sarah A. Denny, MD, FAAP; Linda Quan, MD, FAAP; Julie Gilchrist, MD, FAAP; Tracy McCallin, MD, FAAP; Rohit Shenoi, MD, FAAP; Shabana Yusuf, MD, Med, FAAP; Jeffrey Weiss, MD, FAAP; Benjamin Hoffman, MD, FAAP; and Council on Injury, Violence, and Poison Prevention

ABSTRACT. Drowning is a leading cause of injury-related death in children. In 2018, almost 900 US children younger than 20 years died of drowning. A number of strategies are available to prevent these tragedies. As educators and advocates, pediatricians can play an important role in prevention of drowning. (7/21)

See full text on page 903.

https://doi.org/10.1542/peds.2021-052227

PREVENTION OF SEXUAL HARASSMENT IN THE WORKPLACE AND EDUCATIONAL SETTINGS

Committee on Pediatric Workforce

ABSTRACT. The American Academy of Pediatrics is committed to working to ensure that workplaces and educational settings in which pediatricians spend time are free of sexual harassment. The purpose of this statement is to heighten awareness and sensitivity to this important issue, recognizing that institutions, clinics, and office-based practices may have existing policies. (10/06, reaffirmed 5/09, 1/12, 10/14, 10/19)

https://doi.org/10.1542/peds.2006-1816

THE PREVENTION OF UNINTENTIONAL INJURY AMONG AMERICAN INDIAN AND ALASKA NATIVE CHILDREN: A SUBJECT REVIEW (CLINICAL REPORT)

Committee on Native American Child Health and Committee on Injury and Poison Prevention

ABSTRACT. Among ethnic groups in the United States, American Indian and Alaska Native (AI/AN) children experience the highest rates of injury mortality and morbidity. Injury mortality rates for AI/AN children have decreased during the past quarter century, but remain almost double the rate for all children in the United States. The Indian Health Service (IHS), the federal agency with the primary responsibility for the health care of AI/AN people, has sponsored an internationally recognized injury prevention program designed to reduce the risk of injury death by addressing community-specific risk factors. Model programs developed by the IHS and tribal governments have led to successful outcomes in motor vehicle occupant safety, drowning prevention, and fire safety. Injury prevention programs in tribal communities require special attention to the sovereignty of tribal governments and the unique cultural aspects of health care and communication. Pediatricians working with AI/AN children on reservations or in urban environments are strongly urged to collaborate with tribes and the IHS to create community-based coalitions and develop programs to address highly preventable injury-related mortality and morbidity. Strong advocacy also is needed to promote childhood injury prevention as an important priority for federal agencies and tribes. (12/99, reaffirmed 12/02 COIVPP, 5/03 CONACH, 1/06, 9/08)

https://doi.org/10.1542/peds.104.6.1397

THE PRIMARY CARE PEDIATRICIAN AND THE CARE OF CHILDREN WITH CLEFT LIP AND/OR CLEFT PALATE (CLINICAL REPORT)

Charlotte W. Lewis, MD, MPH, FAAP; Lisa S. Jacob, DDS, MS; Christoph U. Lehmann, MD, FAAP, FACMI; and Section on Oral Health

ABSTRACT. Orofacial clefts, specifically cleft lip and/or cleft palate (CL/P), are among the most common congenital anomalies. CL/P vary in their location and severity and comprise 3 overarching groups: cleft lip (CL), cleft lip with cleft palate (CLP), and cleft palate alone (CP). CL/P may be associated with one of many syndromes that could further complicate a child's needs. Care of patients with CL/P spans prenatal diagnosis into adulthood. The appropriate timing and order of specific cleft-related care are important factors for optimizing outcomes; however, care should be individualized to meet the specific needs of each patient and family. Children with CL/P should receive their specialty cleft-related care from a multidisciplinary cleft or craniofacial team with sufficient patient and surgical volume to promote successful outcomes. The primary care pediatrician at the child's medical home has an essential role in making a timely diagnosis and referral; providing ongoing health care maintenance, anticipatory guidance, and acute care; and functioning as an advocate for the patient and a liaison between the family and the craniofacial/cleft team. This document provides background on CL/P and multidisciplinary team care, information about typical timing and order of cleft-related care, and recommendations for cleft/craniofacial teams and primary care pediatricians in the care of children with CL/P. (4/17)

https://doi.org/10.1542/peds.2017-0628

PRINCIPLES OF CHILD HEALTH CARE FINANCING

Mark L. Hudak, MD, FAAP; Mark E. Helm, MD, MBA, FAAP; Patience H. White, MD, MA, FAAP, FACP; and Committee on Child Health Financing

ABSTRACT. After passage of the Patient Protection and Affordable Care Act, more children and young adults have become insured and have benefited from health care coverage than at any time since the creation of the Medicaid program in 1965. From 2009 to 2015, the uninsurance rate for children younger than 19 years fell from 9.7% to 5.3%, whereas the uninsurance rate for young adults 19 to 25 years of age declined from 31.7% to 14.5%. Nonetheless, much work remains to be done. The American Academy of Pediatrics (AAP) believes that the United States can and should ensure that all children, adolescents, and young adults from birth through the age of 26 years who reside within its borders have affordable access to high-quality and comprehensive health care, regardless of their or their families' incomes. Public and private health insurance should safeguard existing benefits for children and take further steps to cover the full array of essential health care services recommended by the AAP. Each family should be able to afford the premiums, deductibles, and other cost-sharing provisions of the plan. Health plans providing these benefits should ensure, insofar as possible, that families have a choice of professionals and facilities with expertise in the care of children within a reasonable distance of their residence. Traditional and innovative payment methodologies by public and private payers should be structured to guarantee the economic viability of the pediatric medical home and of other pediatric specialty and subspecialty practices to address developing shortages in the pediatric specialty and subspecialty workforce, to promote the use of health information technology, to improve population health and the experience of care, and to encourage the delivery of evidence-based and quality health care in the medical home, as well as in other outpatient, inpatient, and home settings. All current and future health care insurance plans should incorporate the principles for child health financing outlined in this statement. Espousing the core principle to do no harm, the AAP believes that the United States must not sacrifice any of the hard-won gains for our children. Medicaid, as the largest single payer of health care for children and young adults, should remain true to its origins as an entitlement program; in other words, future fiscal or regulatory reforms of Medicaid should not reduce the eligibility and scope of benefits for children and young adults below current levels nor jeopardize children's access to care. Proposed Medicaid funding "reforms" (eg, institution of block grant, capped allotment, or per-capita capitation payments to

states) will achieve their goal of securing cost savings but will inevitably compel states to reduce enrollee eligibility, trim existing benefits (such as Early and Periodic Screening, Diagnostic, and Treatment), and/or compromise children's access to necessary and timely care through cuts in payments to providers and delivery systems. In fact, the AAP advocates for increased Medicaid funding to improve access to essential care for existing enrollees, fund care for eligible but uninsured children once they enroll, and accommodate enrollment growth that will occur in states that choose to expand Medicaid eligibility. The AAP also calls for Congress to extend funding for the Children's Health Insurance Program, a plan vital to the 8.9 million children it covered in fiscal year 2016, for a minimum of 5 years. (8/17)
https://doi.org/10.1542/peds.2017-2098

PRINCIPLES OF FINANCING THE MEDICAL HOME FOR CHILDREN

Jonathan Price, MD, FAAP; Mary L. Brandt, MD, FACS, FAAP; Mark L. Hudak, MD, FAAP; and Committee on Child Health Financing

ABSTRACT. A well-implemented and adequately funded medical home not only is the best approach to optimize the health of the individual patient but also can function as an effective instrument for improving population health. Key financing elements to providing quality, effective, comprehensive care in the pediatric medical home include the following: (1) first dollar coverage without deductibles, copays, or other cost-sharing for necessary preventive care services as recommended by *Bright Futures: Guidelines for Health Supervision of Infants, Children, and Adolescents;* (2) adoption of a uniform definition of medical necessity across payers that embraces services that promote optimal growth and development and prevent, diagnose, and treat the full range of pediatric physical, mental, behavioral, and developmental conditions, in accord with evidence-based science or evidence-informed expert opinion; (3) payment models that promote appropriate use of pediatric primary care and pediatric specialty services and discourage inappropriate, inefficient, or excessive use of medical services; and (4) payment models that strengthen the patient- and family-physician relationship and do not impose additional administrative burdens that will only erode the effectiveness of the medical home. These goals can be met by designing payment models that provide adequate funding of the cost of medical encounters, care coordination, population health services, and quality improvement activities; provide incentives for quality and effectiveness of care; and ease administrative burdens. (12/19)
https://doi.org/10.1542/peds.2019-3451

PRINCIPLES OF PEDIATRIC PATIENT SAFETY: REDUCING HARM DUE TO MEDICAL CARE

Brigitta U. Mueller, MD, MHCM, CPPS, CPHQ, FAAP; Daniel Robert Neuspiel, MD, MPH, FAAP; Erin R. Stucky Fisher, MD, FAAP; Council on Quality Improvement and Patient Safety; and Committee on Hospital Care

ABSTRACT. Pediatricians render care in an increasingly complex environment, which results in multiple opportunities to cause unintended harm. National awareness of patient safety risks has grown since the National Academy of Medicine (formerly the Institute of Medicine) published its report "To Err Is Human: Building a Safer Health System" in 1999. Patients and society as a whole continue to challenge health care providers to examine their practices and implement safety solutions. The depth and breadth of harm incurred by the practice of medicine is still being defined as reports continue to reveal a variety of avoidable errors, from those that involve specific high-risk medications to those that are more generalizable, such as patient misidentification and diagnostic error. Pediatric health care providers in all practice environments benefit from having a working knowledge of patient safety language. Pediatric providers should serve as advocates for best practices and policies with the goal of attending to risks that are unique to children, identifying and supporting a culture of safety, and leading efforts to eliminate avoidable harm in any setting in which medical care is rendered to children. In this Policy Statement, we provide an update to the 2011 Policy Statement "Principles of Pediatric Patient Safety: Reducing Harm Due to Medical Care." (1/19)
https://doi.org/10.1542/peds.2018-3649

PROBIOTICS AND PREBIOTICS IN PEDIATRICS (CLINICAL REPORT)

Dan W. Thomas, MD; Frank R. Greer, MD; Committee on Nutrition; and Section on Gastroenterology, Hepatology, and Nutrition

ABSTRACT. This clinical report reviews the currently known health benefits of probiotic and prebiotic products, including those added to commercially available infant formula and other food products for use in children. Probiotics are supplements or foods that contain viable microorganisms that cause alterations of the microflora of the host. Use of probiotics has been shown to be modestly effective in randomized clinical trials (RCTs) in (1) treating acute viral gastroenteritis in healthy children; and (2) preventing antibiotic-associated diarrhea in healthy children. There is some evidence that probiotics prevent necrotizing enterocolitis in very low birth weight infants (birth weight between 1000 and 1500 g), but more studies are needed. The results of RCTs in which probiotics were used to treat childhood *Helicobacter pylori* gastritis, irritable bowel syndrome, chronic ulcerative colitis, and infantile colic, as well as in preventing childhood atopy, although encouraging, are preliminary and require further confirmation. Probiotics have not been proven to be beneficial in treating or preventing human cancers or in treating children with Crohn disease. There are also safety concerns with the use of probiotics in infants and children who are immunocompromised, chronically debilitated, or seriously ill with indwelling medical devices.

Prebiotics are supplements or foods that contain a nondigestible food ingredient that selectively stimulates the favorable growth and/or activity of indigenous probiotic bacteria. Human milk contains substantial quantities of prebiotics. There is a paucity of RCTs examining prebiotics in children, although there may be some long-term benefit of prebiotics for the prevention of atopic eczema and common infections in healthy infants. Confirmatory well-designed clinical research studies are necessary. (11/10, reaffirmed 3/21)
https://doi.org/10.1542/peds.2010-2548

PROCEDURES FOR THE EVALUATION OF THE VISUAL SYSTEM BY PEDIATRICIANS (CLINICAL REPORT)

Sean P. Donahue, MD, PhD, FAAP; Cynthia N. Baker, MD, FAAP; Committee on Practice and Ambulatory Medicine; and Section on Ophthalmology (joint with American Association of Certified Orthoptists, American Association for Pediatric Ophthalmology and Strabismus, and American Academy of Ophthalmology)

ABSTRACT. Vision screening is crucial for the detection of visual and systemic disorders. It should begin in the newborn nursery and continue throughout childhood. This clinical report provides details regarding methods for pediatricians to use for screening. (12/15)
https://doi.org/10.1542/peds.2015-3597

PROFESSIONALISM IN PEDIATRICS (TECHNICAL REPORT)

Mary E. Fallat, MD; Jacqueline Glover, PhD; and Committee on Bioethics

ABSTRACT. The purpose of this report is to provide a concrete overview of the ideal standards of behavior and professional practice to which pediatricians should aspire and by which students and residents can be evaluated. Recognizing that the

ideal is not always achievable in the practical sense, this document details the key components of professionalism in pediatric practice with an emphasis on core professional values for which pediatricians should strive and that will serve as a moral compass needed to provide quality care for children and their families. (10/07, reaffirmed 5/11)
https://doi.org/10.1542/peds.2007-2230

PROFESSIONALISM IN PEDIATRICS: STATEMENT OF PRINCIPLES

Committee on Bioethics

ABSTRACT. The purpose of this statement is to delineate the concept of professionalism within the context of pediatrics and to provide a brief statement of principles to guide the behavior and professional practice of pediatricians. (10/07, reaffirmed 5/11)
https://doi.org/10.1542/peds.2007-2229

PROMOTING EDUCATION, MENTORSHIP, AND SUPPORT FOR PEDIATRIC RESEARCH

Committee on Pediatric Research

ABSTRACT. Pediatricians play a key role in advancing child health research to best attain and improve the physical, mental, and social health and well-being of all infants, children, adolescents, and young adults. Child health presents unique issues that require investigators who specialize in pediatric research. In addition, the scope of the pediatric research enterprise is transdisciplinary and includes the full spectrum of basic science, translational, community-based, health services, and child health policy research. Although most pediatricians do not directly engage in research, knowledge of research methodologies and approaches promotes critical evaluation of scientific literature, the practice of evidence-based medicine, and advocacy for evidence-based child health policy. This statement includes specific recommendations to promote further research education and support at all levels of pediatric training, from premedical to continuing medical education, as well as recommendations to increase support and mentorship for research activities. Pediatric research is crucial to the American Academy of Pediatrics' goal of improving the health of all children. The American Academy of Pediatrics continues to promote and encourage efforts to facilitate the creation of new knowledge and ways to reduce barriers experienced by trainees, practitioners, and academic faculty pursuing research. (4/14, reaffirmed 2/18)
https://doi.org/10.1542/peds.2014-0448

PROMOTING FOOD SECURITY FOR ALL CHILDREN

Council on Community Pediatrics and Committee on Nutrition

ABSTRACT. Sixteen million US children (21%) live in households without consistent access to adequate food. After multiple risk factors are considered, children who live in households that are food insecure, even at the lowest levels, are likely to be sick more often, recover from illness more slowly, and be hospitalized more frequently. Lack of adequate healthy food can impair a child's ability to concentrate and perform well in school and is linked to higher levels of behavioral and emotional problems from preschool through adolescence. Food insecurity can affect children in any community, not only traditionally underserved ones. Pediatricians can play a central role in screening and identifying children at risk for food insecurity and in connecting families with needed community resources. Pediatricians should also advocate for federal and local policies that support access to adequate healthy food for an active and healthy life for all children and their families. (10/15)
https://doi.org/10.1542/peds.2015-3301

PROMOTING HEALTHY SEXUALITY FOR CHILDREN AND ADOLESCENTS WITH DISABILITIES

Amy Houtrow, MD, PhD, MPH, FAAP; Ellen Roy Elias, MD, FAAP, FACMG; Beth Ellen Davis, MD, MPH, FAAP; and Council on Children With Disabilities

ABSTRACT. This clinical report updates a 2006 report from the American Academy of Pediatrics titled "Sexuality of Children and Adolescents With Developmental Disabilities." The development of a healthy sexuality best occurs through appropriate education, absence of coercion and violence, and developmental acquisition of skills to navigate feelings, desires, relationships, and social pressures. Pediatric health care providers are important resources for anticipatory guidance and education for all children and youth as they understand their changing bodies, feelings, and behaviors. Yet, youth with disabilities and their families report inadequate education and guidance from pediatricians regarding sexual health development. In the decade since the original clinical report was published, there have been many advancements in the understanding and care of children and youth with disabilities, in part because of an increased prevalence and breadth of autism spectrum disorder as well as an increased longevity of individuals with medically complex and severely disabling conditions. During this same time frame, sexual education in US public schools has diminished, and there is emerging evidence that the attitudes and beliefs of all youth (with and without disability) about sex and sexuality are being formed through media rather than formal education or parent and/or health care provider sources. This report aims to provide the pediatric health care provider with resources and tools for clinical practice to address the sexual development of children and youth with disabilities. The report emphasizes strategies to promote competence in achieving a healthy sexuality regardless of physical, cognitive, or socioemotional limitations. (6/21)
See full text on page 929.
https://doi.org/10.1542/peds.2021-052043

PROMOTING HUMAN MILK AND BREASTFEEDING FOR THE VERY LOW BIRTH WEIGHT INFANT (CLINICAL REPORT)

Margaret G. Parker, MD, MPH; Lisa M. Stellwagen, MD; Lawrence Noble, MD; Jae H. Kim, MD, PhD; Brenda B. Poindexter, MD; Karen M. Puopolo, MD, PhD; AAP Section on Breastfeeding; Committee on Nutrition; and Committee on Fetus and Newborn

ABSTRACT. Provision of mother's own milk for hospitalized very low birth weight (VLBW) (≤1500 g) infants in the NICU provides short- and long-term health benefits. Mother's own milk, appropriately fortified, is the optimal nutrition source for VLBW infants. Every mother should receive information about the critical importance of mother's own milk to the health of a VLBW infant. Pasteurized human donor milk is recommended when mother's own milk is not available or sufficient. Neonatal health care providers can support lactation in the NICU and potentially reduce disparities in the provision of mother's own milk by providing institutional supports for early and frequent milk expression and by promoting skin-to-skin contact and direct breastfeeding, when appropriate. Promotion of human milk and breastfeeding for VLBW infants requires multidisciplinary and system-wide adoption of lactation support practices. (10/21)
See full text on page 945.
https://doi.org/10.1542/peds.2021-054272

PROMOTING OPTIMAL DEVELOPMENT: IDENTIFYING INFANTS AND YOUNG CHILDREN WITH DEVELOPMENTAL DISORDERS THROUGH DEVELOPMENTAL SURVEILLANCE AND SCREENING (CLINICAL REPORT)

Paul H. Lipkin, MD, FAAP; Michelle M. Macias, MD, FAAP; Council on Children With Disabilities; and Section on Developmental and Behavioral Pediatrics

ABSTRACT. Early identification and intervention for developmental disorders are critical to the well-being of children and are the responsibility of pediatric professionals as an integral function of the medical home. This report models a universal system of developmental surveillance and screening for the early identification of conditions that affect children's early and long-term development and achievement, followed by ongoing care. These conditions include autism, deafness/hard-of-hearing, intellectual and motor disabilities, behavioral conditions, and those seen in other medical conditions. Developmental surveillance is supported at every health supervision visit, as is as the administration of standardized screening tests at the 9-, 18-, and 30-month visits. Developmental concerns elicited on surveillance at any visit should be followed by standardized developmental screening testing or direct referral to intervention and specialty medical care. Special attention to surveillance is recommended at the 4- to 5-year well-child visit, prior to entry into elementary education, with screening completed if there are any concerns. Developmental surveillance includes bidirectional communication with early childhood professionals in child care, preschools, Head Start, and other programs, including home visitation and parenting, particularly around developmental screening. The identification of problems should lead to developmental and medical evaluations, diagnosis, counseling, and treatment, in addition to early developmental intervention. Children with diagnosed developmental disorders are identified as having special health care needs, with initiation of chronic condition management in the pediatric medical home. (12/19)
https://doi.org/10.1542/peds.2019-3449

PROMOTING OPTIMAL DEVELOPMENT: SCREENING FOR BEHAVIORAL AND EMOTIONAL PROBLEMS (CLINICAL REPORT)

Carol Weitzman, MD, FAAP; Lynn Wegner, MD, FAAP; Section on Developmental and Behavioral Pediatrics; Committee on Psychosocial Aspects of Child and Family Health; and Council on Early Childhood (joint with Society for Developmental and Behavioral Pediatrics)

ABSTRACT. By current estimates, at any given time, approximately 11% to 20% of children in the United States have a behavioral or emotional disorder, as defined in the *Diagnostic and Statistical Manual of Mental Disorders, Fifth Edition.* Between 37% and 39% of children will have a behavioral or emotional disorder diagnosed by 16 years of age, regardless of geographic location in the United States. Behavioral and emotional problems and concerns in children and adolescents are not being reliably identified or treated in the US health system. This clinical report focuses on the need to increase behavioral screening and offers potential changes in practice and the health system, as well as the research needed to accomplish this. This report also (1) reviews the prevalence of behavioral and emotional disorders, (2) describes factors affecting the emergence of behavioral and emotional problems, (3) articulates the current state of detection of these problems in pediatric primary care, (4) describes barriers to screening and means to overcome those barriers, and (5) discusses potential changes at a practice and systems level that are needed to facilitate successful behavioral and emotional screening. Highlighted and discussed are the many factors at the level of the pediatric practice, health system, and society contributing to these behavioral and emotional problems. (1/15, reaffirmed 12/20)
https://doi.org/10.1542/peds.2014-3716

PROMOTING THE PARTICIPATION OF CHILDREN AND ADOLESCENTS WITH DISABILITIES IN SPORTS, RECREATION, AND PHYSICAL ACTIVITY (CLINICAL REPORT)

Paul S. Carbone, MD, FAAP; Peter J. Smith, MD, MA, FAAP; Charron Lewis, MD, FAAP; Claire LeBlanc, MD, FAAP; Council on Children With Disabilities; and Council on Sports Medicine and Fitness

ABSTRACT. The benefits of physical activity are likely universal for all children, including children and adolescents with disabilities (CWD). The participation of CWD in physical activity, including adaptive or therapeutic sports and recreation, promotes inclusion, minimizes deconditioning, optimizes physical functioning, improves mental health as well as academic achievement, and enhances overall well-being. Despite these benefits, CWD face barriers to participation and have lower levels of fitness, reduced rates of participation, and a higher prevalence of overweight and obesity compared with typically developing peers. Pediatricians and caregivers may overestimate the risks or overlook the benefits of physical activity in CWD, which further limits participation. Preparticipation evaluations often include assessment of health status, functional capacity, individual activity preferences, availability of appropriate programs, and safety precautions. Given the complexity, the preparticipation evaluation for CWD may not occur in the context of a single office visit but rather over a period of time with input from the child's multidisciplinary team (physicians, coaches, physical education teachers, school nurses, adaptive recreation specialists, physical and occupational therapists, and others). Some CWD may desire to participate in organized sports to experience the challenge of competition, and others may prefer recreational activities for enjoyment. To reach the goal of inclusion in appropriate physical activities for all children with disabilities, child, family, financial, and societal barriers to participation need to be identified and addressed. Health care providers can facilitate participation by encouraging physical activity among CWD and their families during visits. Health care providers can create "physical activity prescriptions" for CWD on the basis of the child's preferred activities, functional status, need for adaptation of the activity and the recreational opportunities available in the community. This clinical report discusses the importance of participation in sports, recreation, and physical activity for CWD and offers practical suggestions to health care providers. (11/21)
See full text on page 963.
https://doi.org/10.1542/peds.2021-054664

PROMOTING THE WELL-BEING OF CHILDREN WHOSE PARENTS ARE GAY OR LESBIAN

Committee on Psychosocial Aspects of Child and Family Health

ABSTRACT. To promote optimal health and well-being of all children, the American Academy of Pediatrics (AAP) supports access for all children to (1) civil marriage rights for their parents and (2) willing and capable foster and adoptive parents, regardless of the parents' sexual orientation. The AAP has always been an advocate for, and has developed policies to support, the optimal physical, mental, and social health and well-being of all infants, children, adolescents, and young adults. In so doing, the AAP has supported families in all their diversity, because the family has always been the basic social unit in which children develop the supporting and nurturing relationships with adults that they need to thrive. Children may be born to, adopted by, or cared for temporarily by married couples, nonmarried couples, single parents, grandparents, or legal guardians, and any of these may be heterosexual, gay or lesbian, or of another orientation. Children need secure and enduring relationships with committed and nurturing adults to enhance their life experiences for optimal social-emotional and cognitive development. Scientific evidence affirms that children have similar developmental and

emotional needs and receive similar parenting whether they are raised by parents of the same or different genders. If a child has 2 living and capable parents who choose to create a permanent bond by way of civil marriage, it is in the best interests of their child(ren) that legal and social institutions allow and support them to do so, irrespective of their sexual orientation. If 2 parents are not available to the child, adoption or foster parenting remain acceptable options to provide a loving home for a child and should be available without regard to the sexual orientation of the parent(s). (3/13)
https://doi.org/10.1542/peds.2013-0376

PROMOTING THE WELL-BEING OF CHILDREN WHOSE PARENTS ARE GAY OR LESBIAN (TECHNICAL REPORT)

Ellen C. Perrin, MD, MA; Benjamin S. Siegel, MD; and Committee on Psychosocial Aspects of Child and Family Health

ABSTRACT. Extensive data available from more than 30 years of research reveal that children raised by gay and lesbian parents have demonstrated resilience with regard to social, psychological, and sexual health despite economic and legal disparities and social stigma. Many studies have demonstrated that children's well-being is affected much more by their relationships with their parents, their parents' sense of competence and security, and the presence of social and economic support for the family than by the gender or the sexual orientation of their parents. Lack of opportunity for same-gender couples to marry adds to families' stress, which affects the health and welfare of all household members. Because marriage strengthens families and, in so doing, benefits children's development, children should not be deprived of the opportunity for their parents to be married. Paths to parenthood that include assisted reproductive techniques, adoption, and foster parenting should focus on competency of the parents rather than their sexual orientation. (3/13)
https://doi.org/10.1542/peds.2013-0377

PROMOTION OF HEALTHY WEIGHT-CONTROL PRACTICES IN YOUNG ATHLETES (CLINICAL REPORT)

Rebecca L. Carl, MD, MS, FAAP; Miriam D. Johnson, MD, FAAP; Thomas J. Martin, MD, FAAP; and Council on Sports Medicine and Fitness

ABSTRACT. Children and adolescents may participate in sports that favor a particular body type. Some sports, such as gymnastics, dance, and distance running, emphasize a slim or lean physique for aesthetic or performance reasons. Participants in weight-class sports, such as wrestling and martial arts, may attempt weight loss so they can compete at a lower weight class. Other sports, such as football and bodybuilding, highlight a muscular physique; young athletes engaged in these sports may desire to gain weight and muscle mass. This clinical report describes unhealthy methods of weight loss and gain as well as policies and approaches used to curb these practices. The report also reviews healthy strategies for weight loss and weight gain and provides recommendations for pediatricians on how to promote healthy weight control in young athletes. (8/17)
https://doi.org/10.1542/peds.2017-1871

PROTECTING CHILDREN FROM SEXUAL ABUSE BY HEALTH CARE PROVIDERS

Committee on Child Abuse and Neglect

ABSTRACT. Sexual abuse or exploitation of children is never acceptable. Such behavior by health care providers is particularly concerning because of the trust that children and their families place on adults in the health care profession. The American Academy of Pediatrics strongly endorses the social and moral prohibition against sexual abuse or exploitation of children by health care providers. The academy opposes any such sexual abuse or exploitation by providers, particularly by the academy's members. Health care providers should be trained to recognize and abide by appropriate provider-patient boundaries. Medical institutions should screen staff members for a history of child abuse issues, train them to respect and maintain appropriate boundaries, and establish policies and procedures to receive and investigate concerns about patient abuse. Each person has a responsibility to ensure the safety of children in health care settings and to scrupulously follow appropriate legal and ethical reporting and investigation procedures. (6/11, reaffirmed 10/14, 1/20)
https://doi.org/10.1542/peds.2011-1244

PROTECTING CHILDREN FROM TOBACCO, NICOTINE, AND TOBACCO SMOKE (TECHNICAL REPORT)

Harold J. Farber, MD, MSPH, FAAP; Judith Groner, MD, FAAP; Susan Walley, MD, FAAP; Kevin Nelson, MD, PhD, FAAP; and Section on Tobacco Control

ABSTRACT. This technical report serves to provide the evidence base for the American Academy of Pediatrics' policy statements "Clinical Practice Policy to Protect Children From Tobacco, Nicotine, and Tobacco Smoke" and "Public Policy to Protect Children From Tobacco, Nicotine, and Tobacco Smoke." Tobacco use and involuntary exposure are major preventable causes of morbidity and premature mortality in adults and children. Tobacco dependence almost always starts in childhood or adolescence. Electronic nicotine delivery systems are rapidly gaining popularity among youth, and their significant harms are being documented. In utero tobacco smoke exposure, in addition to increasing the risk of preterm birth, low birth weight, stillbirth, placental abruption, and sudden infant death, has been found to increase the risk of obesity and neurodevelopmental disorders. Actions by pediatricians can help to reduce children's risk of developing tobacco dependence and reduce children's involuntary tobacco smoke exposure. Public policy actions to protect children from tobacco are essential to reduce the toll that the tobacco epidemic takes on our children. (10/15, reaffirmed 6/20)
https://doi.org/10.1542/peds.2015-3110

PROVIDING A PRIMARY CARE MEDICAL HOME FOR CHILDREN AND YOUTH WITH CEREBRAL PALSY (CLINICAL REPORT)

Gregory S. Liptak, MD, MPH; Nancy A. Murphy, MD; and Council on Children With Disabilities

ABSTRACT. All primary care providers will care for children with cerebral palsy in their practice. In addition to well-child and acute illness care, the role of the medical home in the management of these children includes diagnosis, planning for interventions, authorizing treatments, and follow-up. Optimizing health and well-being for children with cerebral palsy and their families entails family-centered care provided in the medical home; comanagement is the most common model. This report reviews the aspects of care specific to cerebral palsy that a medical home should provide beyond the routine health care needed by all children. (10/11, reaffirmed 11/14, 8/18)
https://doi.org/10.1542/peds.2011-1468

PROVIDING A PRIMARY CARE MEDICAL HOME FOR CHILDREN AND YOUTH WITH SPINA BIFIDA (CLINICAL REPORT)

Robert Burke, MD, MPH; Gregory S. Liptak, MD, MPH; and Council on Children With Disabilities

ABSTRACT. The pediatric primary care provider in the medical home has a central and unique role in the care of children with spina bifida. The primary care provider addresses not only the typical issues of preventive and acute health care but also the needs specific to these children. Optimal care requires communication and comanagement with pediatric medical and developmental subspecialists, surgical specialists, therapists, and community providers. The medical home provider is essen-

tial in supporting the family and advocating for the child from the time of entry into the practice through adolescence, which includes transition and transfer to adult health care. This report reviews aspects of care specific to the infant with spina bifida (particularly myelomeningocele) that will facilitate optimal medical, functional, and developmental outcomes. (11/11, reaffirmed 2/15, 7/18)
https://doi.org/10.1542/peds.2011-2219

PROVIDING CARE FOR CHILDREN AND ADOLESCENTS FACING HOMELESSNESS AND HOUSING INSECURITY

Council on Community Pediatrics

ABSTRACT. Child health and housing security are closely intertwined, and children without homes are more likely to suffer from chronic disease, hunger, and malnutrition than are children with homes. Homeless children and youth often have significant psychosocial development issues, and their education is frequently interrupted. Given the overall effects that homelessness can have on a child's health and potential, it is important for pediatricians to recognize the factors that lead to homelessness, understand the ways that homelessness and its causes can lead to poor health outcomes, and when possible, help children and families mitigate some of the effects of homelessness. Through practice change, partnership with community resources, awareness, and advocacy, pediatricians can help optimize the health and well-being of children affected by homelessness. (5/13, reaffirmed 10/16)
https://doi.org/10.1542/peds.2013-0645

PROVIDING CARE FOR CHILDREN IN IMMIGRANT FAMILIES

Julie M. Linton, MD, FAAP; Andrea Green, MDCM, FAAP; and Council on Community Pediatrics

ABSTRACT. Children in immigrant families (CIF), who represent 1 in 4 children in the United States, represent a growing and ever more diverse US demographic that pediatric medical providers nationwide will increasingly encounter in clinical care. Immigrant children are those born outside the United States to non–US citizen parents, and CIF are defined as those who are either foreign born or have at least 1 parent who is foreign born. Some families immigrate for economic or educational reasons, and others come fleeing persecution and seeking safe haven. Some US-born children with a foreign-born parent may share vulnerabilities with children who themselves are foreign born, particularly regarding access to care and other social determinants of health. Therefore, the larger umbrella term of CIF is used in this statement. CIF, like all children, have diverse experiences that interact with their biopsychosocial development. CIF may face inequities that can threaten their health and well-being, and CIF also offer strengths and embody resilience that can surpass challenges experienced before and during integration. This policy statement describes the evolving population of CIF in the United States, briefly introduces core competencies to enhance care within a framework of cultural humility and safety, and discusses barriers and opportunities at the practice and systems levels. Practice-level recommendations describe how pediatricians can promote health equity for CIF through careful attention to core competencies in clinical care, thoughtful community engagement, and system-level support. Advocacy and policy recommendations offer ways pediatricians can advocate for policies that promote health equity for CIF. (8/19)
https://doi.org/10.1542/peds.2019-2077

PROVIDING CARE FOR INFANTS BORN AT HOME

Kristi Watterberg, MD, FAAP, and Committee on Fetus and Newborn

ABSTRACT. The American Academy of Pediatrics (AAP) believes that current data show that hospitals and accredited birth centers are the safest settings for birth in the United States. The AAP does not recommend planned home birth, which has been reported to be associated with a twofold to threefold increase in infant mortality in the United States. The AAP recognizes that women may choose to plan a home birth. This statement is intended to help pediatricians provide constructive, informed counsel to women considering home birth while retaining their role as child advocates and to summarize appropriate care for newborn infants born at home that is consistent with care provided for infants born in a medical care facility. Regardless of the circumstances of his or her birth, including location, every newborn infant deserves health care consistent with that highlighted in this statement, which is more completely described in other publications from the AAP, including *Guidelines for Perinatal Care* and the *Textbook of Neonatal Resuscitation.* All health care clinicians and institutions should promote communications and understanding on the basis of professional interaction and mutual respect. (4/20)
https://doi.org/10.1542/peds.2020-0626

PROVIDING PSYCHOSOCIAL SUPPORT TO CHILDREN AND FAMILIES IN THE AFTERMATH OF DISASTERS AND CRISES (CLINICAL REPORT)

David J. Schonfeld, MD, FAAP; Thomas Demaria, PhD; Disaster Preparedness Advisory Council; and Committee on Psychosocial Aspects of Child and Family Health

ABSTRACT. Disasters have the potential to cause short- and long-term effects on the psychological functioning, emotional adjustment, health, and developmental trajectory of children. This clinical report provides practical suggestions on how to identify common adjustment difficulties in children in the aftermath of a disaster and to promote effective coping strategies to mitigate the impact of the disaster as well as any associated bereavement and secondary stressors. This information can serve as a guide to pediatricians as they offer anticipatory guidance to families or consultation to schools, child care centers, and other child congregate care sites. Knowledge of risk factors for adjustment difficulties can serve as the basis for mental health triage. The importance of basic supportive services, psychological first aid, and professional self-care are discussed. Stress is intrinsic to many major life events that children and families face, including the experience of significant illness and its treatment. The information provided in this clinical report may, therefore, be relevant for a broad range of patient encounters, even outside the context of a disaster. Most pediatricians enter the profession because of a heartfelt desire to help children and families most in need. If adequately prepared and supported, pediatricians who are able to draw on their skills to assist children, families, and communities to recover after a disaster will find the work to be particularly rewarding. (9/15, reaffirmed 12/20)
https://doi.org/10.1542/peds.2015-2861

PSYCHOLOGICAL MALTREATMENT (CLINICAL REPORT)

Roberta Hibbard, MD; Jane Barlow, DPhil; Harriet MacMillan, MD; Committee on Child Abuse and Neglect (joint with American Academy of Child and Adolescent Psychiatry Child Maltreatment and Violence Committee)

ABSTRACT. Psychological or emotional maltreatment of children may be the most challenging and prevalent form of child abuse and neglect. Caregiver behaviors include acts of omission (ignoring need for social interactions) or commission (spurning, terrorizing); may be verbal or nonverbal, active or passive, and with or without intent to harm; and negatively affect the child's cognitive, social, emotional, and/or physical development. Psychological maltreatment has been linked with disorders of attachment, developmental and educational problems, socialization problems, disruptive behavior, and later psychopathology. Although no evidence-based interventions that can prevent psychological maltreatment have been identified to date, it is

possible that interventions shown to be effective in reducing overall types of child maltreatment, such as the Nurse Family Partnership, may have a role to play. Furthermore, prevention before occurrence will require both the use of universal interventions aimed at promoting the type of parenting that is now recognized to be necessary for optimal child development, alongside the use of targeted interventions directed at improving parental sensitivity to a child's cues during infancy and later parent-child interactions. Intervention should, first and foremost, focus on a thorough assessment and ensuring the child's safety. Potentially effective treatments include cognitive behavioral parenting programs and other psychotherapeutic interventions. The high prevalence of psychological abuse in advanced Western societies, along with the serious consequences, point to the importance of effective management. Pediatricians should be alert to the occurrence of psychological maltreatment and identify ways to support families who have risk indicators for, or evidence of, this problem. (7/12, reaffirmed 4/16)
https://doi.org/10.1542/peds.2012-1552

PSYCHOSOCIAL FACTORS IN CHILDREN AND YOUTH WITH SPECIAL HEALTH CARE NEEDS AND THEIR FAMILIES (CLINICAL REPORT)

Gerri Mattson, MD, MSPH, FAAP; Dennis Z. Kuo, MD, MHS, FAAP; Committee on Psychosocial Aspects of Child and Family Health; and Council on Children With Disabilities

ABSTRACT. Children and youth with special health care needs (CYSHCN) and their families may experience a variety of internal (ie, emotional and behavioral) and external (ie, interpersonal, financial, housing, and educational) psychosocial factors that can influence their health and wellness. Many CYSHCN and their families are resilient and thrive. Medical home teams can partner with CYSHCN and their families to screen for, evaluate, and promote psychosocial health to increase protective factors and ameliorate risk factors. Medical home teams can promote protective psychosocial factors as part of coordinated, comprehensive chronic care for CYSHCN and their families. A team-based care approach may entail collaboration across the care spectrum, including youth, families, behavioral health providers, specialists, child care providers, schools, social services, and other community agencies. The purpose of this clinical report is to raise awareness of the impact of psychosocial factors on the health and wellness of CYSHCN and their families. This clinical report provides guidance for pediatric providers to facilitate and coordinate care that can have a positive influence on the overall health, wellness, and quality of life of CYSHCN and their families. (12/18)
https://doi.org/10.1542/peds.2018-3171

PSYCHOSOCIAL SUPPORT FOR YOUTH LIVING WITH HIV (CLINICAL REPORT)

Jaime Martinez, MD, FAAP; Rana Chakraborty, MD, FAAP; and Committee on Pediatric AIDS

ABSTRACT. This clinical report provides guidance for the pediatrician in addressing the psychosocial needs of adolescents and young adults living with HIV, which can improve linkage to care and adherence to life-saving antiretroviral (ARV) therapy. Recent national case surveillance data for youth (defined here as adolescents and young adults 13 to 24 years of age) revealed that the burden of HIV/AIDS fell most heavily and disproportionately on African American youth, particularly males having sex with males. To effectively increase linkage to care and sustain adherence to therapy, interventions should address the immediate drivers of ARV compliance and also address factors that provide broader social and structural support for HIV-infected adolescents and young adults. Interventions should address psychosocial development, including lack of future orientation, inadequate educational attainment and limited health literacy, failure to focus on the long-term consequences of near-term risk behaviors, and coping ability. Associated challenges are closely linked to the structural environment. Individual case management is essential to linkage to and retention in care, ARV adherence, and management of associated comorbidities. Integrating these skills into pediatric and adolescent HIV practice in a medical home setting is critical, given the alarming increase in new HIV infections in youth in the United States. (2/14)
https://doi.org/10.1542/peds.2013-4061

A PUBLIC HEALTH RESPONSE TO OPIOID USE IN PREGNANCY

Stephen W. Patrick, MD, MPH, MS, FAAP; Davida M. Schiff, MD, FAAP; and Committee on Substance Use and Prevention

ABSTRACT. The use of opioids during pregnancy has grown rapidly in the past decade. As opioid use during pregnancy increased, so did complications from their use, including neonatal abstinence syndrome. Several state governments responded to this increase by prosecuting and incarcerating pregnant women with substance use disorders; however, this approach has no proven benefits for maternal or infant health and may lead to avoidance of prenatal care and a decreased willingness to engage in substance use disorder treatment programs. A public health response, rather than a punitive approach to the opioid epidemic and substance use during pregnancy, is critical, including the following: a focus on preventing unintended pregnancies and improving access to contraception; universal screening for alcohol and other drug use in women of childbearing age; knowledge and informed consent of maternal drug testing and reporting practices; improved access to comprehensive obstetric care, including opioid-replacement therapy; gender-specific substance use treatment programs; and improved funding for social services and child welfare systems. The American College of Obstetricians and Gynecologists supports the value of this clinical document as an educational tool (December 2016). (2/17)
https://doi.org/10.1542/peds.2016-4070

PUBLIC POLICIES TO REDUCE SUGARY DRINK CONSUMPTION IN CHILDREN AND ADOLESCENTS

Natalie D. Muth, MD, MPH, RDN, FAAP; William H. Dietz, MD, PhD, FAAP; Sheela N. Magge, MD, MSCE, FAAP; Rachel K. Johnson, PhD, MPH, RD, FAHA; Section on Obesity; and Committee on Nutrition (joint with American Heart Association)

ABSTRACT. Excess consumption of added sugars, especially from sugary drinks, poses a grave health threat to children and adolescents, disproportionately affecting children of minority and low-income communities. Public policies, such as those detailed in this statement, are needed to decrease child and adolescent consumption of added sugars and improve health. (3/19)
https://doi.org/10.1542/peds.2019-0282

PUBLIC POLICY TO PROTECT CHILDREN FROM TOBACCO, NICOTINE, AND TOBACCO SMOKE

Section on Tobacco Control

ABSTRACT. Tobacco use and tobacco smoke exposure are among the most important health threats to children, adolescents, and adults. There is no safe level of tobacco smoke exposure. The developing brains of children and adolescents are particularly vulnerable to the development of tobacco and nicotine dependence. Tobacco is unique among consumer products in that it causes disease and death when used exactly as intended. Tobacco continues to be heavily promoted to children and young adults. Flavored and alternative tobacco products, including little cigars, chewing tobacco, and electronic nicotine delivery systems, are gaining popularity among youth. This statement describes important evidence-based public policy actions that, when implemented, will reduce tobacco product use and tobacco

smoke exposure among youth and, by doing so, improve the health of children and young adults. (10/15, reaffirmed 6/20)
https://doi.org/10.1542/peds.2015-3109

QUALITY EARLY EDUCATION AND CHILD CARE FROM BIRTH TO KINDERGARTEN

Elaine A. Donoghue, MD, FAAP, and Council on Early Childhood

ABSTRACT. High-quality early education and child care for young children improves physical and cognitive outcomes for the children and can result in enhanced school readiness. Preschool education can be viewed as an investment (especially for at-risk children), and studies show a positive return on that investment. Barriers to high-quality early childhood education include inadequate funding and staff education as well as variable regulation and enforcement. Steps that have been taken to improve the quality of early education and child care include creating multidisciplinary, evidence-based child care practice standards; establishing state quality rating and improvement systems; improving federal and state regulations; providing child care health consultation; and initiating other innovative partnerships. Pediatricians have a role in promoting quality early education and child care for all children not only in the medical home but also at the community, state, and national levels. (7/17)
https://doi.org/10.1542/peds.2017-1488

RACE, ETHNICITY, AND SOCIOECONOMIC STATUS IN RESEARCH ON CHILD HEALTH

Tina L. Cheng, MD, MPH, FAAP; Elizabeth Goodman, MD, FAAP; and Committee on Pediatric Research

ABSTRACT. An extensive literature documents the existence of pervasive and persistent child health, development, and health care disparities by race, ethnicity, and socioeconomic status (SES). Disparities experienced during childhood can result in a wide variety of health and health care outcomes, including adult morbidity and mortality, indicating that it is crucial to examine the influence of disparities across the life course. Studies often collect data on the race, ethnicity, and SES of research participants to be used as covariates or explanatory factors. In the past, these variables have often been assumed to exert their effects through individual or genetically determined biologic mechanisms. However, it is now widely accepted that these variables have important social dimensions that influence health. SES, a multidimensional construct, interacts with and confounds analyses of race and ethnicity. Because SES, race, and ethnicity are often difficult to measure accurately, leading to the potential for misattribution of causality, thoughtful consideration should be given to appropriate measurement, analysis, and interpretation of such factors. Scientists who study child and adolescent health and development should understand the multiple measures used to assess race, ethnicity, and SES, including their validity and shortcomings and potential confounding of race and ethnicity with SES. The American Academy of Pediatrics (AAP) recommends that research on eliminating health and health care disparities related to race, ethnicity, and SES be a priority. Data on race, ethnicity, and SES should be collected in research on child health to improve their definitions and increase understanding of how these factors and their complex interrelationships affect child health. Furthermore, the AAP believes that researchers should consider both biological and social mechanisms of action of race, ethnicity, and SES as they relate to the aims and hypothesis of the specific area of investigation. It is important to measure these variables, but it is not sufficient to use these variables alone as explanatory for differences in disease, morbidity, and outcomes without attention to the social and biologic influences they have on health throughout the life course. The AAP recommends more research, both in the United States and internationally, on measures of race, ethnicity, and SES and how these complex constructs affect health care and health outcomes throughout the life course. (12/14)
https://doi.org/10.1542/peds.2014-3109

RADIATION RISK TO CHILDREN FROM COMPUTED TOMOGRAPHY (CLINICAL REPORT)

Alan S. Brody, MD; Donald P. Frush, MD; Walter Huda, PhD; Robert L. Brent, MD, PhD; and Section on Radiology

ABSTRACT. Imaging studies that use ionizing radiation are an essential tool for the evaluation of many disorders of childhood. Ionizing radiation is used in radiography, fluoroscopy, angiography, and computed tomography scanning. Computed tomography is of particular interest because of its relatively high radiation dose and wide use. Consensus statements on radiation risk suggest that it is reasonable to act on the assumption that low-level radiation may have a small risk of causing cancer. The medical community should seek ways to decrease radiation exposure by using radiation doses as low as reasonably achievable and by performing these studies only when necessary. There is wide agreement that the benefits of an indicated computed tomography scan far outweigh the risks. Pediatric health care professionals' roles in the use of computed tomography on children include deciding when a computed tomography scan is necessary and discussing the risk with patients and families. Radiologists should be a source of consultation when forming imaging strategies and should create specific protocols with scanning techniques optimized for pediatric patients. Families and patients should be encouraged to ask questions about the risks and benefits of computed tomography scanning. The information in this report is provided to aid in decision-making and discussions with the health care team, patients, and families. (9/07)
https://doi.org/10.1542/peds.2007-1910

RECOGNITION AND MANAGEMENT OF IATROGENICALLY INDUCED OPIOID DEPENDENCE AND WITHDRAWAL IN CHILDREN (CLINICAL REPORT)

Jeffrey Galinkin, MD, FAAP; Jeffrey Lee Koh, MD, FAAP; Committee on Drugs; and Section on Anesthesiology and Pain Medicine

ABSTRACT. Opioids are often prescribed to children for pain relief related to procedures, acute injuries, and chronic conditions. Round-the-clock dosing of opioids can produce opioid dependence within 5 days. According to a 2001 consensus paper from the American Academy of Pain Medicine, American Pain Society, and American Society of Addiction Medicine, dependence is defined as "a state of adaptation that is manifested by a drug class specific withdrawal syndrome that can be produced by abrupt cessation, rapid dose reduction, decreasing blood level of the drug, and/or administration of an antagonist." Although the experience of many children undergoing iatrogenically induced withdrawal may be mild or goes unreported, there is currently no guidance for recognition or management of withdrawal for this population. Guidance on this subject is available only for adults and primarily for adults with substance use disorders. The guideline will summarize existing literature and provide readers with information currently not available in any single source specific for this vulnerable pediatric population. (12/13)
https://doi.org/10.1542/peds.2013-3398

RECOGNITION AND MANAGEMENT OF MEDICAL COMPLEXITY (CLINICAL REPORT)

Dennis Z. Kuo, MD, MHS, FAAP; Amy J. Houtrow, MD, PhD, MPH, FAAP; and Council on Children With Disabilities

ABSTRACT. Children with medical complexity have extensive needs for health services, experience functional limitations, and are high resource utilizers. Addressing the needs of this

population to achieve high-value health care requires optimizing care within the medical home and medical neighborhood. Opportunities exist for health care providers, payers, and policy makers to develop strategies to enhance care delivery and to decrease costs. Important outcomes include decreasing unplanned hospital admissions, decreasing emergency department use, ensuring access to health services, limiting out-of-pocket expenses for families, and improving patient and family experiences, quality of life, and satisfaction with care. This report describes the population of children with medical complexity and provides strategies to optimize medical and health outcomes. (11/16)

https://doi.org/10.1542/peds.2016-3021

RECOGNIZING AND RESPONDING TO MEDICAL NEGLECT (CLINICAL REPORT)

Carole Jenny, MD, MBA, and Committee on Child Abuse and Neglect

ABSTRACT. A caregiver may fail to recognize or respond to a child's medical needs for a variety of reasons. An effective response by a health care professional to medical neglect requires a comprehensive assessment of the child's needs, the parents' resources, the parents' efforts to provide for the needs of the child, and options for ensuring optimal health for the child. Such an assessment requires clear, 2-way communication between the family and the health care professional. Physicians should consider the least intrusive options for managing cases of medical neglect that ensure the health and safety of the child. (12/07, reaffirmed 1/11, 2/16)

https://doi.org/10.1542/peds.2007-2903

RECOMMENDATIONS FOR PREVENTION AND CONTROL OF INFLUENZA IN CHILDREN, 2021–2022

Committee on Infectious Diseases

ABSTRACT. This statement updates the recommendations of the American Academy of Pediatrics for the routine use of influenza vaccine and antiviral medications in the prevention and treatment of influenza in children during the 2021–2022 influenza season. A detailed review of the evidence supporting these recommendations is published in the accompanying technical report. The American Academy of Pediatrics recommends annual influenza immunization of all children without medical contraindications, starting at 6 months of age. Influenza vaccination is an important intervention to protect vulnerable populations and reduce the burden of respiratory illnesses during circulation of severe acute respiratory syndrome coronavirus, which is expected to continue during the 2021–2022 influenza season. Any licensed, recommended, age-appropriate vaccine available can be administered, without preference for one product or formulation over another. Antiviral treatment of influenza with any licensed, recommended, age-appropriate influenza antiviral medication is recommended for children with suspected or confirmed influenza who are hospitalized, have severe or progressive disease, or have underlying conditions that increase their risk of complications of influenza. Antiviral treatment may be considered for any previously healthy, symptomatic outpatient not at high risk for influenza complications, in whom an influenza diagnosis is confirmed or suspected, if treatment can be initiated within 48 hours of illness onset and for children whose siblings or household contacts either are younger than 6 months or have a high-risk condition that predisposes them to complications of influenza. (9/21)

See full text on page 983.

https://doi.org/10.1542/peds.2021-053744

RECOMMENDATIONS FOR PREVENTION AND CONTROL OF INFLUENZA IN CHILDREN, 2021–2022 (TECHNICAL REPORT)

Committee on Infectious Diseases

ABSTRACT. This technical report accompanies the recommendations of the American Academy of Pediatrics for the routine use of the influenza vaccine and antiviral medications in the prevention and treatment of influenza in children during the 2021–2022 season. Influenza vaccination is an important intervention to protect vulnerable populations and reduce the burden of respiratory illnesses during circulation of severe acute respiratory syndrome coronavirus 2, which is expected to continue during this influenza season. In this technical report, we summarize recent influenza seasons, morbidity and mortality in children, vaccine effectiveness, vaccination coverage, and detailed guidance on storage, administration, and implementation. We also provide background on inactivated and live attenuated influenza vaccine recommendations, vaccination during pregnancy and breastfeeding, diagnostic testing, and antiviral medications for treatment and chemoprophylaxis. (9/21)

See full text on page 995.

https://doi.org/10.1542/peds.2021-053745

RECOMMENDATIONS FOR SEROGROUP B MENINGOCOCCAL VACCINE FOR PERSONS 10 YEARS AND OLDER

Committee on Infectious Diseases

ABSTRACT. This policy statement provides recommendations for the prevention of serogroup B meningococcal disease through the use of 2 newly licensed serogroup B meningococcal vaccines: MenB-FHbp (Trumenba; Wyeth Pharmaceuticals, a subsidiary of Pfizer, Philadelphia, PA) and MenB-4C (Bexsero; Novartis Vaccines, Siena, Italy). Both vaccines are approved for use in persons 10 through 25 years of age. MenB-FHbp is licensed as a 2- or 3-dose series, and MenB-4C is licensed as a 2-dose series for all groups. Either vaccine is recommended for routine use in persons 10 years and older who are at increased risk of serogroup B meningococcal disease (category A recommendation). Persons at increased risk of meningococcal serogroup B disease include the following: (1) persons with persistent complement component diseases, including inherited or chronic deficiencies in C3, C5–C9, properdin, factor D, or factor H, or persons receiving eculizumab (Soliris; Alexion Pharmaceuticals, Cheshire, CT), a monoclonal antibody that acts as a terminal complement inhibitor by binding C5 and inhibiting cleavage of C5 to C5A; (2) persons with anatomic or functional asplenia, including sickle cell disease; and (3) healthy persons at increased risk because of a serogroup B meningococcal disease outbreak. Both serogroup B meningococcal vaccines have been shown to be safe and immunogenic and are licensed by the US Food and Drug Administration for individuals between the ages of 10 and 25 years. On the basis of epidemiologic and antibody persistence data, the American Academy of Pediatrics agrees with the Advisory Committee on Immunization Practices of the Centers for Disease Control and Prevention that either vaccine may be administered to healthy adolescents and young adults 16 through 23 years of age (preferred ages are 16 through 18 years) to provide short-term protection against most strains of serogroup B meningococcal disease (category B recommendation). (8/16)

https://doi.org/10.1542/peds.2016-1890

RECOMMENDED CHILDHOOD AND ADOLESCENT IMMUNIZATION SCHEDULE: UNITED STATES, 2022

Committee on Infectious Diseases (2/22)

See full text on page 1025.

https://doi.org/10.1542/peds.2021-056056

RECOMMENDED ESSENTIAL EQUIPMENT FOR BASIC LIFE SUPPORT AND ADVANCED LIFE SUPPORT GROUND AMBULANCES 2020: A JOINT POSITION STATEMENT

John Lyng, MD, NRP; Kathleen Adelgais, MD, MPH; Rachael Alter, BA; Justin Beal, RN; Bruce Chung, MD; Toni Gross, MD; Marc Minkler, NRP; Brian Moore, MD; Tim Stebbins, MD; Sam Vance, NRP; Ken Williams, MD; and Allen Yee, MD

ABSTRACT. The National Association of EMS Physicians, along with these coauthoring associations: American Academy of Pediatrics, American College of Surgeons Committee on Trauma, EMS for Children Innovation and Improvement Center, Emergency Nurses Association, and National Association of State EMS Officials and as also endorsed by the National Association of Emergency Medical Technicians, believes that the delivery of high-quality and effective EMS care is dependent on several factors, including but not limited to the presence of the following:

— providers who have been credentialed to ensure they demonstrate appropriate cognitive knowledge, affective ability, psychomotor skills, and critical thinking;
— clinical protocols or guidelines that are supported by the best available scientific evidence; and
— equipment and supplies necessary to deliver appropriate care as directed by clinical protocols and/or guidelines for patients of all ages.

Several documents, including previous versions of this joint position statement, the National Model EMS Clinical Guidelines Version 2.2, the 2018 National EMS Scope of Practice Model, the Clinical Credentialing of EMS Providers, Physician Oversight of Pediatric Care in Emergency Medical Services, Pediatric Readiness in Emergency Medical Services Systems, and core performance measures from the US Department of Health and Human Services Health Resources and Services Administration EMS for Children (EMSC) Program have been developed to lay the foundation of several of the concepts noted above. (5/21)

See full text on page 1031.

https://doi.org/10.1542/peds.2021-051508

REDUCING INJURY RISK FROM BODY CHECKING IN BOYS' YOUTH ICE HOCKEY

Council on Sports Medicine and Fitness

ABSTRACT. Ice hockey is an increasingly popular sport that allows intentional collision in the form of body checking for males but not for females. There is a two- to threefold increased risk of all injury, severe injury, and concussion related to body checking at all levels of boys' youth ice hockey. The American Academy of Pediatrics reinforces the importance of stringent enforcement of rules to protect player safety as well as educational interventions to decrease unsafe tactics. To promote ice hockey as a lifelong recreational pursuit for boys, the American Academy of Pediatrics recommends the expansion of nonchecking programs and the restriction of body checking to elite levels of boys' youth ice hockey, starting no earlier than 15 years of age. (5/14, reaffirmed 7/18)

https://doi.org/10.1542/peds.2014-0692

REDUCING THE NUMBER OF DEATHS AND INJURIES FROM RESIDENTIAL FIRES

Committee on Injury and Poison Prevention

ABSTRACT. Smoke inhalation, severe burns, and death from residential fires are devastating events, most of which are preventable. In 1998, approximately 381 500 residential structure fires resulted in 3250 non-firefighter deaths, 17 175 injuries, and approximately $4.4 billion in property loss. This statement reviews important prevention messages and intervention strategies related to residential fires. It also includes recommendations for pediatricians regarding office anticipatory guidance, work in the community, and support of regulation and legislation that could result in a decrease in the number of fire-related injuries and deaths to children. (6/00)

https://doi.org/10.1542/peds.105.6.1355

REFERRAL TO PEDIATRIC SURGICAL SPECIALISTS

Surgical Advisory Panel

ABSTRACT. The American Academy of Pediatrics, with the collaboration of the Surgical Sections of the American Academy of Pediatrics, has created referral recommendations intended to serve as voluntary practice parameters to assist general pediatricians in determining when and to whom to refer their patients for pediatric surgical specialty care. It is recognized that these recommendations may be difficult to implement, because communities vary in terms of access to major pediatric medical centers. Limited access does not negate the value of the recommendations, however, because the child who needs specialized surgical and anesthetic care is best served by the skills of the appropriate pediatric surgical team. Major congenital anomalies, malignancies, major trauma, and chronic illnesses (including those associated with preterm birth) in infants and children should be managed by pediatric medical subspecialists and pediatric surgical specialists at pediatric referral centers that can provide expertise in many areas, including the pediatric medical subspecialties and surgical specialties of pediatric radiology, pediatric anesthesiology, pediatric pathology, and pediatric intensive care. The optimal management of the child with complex problems, chronic illness, or disabilities requires coordination, communication, and cooperation of the pediatric surgical specialist with the child's primary care pediatrician or physician. (1/14)

https://doi.org/10.1542/peds.2013-3820

RELIEF OF PAIN AND ANXIETY IN PEDIATRIC PATIENTS IN EMERGENCY MEDICAL SYSTEMS (CLINICAL REPORT)

Joel A. Fein, MD, MPH; William T. Zempsky, MD, MPH; Joseph P. Cravero, MD; Committee on Pediatric Emergency Medicine; and Section on Anesthesiology and Pain Medicine

ABSTRACT. Control of pain and stress for children is a vital component of emergency medical care. Timely administration of analgesia affects the entire emergency medical experience and can have a lasting effect on a child's and family's reaction to current and future medical care. A systematic approach to pain management and anxiolysis, including staff education and protocol development, can provide comfort to children in the emergency setting and improve staff and family satisfaction. (10/12, reaffirmed 9/15, 12/20)

https://doi.org/10.1542/peds.2012-2536

RESCUE MEDICINE FOR EPILEPSY IN EDUCATION SETTINGS (CLINICAL REPORT)

Adam L. Hartman, MD, FAAP; Cynthia Di Laura Devore, MD; Section on Neurology; and Council on School Health

ABSTRACT. Children and adolescents with epilepsy may experience prolonged seizures in school-associated settings (eg, during transportation, in the classroom, or during sports activities). Prolonged seizures may evolve into status epilepticus. Administering a seizure rescue medication can abort the seizure and may obviate the need for emergency medical services and subsequent care in an emergency department. In turn, this may save patients from the morbidity of more invasive interventions and the cost of escalated care. There are significant variations in prescribing practices for seizure rescue medications, partly because of inconsistencies between jurisdictions in legislation and professional practice guidelines among potential first responders (including school staff). There also are potential liability issues for prescribers, school districts, and unlicensed

assistive personnel who might administer the seizure rescue medications. This clinical report highlights issues that providers may consider when prescribing seizure rescue medications and creating school medical orders and/or action plans for students with epilepsy. Collaboration among prescribing providers, families, and schools may be useful in developing plans for the use of seizure rescue medications. (12/15)
https://doi.org/10.1542/peds.2015-3876

RESISTANCE TRAINING FOR CHILDREN AND ADOLESCENTS (CLINICAL REPORT)

Paul R. Stricker, MD, FAAP; Avery D. Faigenbaum, EdD, FACSM, FNSCA; Teri M. McCambridge, MD, FAAP; and Council on Sports Medicine and Fitness

ABSTRACT. Resistance training is becoming more important as an integral part of comprehensive sport training regimens, school physical education classes, and after-school fitness programs. The increasing number of youth who are involved in sport activities, coupled with the health problems of inactivity and being overweight, have resulted in increased interest in resistance training. Secular declines in measures of muscular fitness in modern-day youth highlight the need for participation in youth resistance training for nonathletes as well as athletes. Parents often ask pediatricians to offer advice regarding the safety, benefits, and implementation of an effective resistance-training program. This report is a revision of the 2008 American Academy of Pediatrics policy statement and reviews current information and research on the benefits and risks of resistance training for children and adolescents. (5/20)
https://doi.org/10.1542/peds.2020-1011

RESOURCES RECOMMENDED FOR THE CARE OF PEDIATRIC PATIENTS IN HOSPITALS (CLINICAL REPORT)

Kimberly D. Ernst, MD, MSMI, FAAP, and Committee on Hospital Care

ABSTRACT. It is crucial that all children are provided with high-quality and safe health care. Pediatric inpatient needs are unique in regard to policies, equipment, facilities, and personnel. The intent of this clinical report is to provide recommendations for the resources necessary to provide high-quality and safe pediatric inpatient medical care. (3/20)
https://doi.org/10.1542/peds.2020-0204

RESPIRATORY SUPPORT IN PRETERM INFANTS AT BIRTH

Committee on Fetus and Newborn

ABSTRACT. Current practice guidelines recommend administration of surfactant at or soon after birth in preterm infants with respiratory distress syndrome. However, recent multicenter randomized controlled trials indicate that early use of continuous positive airway pressure with subsequent selective surfactant administration in extremely preterm infants results in lower rates of bronchopulmonary dysplasia/death when compared with treatment with prophylactic or early surfactant therapy. Continuous positive airway pressure started at or soon after birth with subsequent selective surfactant administration may be considered as an alternative to routine intubation with prophylactic or early surfactant administration in preterm infants. (12/13)
https://doi.org/10.1542/peds.2013-3442

RESPONDING TO PARENTAL REFUSALS OF IMMUNIZATION OF CHILDREN (CLINICAL REPORT)

Douglas S. Diekema, MD, MPH, and Committee on Bioethics

ABSTRACT. The American Academy of Pediatrics strongly endorses universal immunization. However, for childhood immunization programs to be successful, parents must comply with immunization recommendations. The problem of parental refusal of immunization for children is an important one for pediatricians. The goal of this report is to assist pediatricians in understanding the reasons parents may have for refusing to immunize their children, review the limited circumstances under which parental refusals should be referred to child protective services agencies or public health authorities, and provide practical guidance to assist the pediatrician faced with a parent who is reluctant to allow immunization of his or her child. (5/05, reaffirmed 1/09, 11/12)
https://doi.org/10.1542/peds.2005-0316

RESPONSIBLE INNOVATION IN CHILDREN'S SURGICAL CARE

Section on Surgery and Committee on Bioethics (joint with American Pediatric Surgical Association New Technology Committee)

ABSTRACT. Advances in medical care may occur when a change in practice incorporates a new treatment or methodology. In surgery, this may involve the translation of a completely novel concept into a new procedure or device or the adaptation of existing treatment approaches or technology to a new clinical application. Regardless of the specifics, innovation should have, as its primary goal, the enhancement of care leading to improved outcomes from the patient's perspective. This policy statement examines innovation as it pertains to surgical care, focusing on some of the definitions that help differentiate applied innovation or innovative therapy from research. The ethical challenges and the potential for conflict of interest for surgeons or institutions seeking to offer innovative surgical therapy are examined. The importance of engaging patients and families as "innovation partners" to ensure complete transparency of expectations from the patient's and provider's perspectives is also examined, with specific emphasis on cultural competence and mutually respectful approaches. A framework for identifying, evaluating, and safely implementing innovative surgical therapy in children is provided. (12/16)
https://doi.org/10.1542/peds.2016-3437

RETURNING TO LEARNING FOLLOWING A CONCUSSION (CLINICAL REPORT)

Mark E. Halstead, MD, FAAP; Karen McAvoy, PsyD; Cynthia D. Devore, MD, FAAP; Rebecca Carl, MD, FAAP; Michael Lee, MD, FAAP; Kelsey Logan, MD, FAAP; Council on Sports Medicine and Fitness; and Council on School Health

ABSTRACT. Following a concussion, it is common for children and adolescents to experience difficulties in the school setting. Cognitive difficulties, such as learning new tasks or remembering previously learned material, may pose challenges in the classroom. The school environment may also increase symptoms with exposure to bright lights and screens or noisy cafeterias and hallways. Unfortunately, because most children and adolescents look physically normal after a concussion, school officials often fail to recognize the need for academic or environmental adjustments. Appropriate guidance and recommendations from the pediatrician may ease the transition back to the school environment and facilitate the recovery of the child or adolescent. This report serves to provide a better understanding of possible factors that may contribute to difficulties in a school environment after a concussion and serves as a framework for the medical home, the educational home, and the family home to guide the student to a successful and safe return to learning. (10/13, reaffirmed 7/18)
https://doi.org/10.1542/peds.2013-2867

RITUAL GENITAL CUTTING OF FEMALE MINORS

Board of Directors (6/10)
https://doi.org/10.1542/peds.2010-1568

THE ROLE OF INTEGRATED CARE IN A MEDICAL HOME FOR PATIENTS WITH A FETAL ALCOHOL SPECTRUM DISORDER (CLINICAL REPORT)

Renee M. Turchi, MD, MPH, FAAP; Vincent C. Smith, MD, MPH, FAAP; Committee on Substance Use and Prevention; and Council on Children With Disabilities

ABSTRACT. Fetal alcohol spectrum disorder (FASD) is an umbrella term used to describe preventable birth defects and intellectual and/or developmental disabilities resulting from prenatal alcohol exposure. The American Academy of Pediatrics has a previous clinical report in which diagnostic criteria for a child with an FASD are discussed and tools to assist pediatricians with its management can be found. This clinical report is intended to foster pediatrician awareness of approaches for screening for prenatal alcohol exposure in clinical practice, to guide management of a child with an FASD after the diagnosis is made, and to summarize available resources for FASD management. (9/18)

https://doi.org/10.1542/peds.2018-2333

THE ROLE OF PEDIATRICIANS IN GLOBAL HEALTH

Parminder S. Suchdev, MD, MPH, FAAP; Cynthia R. Howard, MD, MPHTM, FAAP; Section on International Child Health

ABSTRACT. Ninety percent of the world's children live in low- and middle-income countries, where barriers to health contribute to significant child morbidity and mortality. The American Academy of Pediatrics is dedicated to the health and well-being of *all* children. To fulfill this promise, this policy statement defines the role of the pediatrician in global health and provides a specific set of recommendations directed to all pediatricians, emphasizing the importance of global health as an integral function of the profession of pediatrics. (11/18)

https://doi.org/10.1542/peds.2018-2997

ROLE OF PULSE OXIMETRY IN EXAMINING NEWBORNS FOR CONGENITAL HEART DISEASE: A SCIENTIFIC STATEMENT FROM THE AHA AND AAP

William T. Mahle, MD; Jane W. Newburger, MD, MPH; G. Paul Matherne, MD; Frank C. Smith, MD; Tracey R. Hoke, MD; Robert Koppel, MD; Samuel S. Gidding, MD; Robert H. Beekman III, MD; Scott D. Grosse, PhD; on behalf of Section on Cardiology and Cardiac Surgery and Committee of Fetus and Newborn (joint with American Heart Association Congenital Heart Defects Committee of the Council on Cardiovascular Disease in the Young, Council on Cardiovascular Nursing, and Interdisciplinary Council on Quality of Care and Outcomes Research)

ABSTRACT. *Background.* The purpose of this statement is to address the state of evidence on the routine use of pulse oximetry in newborns to detect critical congenital heart disease (CCHD).

Methods and Results. A writing group appointed by the American Heart Association and the American Academy of Pediatrics reviewed the available literature addressing current detection methods for CCHD, burden of missed and/or delayed diagnosis of CCHD, rationale of oximetry screening, and clinical studies of oximetry in otherwise asymptomatic newborns. MEDLINE database searches from 1966 to 2008 were done for English-language papers using the following search terms: congenital heart disease, pulse oximetry, physical examination, murmur, echocardiography, fetal echocardiography, and newborn screening. The reference lists of identified papers were also searched. Published abstracts from major pediatric scientific meetings in 2006 to 2008 were also reviewed. The American Heart Association classification of recommendations and levels of evidence for practice guidelines were used. In an analysis of pooled studies of oximetry assessment performed after 24 hours of life, the estimated sensitivity for detecting CCHD was 69.6%, and the positive predictive value was 47.0%; however, sensitivity varied dramatically among studies from 0% to 100%. False-positive screens that required further evaluation occurred in only 0.035% of infants screened after 24 hours.

Conclusions. Currently, CCHD is not detected in some newborns until after their hospital discharge, which results in significant morbidity and occasional mortality. Furthermore, routine pulse oximetry performed on asymptomatic newborns after 24 hours of life, but before hospital discharge, may detect CCHD. Routine pulse oximetry performed after 24 hours in hospitals that have on-site pediatric cardiovascular services incurs very low cost and risk of harm. Future studies in larger populations and across a broad range of newborn delivery systems are needed to determine whether this practice should become standard of care in the routine assessment of the neonate. (8/09)

https://doi.org/10.1542/peds.2009-1397

THE ROLE OF THE PEDIATRICIAN IN PRIMARY PREVENTION OF OBESITY (CLINICAL REPORT)

Stephen R. Daniels, MD, PhD, FAAP; Sandra G. Hassink, MD, FAAP; and Committee on Nutrition

ABSTRACT. The adoption of healthful lifestyles by individuals and families can result in a reduction in many chronic diseases and conditions of which obesity is the most prevalent. Obesity prevention, in addition to treatment, is an important public health priority. This clinical report describes the rationale for pediatricians to be an integral part of the obesity-prevention effort. In addition, the 2012 Institute of Medicine report "Accelerating Progress in Obesity Prevention" includes health care providers as a crucial component of successful weight control. Research on obesity prevention in the pediatric care setting as well as evidence-informed practical approaches and targets for prevention are reviewed. Pediatricians should use a longitudinal, developmentally appropriate life-course approach to help identify children early on the path to obesity and base prevention efforts on family dynamics and reduction in high-risk dietary and activity behaviors. They should promote a diet free of sugar-sweetened beverages, of fewer foods with high caloric density, and of increased intake of fruits and vegetables. It is also important to promote a lifestyle with reduced sedentary behavior and with 60 minutes of daily moderate to vigorous physical activity. This report also identifies important gaps in evidence that need to be filled by future research. (6/15)

https://doi.org/10.1542/peds.2015-1558

THE ROLE OF THE PEDIATRICIAN IN RURAL EMERGENCY MEDICAL SERVICES FOR CHILDREN

Committee on Pediatric Emergency Medicine

ABSTRACT. In rural America, pediatricians can play a key role in the development, implementation, and ongoing supervision of emergency medical services for children (EMSC). Pediatricians may represent the only source of pediatric expertise for a large region and are a vital resource for rural physicians (eg, general and family practice, emergency medicine) and other rural health care professionals (physician assistants, nurse practitioners, and emergency medical technicians), providing education about management and prevention of pediatric illness and injury; appropriate equipment for the acutely ill or injured child; and acute, chronic, and rehabilitative care. In addition to providing clinical expertise, the pediatrician may be involved in quality assurance, clinical protocol development, and advocacy, and may serve as a liaison between emergency medical services and other entities working with children (eg, school nurses, child care centers, athletic programs, and programs for children with special health care needs). (10/12, reaffirmed 9/15)

https://doi.org/10.1542/peds.2012-2547

ROLE OF THE PEDIATRICIAN IN YOUTH VIOLENCE PREVENTION

Committee on Injury, Violence, and Poison Prevention

ABSTRACT. Youth violence continues to be a serious threat to the health of children and adolescents in the United States. It is crucial that pediatricians clearly define their role and develop the appropriate skills to address this threat effectively. From a clinical perspective, pediatricians should become familiar with *Connected Kids: Safe, Strong, Secure,* the American Academy of Pediatrics' primary care violence prevention protocol. Using this material, practices can incorporate preventive education, screening for risk, and linkages to community-based counseling and treatment resources. As advocates, pediatricians may bring newly developed information regarding key risk factors such as exposure to firearms, teen dating violence, and bullying to the attention of local and national policy makers. This policy statement refines the developing role of pediatricians in youth violence prevention and emphasizes the importance of this issue in the strategic agenda of the American Academy of Pediatrics. (6/09, reaffirmed 4/19)
https://doi.org/10.1542/peds.2009-0943

ROLE OF THE SCHOOL NURSE IN PROVIDING SCHOOL HEALTH SERVICES

Council on School Health

ABSTRACT. The American Academy of Pediatrics recognizes the important role school nurses play in promoting the optimal biopsychosocial health and well-being of school-aged children in the school setting. Although the concept of a school nurse has existed for more than a century, uniformity among states and school districts regarding the role of a registered professional nurse in schools and the laws governing it are lacking. By understanding the benefits, roles, and responsibilities of school nurses working as a team with the school physician, as well as their contributions to school-aged children, pediatricians can collaborate with, support, and promote school nurses in their own communities, thus improving the health, wellness, and safety of children and adolescents. (5/16)
https://doi.org/10.1542/peds.2016-0852

ROLE OF THE SCHOOL PHYSICIAN

Council on School Health

ABSTRACT. The American Academy of Pediatrics recognizes the important role physicians play in promoting the optimal biopsychosocial well-being of children in the school setting. Although the concept of a school physician has existed for more than a century, uniformity among states and school districts regarding physicians in schools and the laws governing it are lacking. By understanding the roles and contributions physicians can make to schools, pediatricians can support and promote school physicians in their communities and improve health and safety for children. (12/12, reaffirmed 1/19)
https://doi.org/10.1542/peds.2012-2995

ROUTINE NEUROIMAGING OF THE PRETERM BRAIN (CLINICAL REPORT)

Ivan L. Hand, MD, FAAP; Renée A. Shellhaas, MD, MS, FAAP; Sarah S. Milla, MD, FAAP; Committee on Fetus and Newborn; Section on Neurology; and Section on Radiology

ABSTRACT. Neuroimaging of the preterm infant is a common assessment performed in the NICU. Timely and focused studies can be used for diagnostic, therapeutic, and prognostic information. However, significant variability exists among neonatal units as to which modalities are used and when imaging studies are obtained. Appropriate timing and selection of neuroimaging studies can help identify neonates with brain injury who may require therapeutic intervention or who may be at risk for neurodevelopmental impairment. This clinical report reviews the different modalities of imaging broadly available to the clinician. Evidence-based indications for each modality, optimal timing of examinations, and prognostic value are discussed. (10/20)
https://doi.org/10.1542/peds.2020-029082

RUNAWAY YOUTH: CARING FOR THE NATION'S LARGEST SEGMENT OF MISSING CHILDREN (CLINICAL REPORT)

Thresia B. Gambon, MD, MPH, MBA, FAAP; Janna R. Gewirtz O'Brien, MD, FAAP; Committee on Psychosocial Aspects of Child and Family Health; and Council on Community Pediatrics

ABSTRACT. The largest segment of missing children in the United States includes runaways, children who run away from home, and thrownaways, children who are told to leave or stay away from home by a household adult. Although estimates vary, as many as 1 in 20 youth run away from home annually. These unaccompanied youth have unique health needs, including high rates of trauma, mental illness, substance use, pregnancy, and sexually transmitted infections. While away, youth who run away are at high risk for additional trauma, victimization, and violence. Runaway and thrownaway youth have high unmet health care needs and limited access to care. Several populations are at particular high risk for runaway episodes, including victims of abuse and neglect; lesbian, gay, bisexual, transgender, and questioning youth; and youth in protective custody. Pediatricians and other health care professionals have a critical role to play in supporting runaway youth, addressing their unique health needs, fostering positive relationships within their families and with other supportive adults, and connecting them with available community resources. This report provides clinical guidance for pediatricians and other health care professionals regarding (1) the identification of adolescents who are at risk for running away or being thrown away and (2) the management of the unique medical, mental health, and social needs of these youth. In partnership with national, state, and local resources, pediatricians can significantly reduce risk and improve long-term outcomes for runaway youth. (1/20)
https://doi.org/10.1542/peds.2019-3752

SAFE SLEEP AND SKIN-TO-SKIN CARE IN THE NEONATAL PERIOD FOR HEALTHY TERM NEWBORNS (CLINICAL REPORT)

Lori Feldman-Winter, MD, MPH, FAAP; Jay P. Goldsmith, MD, FAAP; Committee on Fetus and Newborn; and Task Force on Sudden Infant Death Syndrome

ABSTRACT. Skin-to-skin care (SSC) and rooming-in have become common practice in the newborn period for healthy newborns with the implementation of maternity care practices that support breastfeeding as delineated in the World Health Organization's "Ten Steps to Successful Breastfeeding." SSC and rooming-in are supported by evidence that indicates that the implementation of these practices increases overall and exclusive breastfeeding, safer and healthier transitions, and improved maternal-infant bonding. In some cases, however, the practice of SSC and rooming-in may pose safety concerns, particularly with regard to sleep. There have been several recent case reports and case series of severe and sudden unexpected postnatal collapse in the neonatal period among otherwise healthy newborns and near fatal or fatal events related to sleep, suffocation, and falls from adult hospital beds. Although these are largely case reports, there are potential dangers of unobserved SSC immediately after birth and throughout the postpartum hospital period as well as with unobserved rooming-in for at-risk situations. Moreover, behaviors that are modeled in the hospital after birth, such as sleep position, are likely to influence sleeping practices after discharge. Hospitals and birthing centers have found it difficult to develop policies that will allow SSC and rooming-in to continue in a safe manner. This clinical report is intended for birthing centers and delivery hospitals caring for healthy newborns to assist

in the establishment of appropriate SSC and safe sleep policies. (8/16)
https://doi.org/10.1542/peds.2016-1889

SAFE TRANSPORTATION OF PRETERM AND LOW BIRTH WEIGHT INFANTS AT HOSPITAL DISCHARGE (CLINICAL REPORT)

Marilyn J. Bull, MD; William A. Engle, MD; Committee on Injury, Violence, and Poison Prevention; and Committee on Fetus and Newborn

ABSTRACT. Safe transportation of preterm and low birth weight infants requires special considerations. Both physiologic immaturity and low birth weight must be taken into account to properly position such infants. This clinical report provides guidelines for pediatricians and other caregivers who counsel parents of preterm and low birth weight infants about car safety seats. (4/09, reaffirmed 8/13, 6/18)
https://doi.org/10.1542/peds.2009-0559

SCHOOL BUS TRANSPORTATION OF CHILDREN WITH SPECIAL HEALTH CARE NEEDS

Joseph O'Neil, MD, MPH, FAAP; Benjamin D. Hoffman, MD, FAAP; and Council on Injury, Violence, and Poison Prevention

ABSTRACT. School systems are responsible for ensuring that children with special needs are safely transported on all forms of federally approved transportation provided by the school system. A plan to provide the most current and proper support to children with special transportation needs should be developed by the Individualized Education Program team, including the parent, school transportation director, and school nurse, in conjunction with physician orders and recommendations. With this statement, we provide current guidance for the protection of child passengers with specific health care needs. Guidance that applies to general school transportation should be followed, inclusive of staff training, provision of nurses or aides if needed, and establishment of a written emergency evacuation plan as well as a comprehensive infection control program. Researchers provide the basis for recommendations concerning occupant securement for children in wheelchairs and children with other special needs who are transported on a school bus. Pediatricians can help their patients by being aware of guidance for restraint systems for children with special needs and by remaining informed of new resources. Pediatricians can also play an important role at the state and local level in the development of school bus specifications. (4/18)
https://doi.org/10.1542/peds.2018-0513

SCHOOL READINESS (TECHNICAL REPORT)

P. Gail Williams, MD, FAAP; Marc Alan Lerner, MD, FAAP; Council on Early Childhood; and Council on School Health

ABSTRACT. School readiness includes the readiness of the individual child, the school's readiness for children, and the ability of the family and community to support optimal early child development. It is the responsibility of schools to meet the needs of all children at all levels of readiness. Children's readiness for kindergarten should become an outcome measure for a coordinated system of community-based programs and supports for the healthy development of young children. Our rapidly expanding insights into early brain and child development have revealed that modifiable factors in a child's early experience can greatly affect that child's health and learning trajectories. Many children in the United States enter kindergarten with limitations in their social, emotional, cognitive, and physical development that might have been significantly diminished or eliminated through early identification and attention to child and family needs. A strong correlation between social-emotional development and school and life success, combined with alarming rates of preschool expulsion, point toward the urgency of leveraging opportunities to support social-emotional development and address behavioral concerns early. Pediatric primary care providers have access to the youngest children and their families. Pediatricians can promote and use community supports, such as home visiting programs, quality early care and education programs, family support programs and resources, early intervention services, children's museums, and libraries, which are important for addressing school readiness and are too often underused by populations who can benefit most from them. When these are not available, pediatricians can support the development of such resources. The American Academy of Pediatrics affords pediatricians many opportunities to improve the physical, social-emotional, and educational health of young children, in conjunction with other advocacy groups. This technical report provides an updated version of the previous iteration from the American Academy of Pediatrics published in 2008. (7/19)
https://doi.org/10.1542/peds.2019-1766

SCHOOL START TIMES FOR ADOLESCENTS

Adolescent Sleep Working Group, Committee on Adolescence, and Council on School Health

ABSTRACT. The American Academy of Pediatrics recognizes insufficient sleep in adolescents as an important public health issue that significantly affects the health and safety, as well as the academic success, of our nation's middle and high school students. Although a number of factors, including biological changes in sleep associated with puberty, lifestyle choices, and academic demands, negatively affect middle and high school students' ability to obtain sufficient sleep, the evidence strongly implicates earlier school start times (ie, before 8:30 AM) as a key modifiable contributor to insufficient sleep, as well as circadian rhythm disruption, in this population. Furthermore, a substantial body of research has now demonstrated that delaying school start times is an effective countermeasure to chronic sleep loss and has a wide range of potential benefits to students with regard to physical and mental health, safety, and academic achievement. The American Academy of Pediatrics strongly supports the efforts of school districts to optimize sleep in students and urges high schools and middle schools to aim for start times that allow students the opportunity to achieve optimal levels of sleep (8.5–9.5 hours) and to improve physical (eg, reduced obesity risk) and mental (eg, lower rates of depression) health, safety (eg, drowsy driving crashes), academic performance, and quality of life. (8/14)
https://doi.org/10.1542/peds.2014-1697

SCHOOL TRANSPORTATION SAFETY

Committee on Injury, Violence, and Poison Prevention and Council on School Health

ABSTRACT. This policy statement replaces the previous version published in 1996. It provides new information, studies, regulations, and recommendations related to the safe transportation of children to and from school and school-related activities. Pediatricians can play an important role at the patient/family, community, state, and national levels as child advocates and consultants to schools and early education programs about transportation safety. (7/07, reaffirmed 10/11)
https://doi.org/10.1542/peds.2007-1278

SCHOOL-AGED CHILDREN WHO ARE NOT PROGRESSING ACADEMICALLY: CONSIDERATIONS FOR PEDIATRICIANS (CLINICAL REPORT)

Celiane Rey-Casserly, PhD; Laura McGuinn, MD, FAAP; Arthur Lavin, MD, FAAP; Committee on Psychosocial Aspects of Child and Family Health; Section on Developmental and Behavioral Pediatrics

ABSTRACT. Pediatricians and other pediatric primary care providers may be consulted when families have concerns that their child is not making expected progress in school. Pediatricians care not only for an increasingly diverse population of children who may have behavioral, psychological, and learning difficulties but also for increasing numbers of children with complex and chronic medical problems that can affect the development of the central nervous system and can present with learning and academic concerns. In many instances, pediatric providers require additional information about the nature of cognitive, psychosocial, and educational difficulties that affect their school-aged patients. Our purpose for this report is to describe the current state of the science regarding educational achievement to inform pediatricians' decisions regarding further evaluation of a child's challenges. In this report, we review commonly available options for psychological evaluation and/or treatment, medical referrals, and/or recommendations for referral for eligibility determinations at school and review strategies for collaborating with families, schools, and specialists to best serve children and families. (9/19)

https://doi.org/10.1542/peds.2019-2520

SCHOOL-BASED HEALTH CENTERS AND PEDIATRIC PRACTICE

Chris Kjolhede, MD, MPH, FAAP; April C. Lee, MD, FAAP; and Council on School Health

ABSTRACT. School-based health centers (SBHCs) are unique health care settings for our nation's school-aged children and adolescents. SBHCs represent the collaboration between the health and school communities to support the health and mental health needs and the academic achievements of children and adolescents, particularly students with health disparities or poor access to health care. SBHCs improve access to health care services for students by decreasing financial, geographic, age, and cultural barriers. This policy statement provides an overview of SBHCs, including the scope of services as well as some of the documented benefits and challenges. This policy statement also reviews the role of SBHCs in working with the pediatric medical home and provides recommendations that support the coordination of SBHCs with pediatric primary care providers and the pediatric medical home. (9/21)

See full text on page 1041.

https://doi.org/10.1542/peds.2021-053758

SCOPE OF HEALTH CARE BENEFITS FOR CHILDREN FROM BIRTH THROUGH AGE 26

Committee on Child Health Financing

ABSTRACT. The optimal health of all children is best achieved with access to appropriate and comprehensive health care benefits. This policy statement outlines and defines the recommended set of health insurance benefits for children through age 26. The American Academy of Pediatrics developed a set of recommendations concerning preventive care services for children, adolescents, and young adults. These recommendations are compiled in the publication *Bright Futures: Guidelines for Health Supervision of Infants, Children, and Adolescents,* third edition. The Bright Futures recommendations were referenced as a standard for access and design of age-appropriate health insurance benefits for infants, children, adolescents, and young adults in the Patient Protection and Affordable Care Act of 2010 (Pub L No. 114–148). (12/11)

https://doi.org/10.1542/peds.2011-2936

SCOPE OF PRACTICE ISSUES IN THE DELIVERY OF PEDIATRIC HEALTH CARE

Committee on Pediatric Workforce

ABSTRACT. The American Academy of Pediatrics (AAP) believes that optimal pediatric health care depends on a team-based approach with supervision by a physician leader, preferably a pediatrician. The pediatrician, here defined to include not only pediatric generalists but all pediatric medical subspecialists, all surgical specialists, and internal medicine/pediatric physicians, is uniquely qualified to manage, coordinate, and supervise the entire spectrum of pediatric care, from diagnosis through all stages of treatment, in all practice settings. The AAP recognizes the valuable contributions of nonphysician clinicians, including nurse practitioners and physician assistants, in delivering optimal pediatric care. However, the expansion of the scope of practice of nonphysician pediatric clinicians raises critical public policy and child health advocacy concerns. Pediatricians should serve as advocates for optimal pediatric care in state legislatures, public policy forums, and the media and should pursue opportunities to resolve scope of practice conflicts outside state legislatures. The AAP affirms the importance of appropriate documentation and standards in pediatric education, training, skills, clinical competencies, examination, regulation, and patient care to ensure safety and quality health care for all infants, children, adolescents, and young adults. (5/13, reaffirmed 10/15)

https://doi.org/10.1542/peds.2013-0943

SCREENING EXAMINATION OF PREMATURE INFANTS FOR RETINOPATHY OF PREMATURITY

Walter M. Fierson, MD, FAAP, and Section on Ophthalmology (joint with American Academy of Ophthalmology, American Association for Pediatric Ophthalmology and Strabismus, and American Association of Certified Orthoptists)

ABSTRACT. This policy statement revises a previous statement on screening of preterm infants for retinopathy of prematurity (ROP) that was published in 2013. ROP is a pathologic process that occurs in immature retinal tissue and can progress to a tractional retinal detachment, which may then result in visual loss or blindness. For more than 3 decades, treatment of severe ROP that markedly decreases the incidence of this poor visual outcome has been available. However, severe, treatment-requiring ROP must be diagnosed in a timely fashion to be treated effectively. The sequential nature of ROP requires that infants who are at-risk and preterm be examined at proper times and intervals to detect the changes of ROP before they become destructive. This statement presents the attributes of an effective program to detect and treat ROP, including the timing of initial and follow-up examinations. (11/18)

https://doi.org/10.1542/peds.2018-3061

SCREENING FOR NONVIRAL SEXUALLY TRANSMITTED INFECTIONS IN ADOLESCENTS AND YOUNG ADULTS

Committee on Adolescence (joint with Society for Adolescent Health and Medicine)

ABSTRACT. Prevalence rates of many sexually transmitted infections (STIs) are highest among adolescents. If nonviral STIs are detected early, they can be treated, transmission to others can be eliminated, and sequelae can be averted. The US Preventive Services Task Force and the Centers for Disease Control and Prevention have published chlamydia, gonorrhea, and syphilis screening guidelines that recommend screening those at risk on the basis of epidemiologic and clinical outcomes data. This policy statement specifically focuses on these curable, nonviral STIs and

reviews the evidence for nonviral STI screening in adolescents, communicates the value of screening, and outlines recommendations for routine nonviral STI screening of adolescents. (6/14)
https://doi.org/10.1542/peds.2014-1024

SCREENING FOR RETINOPATHY IN THE PEDIATRIC PATIENT WITH TYPE 1 DIABETES MELLITUS (CLINICAL REPORT)

Gregg T. Lueder, MD; Janet Silverstein, MD; Section on Ophthalmology; and Section on Endocrinology (joint with American Association for Pediatric Ophthalmology and Strabismus)

ABSTRACT. Diabetic retinopathy (DR) is the leading cause of blindness in young adults in the United States. Early identification and treatment of DR can decrease the risk of vision loss in affected patients. This clinical report reviews the risk factors for the development of DR and screening guidance for pediatric patients with type 1 diabetes mellitus. (7/05, reaffirmed 1/09, 7/14, 11/19)
https://doi.org/10.1542/peds.2005-0875

SELECTING APPROPRIATE TOYS FOR YOUNG CHILDREN IN THE DIGITAL ERA (CLINICAL REPORT)

Aleeya Healey, MD, FAAP; Alan Mendelsohn, MD, FAAP; and Council on Early Childhood

ABSTRACT. Play is essential to optimal child development because it contributes to the cognitive, physical, social, and emotional well-being of children and youth. It also offers an ideal and significant opportunity for parents and other caregivers to engage fully with children using toys as an instrument of play and interaction. The evolution of societal perceptions of toys from children's playthings to critical facilitators of early brain and child development has challenged caregivers in deciding which toys are most appropriate for their children. This clinical report strives to provide pediatric health care providers with evidence-based information that can be used to support caregivers as they choose toys for their children. The report highlights the broad definition of a toy; consideration of potential benefits and possible harmful effects of toy choices on child development; and the promotion of positive caregiving and development when toys are used to engage caregivers in play-based interactions with their children that are rich in language, pretending, problem-solving, and creativity. The report aims to address the evolving replacement of more traditional toys with digital media–based virtual "toys" and the lack of evidence for similar benefits in child development. Furthermore, this report briefly addresses the role of toys in advertising and/or incentive programs and aims to bring awareness regarding safety and health hazards associated with toy availability and accessibility in public settings, including some health care settings. (12/18)
https://doi.org/10.1542/peds.2018-3348

SENSORY INTEGRATION THERAPIES FOR CHILDREN WITH DEVELOPMENTAL AND BEHAVIORAL DISORDERS

Section on Complementary and Integrative Medicine and Council on Children With Disabilities

ABSTRACT. Sensory-based therapies are increasingly used by occupational therapists and sometimes by other types of therapists in treatment of children with developmental and behavioral disorders. Sensory-based therapies involve activities that are believed to organize the sensory system by providing vestibular, proprioceptive, auditory, and tactile inputs. Brushes, swings, balls, and other specially designed therapeutic or recreational equipment are used to provide these inputs. However, it is unclear whether children who present with sensory-based problems have an actual "disorder" of the sensory pathways of the brain or whether these deficits are characteristics associated with other developmental and behavioral disorders. Because there is no universally accepted framework for diagnosis, sensory processing disorder generally should not be diagnosed. Other developmental and behavioral disorders must always be considered, and a thorough evaluation should be completed. Difficulty tolerating or processing sensory information is a characteristic that may be seen in many developmental behavioral disorders, including autism spectrum disorders, attention-deficit/hyperactivity disorder, developmental coordination disorders, and childhood anxiety disorders.

Occupational therapy with the use of sensory-based therapies may be acceptable as one of the components of a comprehensive treatment plan. However, parents should be informed that the amount of research regarding the effectiveness of sensory integration therapy is limited and inconclusive. Important roles for pediatricians and other clinicians may include discussing these limitations with parents, talking with families about a trial period of sensory integration therapy, and teaching families how to evaluate the effectiveness of a therapy. (5/12)
https://doi.org/10.1542/peds.2012-0876

SEXUAL AND REPRODUCTIVE HEALTH CARE SERVICES IN THE PEDIATRIC SETTING (CLINICAL REPORT)

Arik V. Marcell, MD, MPH; Gale R. Burstein, MD, MPH; and Committee on Adolescence

ABSTRACT. Pediatricians are an important source of health care for adolescents and young adults and can play a significant role in addressing their patients' sexual and reproductive health needs, including preventing unintended pregnancies and sexually transmitted infections (STIs), including HIV, and promoting healthy relationships. STIs, HIV, and unintended pregnancy are all preventable health outcomes with potentially serious permanent sequelae; the highest rates of STIs, HIV, and unintended pregnancy are reported among adolescents and young adults. Office visits present opportunities to provide comprehensive education and health care services to adolescents and young adults to prevent STIs, HIV, and unintended pregnancies. The American Academy of Pediatrics, other professional medical organizations, and the government have guidelines and recommendations regarding the provision of sexual and reproductive health information and services. However, despite these recommendations, recent studies have revealed that there is substantial room for improvement in actually delivering the recommended services. The purpose of this clinical report is to assist pediatricians to operationalize the provision of various aspects of sexual and reproductive health care into their practices and to provide guidance on overcoming barriers to providing this care routinely while maximizing opportunities for confidential health services delivery in their offices. (10/17)
https://doi.org/10.1542/peds.2017-2858

SEXUALITY EDUCATION FOR CHILDREN AND ADOLESCENTS (CLINICAL REPORT)

Cora C. Breuner, MD, MPH, FAAP; Gerri Mattson, MD, MSPH, FAAP; Committee on Adolescence; and Committee on Psychosocial Aspects of Child and Family Health

ABSTRACT. The purpose of this clinical report is to provide pediatricians updated research on evidence-based sexual and reproductive health education conducted since the original clinical report on the subject was published by the American Academy of Pediatrics in 2001. Sexuality education is defined as teaching about human sexuality, including intimate relationships, human sexual anatomy, sexual reproduction, sexually transmitted infections, sexual activity, sexual orientation, gender identity, abstinence, contraception, and reproductive rights and responsibilities. Developmentally appropriate and evidence-based education about human sexuality and sexual reproduction over time provided by pediatricians, schools, other professionals, and parents is important to help children and adolescents

make informed, positive, and safe choices about healthy relationships, responsible sexual activity, and their reproductive health. Sexuality education has been shown to help to prevent and reduce the risks of adolescent pregnancy, HIV, and sexually transmitted infections for children and adolescents with and without chronic health conditions and disabilities in the United States. (7/16)
https://doi.org/10.1542/peds.2016-1348

SHARED DECISION-MAKING AND CHILDREN WITH DISABILITIES: PATHWAYS TO CONSENSUS (CLINICAL REPORT)

Richard C. Adams, MD, FAAP; Susan E. Levy, MD, MPH, FAAP; and Council on Children With Disabilities

ABSTRACT. Shared decision-making (SDM) promotes family and clinician collaboration, with ultimate goals of improved health and satisfaction. This clinical report provides a basis for a systematic approach to the implementation of SDM by clinicians for children with disabilities. Often in the discussion of treatment plans, there are gaps between the child's/family's values, priorities, and understanding of perceived "best choices" and those of the clinician. When conducted well, SDM affords an appropriate balance incorporating voices of all stakeholders, ultimately supporting both the child/family and clinician. With increasing knowledge of and functional use of SDM skills, the clinician will become an effective partner in the decision-making process with families, providing family-centered care. The outcome of the process will support the beneficence of the physician, the authority of the family, and the autonomy and well-being of the child. (5/17)
https://doi.org/10.1542/peds.2017-0956

SHOPPING CART–RELATED INJURIES TO CHILDREN

Committee on Injury, Violence, and Poison Prevention

ABSTRACT. Shopping cart–related injuries to children are common and can result in severe injury or even death. Most injuries result from falls from carts or cart tip-overs, and injuries to the head and neck represent three fourths of cases. The current US standard for shopping carts should be revised to include clear and effective performance criteria to prevent falls from carts and cart tip-overs. Pediatricians have an important role as educators, researchers, and advocates to promote the prevention of these injuries. (8/06, reaffirmed 4/09, 8/13)
https://doi.org/10.1542/peds.2006-1215

SHOPPING CART–RELATED INJURIES TO CHILDREN (TECHNICAL REPORT)

Gary A. Smith, MD, DrPH, for Committee on Injury, Violence, and Poison Prevention

ABSTRACT. An estimated 24 200 children younger than 15 years, 20 700 (85%) of whom were younger than 5 years, were treated in US hospital emergency departments in 2005 for shopping cart–related injuries. Approximately 4% of shopping cart–related injuries to children younger than 15 years require admission to the hospital. Injuries to the head and neck represent three fourths of all injuries. Fractures account for 45% of all hospitalizations. Deaths have occurred from falls from shopping carts and cart tip-overs. Falls are the most common mechanism of injury and account for more than half of injuries associated with shopping carts. Cart tip-overs are the second most common mechanism, responsible for up to one fourth of injuries and almost 40% of shopping cart–related injuries among children younger than 2 years. Public-awareness initiatives, education programs, and parental supervision, although important, are not enough to prevent these injuries effectively. European Standard EN 1929-1:1998 and joint Australian/New Zealand Standard AS/NZS 3847.1:1999 specify requirements for the construction, performance, testing, and safety of shopping carts and have been implemented as national standards in 21 countries. A US performance standard for shopping carts (ASTM [American Society for Testing and Materials] F2372-04) was established in July 2004; however, it does not adequately address falls and cart tip-overs, which are the leading mechanisms of shopping cart–related injuries to children. The current US standard for shopping carts should be revised to include clear and effective performance criteria for shopping cart child-restraint systems and cart stability to prevent falls from carts and cart tip-overs. This is imperative to decrease the number and severity of shopping cart–related injuries to children. Recommendations from the American Academy of Pediatrics regarding prevention of shopping cart–related injuries are included in the accompanying policy statement. (8/06, reaffirmed 4/09, 8/13)
https://doi.org/10.1542/peds.2006-1216

SIDS AND OTHER SLEEP-RELATED INFANT DEATHS: EVIDENCE BASE FOR 2016 UPDATED RECOMMENDATIONS FOR A SAFE INFANT SLEEPING ENVIRONMENT (TECHNICAL REPORT)

Rachel Y. Moon, MD, FAAP, and Task Force on Sudden Infant Death Syndrome

ABSTRACT. Approximately 3500 infants die annually in the United States from sleep-related infant deaths, including sudden infant death syndrome (SIDS), ill-defined deaths, and accidental suffocation and strangulation in bed. After an initial decrease in the 1990s, the overall sleep-related infant death rate has not declined in more recent years. Many of the modifiable and nonmodifiable risk factors for SIDS and other sleep-related infant deaths are strikingly similar. The American Academy of Pediatrics recommends a safe sleep environment that can reduce the risk of all sleep-related infant deaths. Recommendations for a safe sleep environment include supine positioning, use of a firm sleep surface, room-sharing without bed-sharing, and avoidance of soft bedding and overheating. Additional recommendations for SIDS risk reduction include avoidance of exposure to smoke, alcohol, and illicit drugs; breastfeeding; routine immunization; and use of a pacifier. New evidence and rationale for recommendations are presented for skin-to-skin care for newborn infants, bedside and in-bed sleepers, sleeping on couches/armchairs and in sitting devices, and use of soft bedding after 4 months of age. In addition, expanded recommendations for infant sleep location are included. The recommendations and strength of evidence for each recommendation are published in the accompanying policy statement, "SIDS and Other Sleep-Related Infant Deaths: Updated 2016 Recommendations for a Safe Infant Sleeping Environment," which is included in this issue. (10/16)
https://doi.org/10.1542/peds.2016-2940

SIDS AND OTHER SLEEP-RELATED INFANT DEATHS: EXPANSION OF RECOMMENDATIONS FOR A SAFE INFANT SLEEPING ENVIRONMENT

Rachel Y. Moon, MD, FAAP, and Task Force on Sudden Infant Death Syndrome

ABSTRACT. Despite a major decrease in the incidence of sudden infant death syndrome (SIDS) since the American Academy of Pediatrics (AAP) released its recommendation in 1992 that infants be placed for sleep in a nonprone position, this decline has plateaued in recent years. Concurrently, other causes of sudden unexpected infant death that occur during sleep (sleep-related deaths), including suffocation, asphyxia, and entrapment, and ill-defined or unspecified causes of death have increased in incidence, particularly since the AAP published its last statement on SIDS in 2005. It has become increasingly important to address these other causes of sleep-related infant death. Many of the modifiable and nonmodifiable risk factors for SIDS and suffocation are strikingly similar. The AAP, therefore, is expanding its recommendations from focusing only on SIDS to

focusing on a safe sleep environment that can reduce the risk of all sleep-related infant deaths, including SIDS. The recommendations described in this policy statement include supine positioning, use of a firm sleep surface, breastfeeding, room-sharing without bed-sharing, routine immunizations, consideration of using a pacifier, and avoidance of soft bedding, overheating, and exposure to tobacco smoke, alcohol, and illicit drugs. The rationale for these recommendations is discussed in detail in the accompanying "Technical Report—SIDS and Other Sleep-Related Infant Deaths: Expansion of Recommendations for a Safe Infant Sleeping Environment," which is included in this issue of *Pediatrics* (www.pediatrics.org/cgi/content/full/128/5/e1341). (4/11, reaffirmed 10/20)
https://doi.org/10.1542/peds.2011-2284

SIDS AND OTHER SLEEP-RELATED INFANT DEATHS: EXPANSION OF RECOMMENDATIONS FOR A SAFE INFANT SLEEPING ENVIRONMENT (TECHNICAL REPORT)

Rachel Y. Moon, MD, FAAP, and Task Force on Sudden Infant Death Syndrome

ABSTRACT. Despite a major decrease in the incidence of sudden infant death syndrome (SIDS) since the American Academy of Pediatrics (AAP) released its recommendation in 1992 that infants be placed for sleep in a nonprone position, this decline has plateaued in recent years. Concurrently, other causes of sudden unexpected infant death occurring during sleep (sleep-related deaths), including suffocation, asphyxia, and entrapment, and ill-defined or unspecified causes of death have increased in incidence, particularly since the AAP published its last statement on SIDS in 2005. It has become increasingly important to address these other causes of sleep-related infant death. Many of the modifiable and nonmodifiable risk factors for SIDS and suffocation are strikingly similar. The AAP, therefore, is expanding its recommendations from being only SIDS-focused to focusing on a safe sleep environment that can reduce the risk of all sleep-related infant deaths including SIDS. The recommendations described in this report include supine positioning, use of a firm sleep surface, breastfeeding, room-sharing without bed-sharing, routine immunization, consideration of a pacifier, and avoidance of soft bedding, overheating, and exposure to tobacco smoke, alcohol, and illicit drugs. The rationale for these recommendations is discussed in detail in this technical report. The recommendations are published in the accompanying "Policy Statement—Sudden Infant Death Syndrome and Other Sleep-Related Infant Deaths: Expansion of Recommendations for a Safe Infant Sleeping Environment," which is included in this issue (www.pediatrics.org/cgi/doi/10.1542/peds.2011-2220). (4/11, reaffirmed 10/20)
https://doi.org/10.1542/peds.2011-2285

SIDS AND OTHER SLEEP-RELATED INFANT DEATHS: UPDATED 2016 RECOMMENDATIONS FOR A SAFE INFANT SLEEPING ENVIRONMENT

Task Force on Sudden Infant Death Syndrome

ABSTRACT. Approximately 3500 infants die annually in the United States from sleep-related infant deaths, including sudden infant death syndrome (SIDS; International Classification of Diseases, 10th Revision [ICD-10], R95), ill-defined deaths (ICD-10 R99), and accidental suffocation and strangulation in bed (ICD-10 W75). After an initial decrease in the 1990s, the overall death rate attributable to sleep-related infant deaths has not declined in more recent years. Many of the modifiable and nonmodifiable risk factors for SIDS and other sleep-related infant deaths are strikingly similar. The American Academy of Pediatrics recommends a safe sleep environment that can reduce the risk of all sleep-related infant deaths. Recommendations for a safe sleep environment include supine positioning, the use of a firm sleep surface, room-sharing without bed-sharing, and the avoidance of soft bedding and overheating. Additional recommendations for SIDS reduction include the avoidance of exposure to smoke, alcohol, and illicit drugs; breastfeeding; routine immunization; and use of a pacifier. New evidence is presented for skin-to-skin care for newborn infants, use of bedside and in-bed sleepers, sleeping on couches/armchairs and in sitting devices, and use of soft bedding after 4 months of age. The recommendations and strength of evidence for each recommendation are included in this policy statement. The rationale for these recommendations is discussed in detail in the accompanying technical report (www.pediatrics.org/cgi/doi/10.1542/peds.2016-2940). (10/16)
https://doi.org/10.1542/peds.2016-2938

SKATEBOARD AND SCOOTER INJURIES

Committee on Injury, Violence, and Poison Prevention

ABSTRACT. Skateboard-related injuries account for an estimated 50 000 emergency department visits and 1500 hospitalizations among children and adolescents in the United States each year. Nonpowered scooter-related injuries accounted for an estimated 9400 emergency department visits between January and August 2000, and 90% of these patients were children younger than 15 years. Many such injuries can be avoided if children and youth do not ride in traffic, if proper protective gear is worn, and if, in the absence of close adult supervision, skateboards and scooters are not used by children younger than 10 and 8 years, respectively. (3/02, reaffirmed 5/05, 10/08, 10/13)
https://doi.org/10.1542/peds.109.3.542

SKIN-TO-SKIN CARE FOR TERM AND PRETERM INFANTS IN THE NEONATAL ICU (CLINICAL REPORT)

Jill Baley, MD, and Committee on Fetus and Newborn

ABSTRACT. "Kangaroo mother care" was first described as an alternative method of caring for low birth weight infants in resource-limited countries, where neonatal mortality and infection rates are high because of overcrowded nurseries, inadequate staffing, and lack of equipment. Intermittent skin-to-skin care (SSC), a modified version of kangaroo mother care, is now being offered in resource-rich countries to infants needing neonatal intensive care, including those who require ventilator support or are extremely premature. SSC significantly improves milk production by the mother and is associated with a longer duration of breastfeeding. Increased parent satisfaction, better sleep organization, a longer duration of quiet sleep, and decreased pain perception during procedures have also been reported in association with SSC. Despite apparent physiologic stability during SSC, it is prudent that infants in the NICU have continuous cardiovascular monitoring and that care be taken to verify correct head positioning for airway patency as well as the stability of the endotracheal tube, arterial and venous access devices, and other life support equipment. (8/15)
https://doi.org/10.1542/peds.2015-2335

SNACKS, SWEETENED BEVERAGES, ADDED SUGARS, AND SCHOOLS

Council on School Health and Committee on Nutrition

ABSTRACT. Concern over childhood obesity has generated a decade-long reformation of school nutrition policies. Food is available in school in 3 venues: federally sponsored school meal programs; items sold in competition to school meals, such as a la carte, vending machines, and school stores; and foods available in myriad informal settings, including packed meals and snacks, bake sales, fundraisers, sports booster sales, in-class parties, or other school celebrations. High-energy, low-nutrient beverages, in particular, contribute substantial calories, but little nutrient content, to a student's diet. In 2004, the American Academy of Pediatrics recommended that sweetened drinks be replaced in school by water, white and flavored milks, or 100% fruit and vegetable beverages. Since then, school nutrition has undergone

a significant transformation. Federal, state, and local regulations and policies, along with alternative products developed by industry, have helped decrease the availability of nutrient-poor foods and beverages in school. However, regular access to foods of high energy and low quality remains a school issue, much of it attributable to students, parents, and staff. Pediatricians, aligning with experts on child nutrition, are in a position to offer a perspective promoting nutrient-rich foods within calorie guidelines to improve those foods brought into or sold in schools. A positive emphasis on nutritional value, variety, appropriate portion, and encouragement for a steady improvement in quality will be a more effective approach for improving nutrition and health than simply advocating for the elimination of added sugars. (2/15)
https://doi.org/10.1542/peds.2014-3902

SNOWMOBILING HAZARDS

Committee on Injury and Poison Prevention

ABSTRACT. Snowmobiles continue to pose a significant risk to children younger than 15 years and adolescents and young adults 15 through 24 years of age. Head injuries remain the leading cause of mortality and serious morbidity, arising largely from snowmobilers colliding, falling, or overturning during operation. Children also were injured while being towed in a variety of conveyances by snowmobiles. No uniform code of state laws governs the use of snowmobiles by children and youth. Because evidence is lacking to support the effectiveness of operator safety certification and because many children and adolescents do not have the required strength and skills to operate a snowmobile safely, the recreational operation of snowmobiles by persons younger than 16 years is not recommended. Snowmobiles should not be used to tow persons on a tube, tire, sled, or saucer. Furthermore, a graduated licensing program is advised for snowmobilers 16 years and older. Both active and passive snowmobile injury prevention strategies are suggested, as well as recommendations for manufacturers to make safer equipment for snowmobilers of all ages. (11/00, reaffirmed 5/04, 1/07, 6/10)
https://doi.org/10.1542/peds.106.5.1142

SOCCER INJURIES IN CHILDREN AND ADOLESCENTS (CLINICAL REPORT)

Andrew Watson, MD, MS, FAAP; Jeffrey M. Mjaanes, MD, FAAP; Council on Sports Medicine and Fitness

ABSTRACT. Participation in youth soccer in the United States continues to increase steadily, with a greater percentage of preadolescent participants than perhaps any other youth sport. Despite the wide-ranging health benefits of participation in organized sports, injuries occur and represent a threat to the health and performance of young athletes. Youth soccer has a greater reported injury rate than many other contact sports, and recent studies suggest that injury rates are increasing. Large increases in the incidence of concussions in youth soccer have been reported, and anterior cruciate ligament injuries remain a significant problem in this sport, particularly among female athletes. Considerable new research has identified a number of modifiable risk factors for lower-extremity injuries and concussion, and several prevention programs have been identified to reduce the risk of injury. Rule enforcement and fair play also serve an important role in reducing the risk of injury among youth soccer participants. This report provides an updated review of the relevant literature as well as recommendations to promote the safe participation of children and adolescents in soccer. (10/19)
https://doi.org/10.1542/peds.2019-2759

SPECIAL REQUIREMENTS OF ELECTRONIC HEALTH RECORD SYSTEMS IN PEDIATRICS (CLINICAL REPORT)

S. Andrew Spooner, MD, MS, and Council on Clinical Information Technology

ABSTRACT. Some functions of an electronic health record system are much more important in providing pediatric care than in adult care. Pediatricians commonly complain about the absence of these "pediatric functions" when they are not available in electronic health record systems. To stimulate electronic health record system vendors to recognize and incorporate pediatric functionality into pediatric electronic health record systems, this clinical report reviews the major functions of importance to child health care providers. Also reviewed are important but less critical functions, any of which might be of major importance in a particular clinical context. The major areas described here are immunization management, growth tracking, medication dosing, data norms, and privacy in special pediatric populations. The American Academy of Pediatrics believes that if the functions described in this document are supported in all electronic health record systems, these systems will be more useful for patients of all ages. (3/07, reaffirmed 5/12, 5/16)
https://doi.org/10.1542/peds.2006-3527

SPECTRUM OF NONINFECTIOUS HEALTH EFFECTS FROM MOLDS

Committee on Environmental Health

ABSTRACT. Molds are eukaryotic (possessing a true nucleus) nonphotosynthetic organisms that flourish both indoors and outdoors. For humans, the link between mold exposure and asthma exacerbations, allergic rhinitis, infections, and toxicities from ingestion of mycotoxin-contaminated foods are well known. However, the cause-and-effect relationship between inhalational exposure to mold and other untoward health effects (eg, acute idiopathic pulmonary hemorrhage in infants and other illnesses and health complaints) requires additional investigation. Pediatricians play an important role in the education of families about mold, its adverse health effects, exposure prevention, and remediation procedures. (12/06, reaffirmed 9/16)
https://doi.org/10.1542/peds.2006-2828

SPECTRUM OF NONINFECTIOUS HEALTH EFFECTS FROM MOLDS (TECHNICAL REPORT)

Lynnette J. Mazur, MD, MPH; Janice Kim, MD, PhD, MPH; and Committee on Environmental Health

ABSTRACT. Molds are multicellular fungi that are ubiquitous in outdoor and indoor environments. For humans, they are both beneficial (for the production of antimicrobial agents, chemotherapeutic agents, and vitamins) and detrimental. Exposure to mold can occur through inhalation, ingestion, and touching moldy surfaces. Adverse health effects may occur through allergic, infectious, irritant, or toxic processes. The cause-and-effect relationship between mold exposure and allergic and infectious illnesses is well known. Exposures to toxins via the gastrointestinal tract also are well described. However, the cause-and-effect relationship between inhalational exposure to mold toxins and other untoward health effects (eg, acute idiopathic pulmonary hemorrhage in infants and other illnesses and health complaints) is controversial and requires additional investigation. In this report we examine evidence of fungal-related illnesses and the unique aspects of mold exposure to children. Mold-remediation procedures are also discussed. (12/06, reaffirmed 9/16)
https://doi.org/10.1542/peds.2006-2829

SPORT-RELATED CONCUSSION IN CHILDREN AND ADOLESCENTS (CLINICAL REPORT)

Mark E. Halstead, MD, FAAP; Kevin D. Walter, MD, FAAP; Kody Moffatt, MD, FAAP; and Council on Sports Medicine and Fitness

ABSTRACT. Sport-related concussion is an important topic in nearly all sports and at all levels of sport for children and adolescents. Concussion knowledge and approaches to management have progressed since the American Academy of Pediatrics published its first clinical report on the subject in 2010. Concussion's definition, signs, and symptoms must be understood to diagnose it and rule out more severe intracranial injury. Pediatric health care providers should have a good understanding of diagnostic evaluation and initial management strategies. Effective management can aid recovery and potentially reduce the risk of long-term symptoms and complications. Because concussion symptoms often interfere with school, social life, family relationships, and athletics, a concussion may affect the emotional well-being of the injured athlete. Because every concussion has its own unique spectrum and severity of symptoms, individualized management is appropriate. The reduction, not necessarily elimination, of physical and cognitive activity is the mainstay of treatment. A full return to activity and/or sport is accomplished by using a stepwise program while evaluating for a return of symptoms. An understanding of prolonged symptoms and complications will help the pediatric health care provider know when to refer to a specialist. Additional research is needed in nearly all aspects of concussion in the young athlete. This report provides education on the current state of sport-related concussion knowledge, diagnosis, and management in children and adolescents. (11/18)

https://doi.org/10.1542/peds.2018-3074

SPORTS DRINKS AND ENERGY DRINKS FOR CHILDREN AND ADOLESCENTS: ARE THEY APPROPRIATE? (CLINICAL REPORT)

Committee on Nutrition and Council on Sports Medicine and Fitness

ABSTRACT. Sports and energy drinks are being marketed to children and adolescents for a wide variety of inappropriate uses. Sports drinks and energy drinks are significantly different products, and the terms should not be used interchangeably. The primary objectives of this clinical report are to define the ingredients of sports and energy drinks, categorize the similarities and differences between the products, and discuss misuses and abuses. Secondary objectives are to encourage screening during annual physical examinations for sports and energy drink use, to understand the reasons why youth consumption is widespread, and to improve education aimed at decreasing or eliminating the inappropriate use of these beverages by children and adolescents. Rigorous review and analysis of the literature reveal that caffeine and other stimulant substances contained in energy drinks have no place in the diet of children and adolescents. Furthermore, frequent or excessive intake of caloric sports drinks can substantially increase the risk for overweight or obesity in children and adolescents. Discussion regarding the appropriate use of sports drinks in the youth athlete who participates regularly in endurance or high-intensity sports and vigorous physical activity is beyond the scope of this report. (5/11, reaffirmed 7/17)

https://doi.org/10.1542/peds.2011-0965

SPORTS SPECIALIZATION AND INTENSIVE TRAINING IN YOUNG ATHLETES (CLINICAL REPORT)

Joel S. Brenner, MD, MPH, FAAP, and Council on Sports Medicine and Fitness

ABSTRACT. Sports specialization is becoming the norm in youth sports for a variety of reasons. When sports specialization occurs too early, detrimental effects may occur, both physically and psychologically. If the timing is correct and sports specialization is performed under the correct conditions, the athlete may be successful in reaching specific goals. Young athletes who train intensively, whether specialized or not, can also be at risk of adverse effects on the mind and body. The purpose of this clinical report is to assist pediatricians in counseling their young athlete patients and their parents regarding sports specialization and intensive training. This report supports the American Academy of Pediatrics clinical report "Overuse Injuries, Overtraining, and Burnout in Child and Adolescent Athletes." (8/16)

https://doi.org/10.1542/peds.2016-2148

STANDARD TERMINOLOGY FOR FETAL, INFANT, AND PERINATAL DEATHS (CLINICAL REPORT)

Wanda D. Barfield, MD, MPH, FAAP, and Committee on Fetus and Newborn

ABSTRACT. Accurately defining and reporting perinatal deaths (ie, fetal and infant deaths) is a critical first step in understanding the magnitude and causes of these important events. In addition to obstetric health care providers, neonatologists and pediatricians should have easy access to current and updated resources that clearly provide US definitions and reporting requirements for live births, fetal deaths, and infant deaths. Correct identification of these vital events will improve local, state, and national data so that these deaths can be better addressed and prevented. (4/16)

https://doi.org/10.1542/peds.2011-0965

STANDARDIZATION OF INPATIENT HANDOFF COMMUNICATION (CLINICAL REPORT)

Jennifer A. Jewell, MD, FAAP, and Committee on Hospital Care

ABSTRACT. Handoff communication is identified as an integral part of hospital care. Throughout medical communities, inadequate handoff communication is being highlighted as a significant risk to patients. The complexity of hospitals and the number of providers involved in the care of hospitalized patients place inpatients at high risk of communication lapses. This miscommunication and the potential resulting harm make effective handoffs more critical than ever. Although hospitalized patients are being exposed to many handoffs each day, this report is limited to describing the best handoff practices between providers at the time of shift change. (10/16)

https://doi.org/10.1542/peds.2016-2681

STANDARDS FOR HEALTH INFORMATION TECHNOLOGY TO ENSURE ADOLESCENT PRIVACY

Committee on Adolescence and Council on Clinical Information Technology

ABSTRACT. Privacy and security of health information is a basic expectation of patients. Despite the existence of federal and state laws safeguarding the privacy of health information, health information systems currently lack the capability to allow for protection of this information for minors. This policy statement reviews the challenges to privacy for adolescents posed by commercial health information technology systems and recommends basic principles for ideal electronic health record systems. This policy statement has been endorsed by the Society for Adolescent Health and Medicine. (10/12, reaffirmed 12/18)

https://doi.org/10.1542/peds.2012-2580

STANDARDS FOR PEDIATRIC CANCER CENTERS

Section on Hematology/Oncology

ABSTRACT. Since the American Academy of Pediatrics–published guidelines for pediatric cancer centers in 1986, 1997, and 2004, significant changes in the delivery of health care have prompted a review of the role of medical centers in the care of pediatric patients. The potential effect of these changes on the treatment and survival rates of children with cancer led to this revision. The intent of this statement is to delineate personnel, capabilities, and facilities that are essential to provide state-of-

the-art care for children, adolescents, and young adults with cancer. This statement emphasizes the importance of board-certified pediatric hematologists/oncologists and appropriately qualified pediatric medical subspecialists and pediatric surgical specialists overseeing patient care and the need for specialized facilities as essential for the initial management and much of the follow-up for pediatric, adolescent, and young adult patients with cancer. For patients without practical access to a pediatric cancer center, care may be provided locally by a primary care physician or adult oncologist but at the direction of a pediatric oncologist. (7/14, reaffirmed 10/18)
https://doi.org/10.1542/peds.2014-1526

STIGMA EXPERIENCED BY CHILDREN AND ADOLESCENTS WITH OBESITY

Stephen J. Pont, MD, MPH, FAAP; Rebecca Puhl, PhD, FTOS; Stephen R. Cook, MD, MPH, FAAP, FTOS; Wendelin Slusser, MD, MS, FAAP; and Section on Obesity (joint with The Obesity Society)

ABSTRACT. The stigmatization of people with obesity is widespread and causes harm. Weight stigma is often propagated and tolerated in society because of beliefs that stigma and shame will motivate people to lose weight. However, rather than motivating positive change, this stigma contributes to behaviors such as binge eating, social isolation, avoidance of health care services, decreased physical activity, and increased weight gain, which worsen obesity and create additional barriers to healthy behavior change. Furthermore, experiences of weight stigma also dramatically impair quality of life, especially for youth. Health care professionals continue to seek effective strategies and resources to address the obesity epidemic; however, they also frequently exhibit weight bias and stigmatizing behaviors. This policy statement seeks to raise awareness regarding the prevalence and negative effects of weight stigma on pediatric patients and their families and provides 6 clinical practice and 4 advocacy recommendations regarding the role of pediatricians in addressing weight stigma. In summary, these recommendations include improving the clinical setting by modeling best practices for nonbiased behaviors and language; using empathetic and empowering counseling techniques, such as motivational interviewing, and addressing weight stigma and bullying in the clinic visit; advocating for inclusion of training and education about weight stigma in medical schools, residency programs, and continuing medical education programs; and empowering families to be advocates to address weight stigma in the home environment and school setting. (11/17)
https://doi.org/10.1542/peds.2017-3034

STRATEGIES FOR PREVENTION OF HEALTH CARE–ASSOCIATED INFECTIONS IN THE NICU (CLINICAL REPORT)

Richard A. Polin, MD; Susan Denson, MD; Michael T. Brady, MD; Committee on Fetus and Newborn; and Committee on Infectious Diseases

ABSTRACT. Health care–associated infections in the NICU result in increased morbidity and mortality, prolonged lengths of stay, and increased medical costs. Neonates are at high risk of acquiring health care–associated infections because of impaired host-defense mechanisms, limited amounts of protective endogenous flora on skin and mucosal surfaces at time of birth, reduced barrier function of their skin, use of invasive procedures and devices, and frequent exposure to broad-spectrum antibiotic agents. This clinical report reviews management and prevention of health care–associated infections in newborn infants. (3/12, reaffirmed 2/16)
https://doi.org/10.1542/peds.2012-0145

SUBSTANCE USE SCREENING, BRIEF INTERVENTION, AND REFERRAL TO TREATMENT

Committee on Substance Use and Prevention

ABSTRACT. The enormous public health impact of adolescent substance use and its preventable morbidity and mortality show the need for the health care sector, including pediatricians and the medical home, to increase its capacity related to substance use prevention, detection, assessment, and intervention. The American Academy of Pediatrics published its policy statement "Substance Use Screening, Brief Intervention, and Referral to Treatment for Pediatricians" in 2011 to introduce the concepts and terminology of screening, brief intervention, and referral to treatment (SBIRT) and to offer clinical guidance about available substance use screening tools and intervention procedures. This policy statement is a revision of the 2011 SBIRT statement. An accompanying clinical report updates clinical guidance for adolescent SBIRT. (6/16)
https://doi.org/10.1542/peds.2016-1210

SUBSTANCE USE SCREENING, BRIEF INTERVENTION, AND REFERRAL TO TREATMENT (CLINICAL REPORT)

Sharon J. L. Levy, MD, MPH, FAAP; Janet F. Williams, MD, FAAP; and Committee on Substance Use and Prevention

ABSTRACT. The enormous public health impact of adolescent substance use and its preventable morbidity and mortality highlight the need for the health care sector, including pediatricians and the medical home, to increase its capacity regarding adolescent substance use screening, brief intervention, and referral to treatment (SBIRT). The American Academy of Pediatrics first published a policy statement on SBIRT and adolescents in 2011 to introduce SBIRT concepts and terminology and to offer clinical guidance about available substance use screening tools and intervention procedures. This clinical report provides a simplified adolescent SBIRT clinical approach that, in combination with the accompanying updated policy statement, guides pediatricians in implementing substance use prevention, detection, assessment, and intervention practices across the varied clinical settings in which adolescents receive health care. (6/16)
https://doi.org/10.1542/peds.2016-1211

SUDDEN DEATH IN THE YOUNG: INFORMATION FOR THE PRIMARY CARE PROVIDER

Christopher C. Erickson, MD, FAAP; Jack C. Salerno, MD; Stuart Berger, MD, FAAP; Robert Campbell, MD, FAAP; Bryan Cannon, MD; James Christiansen, MD; Kody Moffatt, MD, MS, FAAP; Andreas Pflaumer, MD; Christopher S. Snyder, MD, FAAP; Chandra Srinivasan, MD; Santiago O. Valdes, MD, FAAP; Victoria L. Vetter, MD, MPH, FAAP; Frank Zimmerman, MD; and Section on Cardiology and Cardiac Surgery (joint with Pediatric and Congenital Electrophysiology Society [PACES] Task Force on Prevention of Sudden Death in the Young)

ABSTRACT. There are multiple conditions that can make children prone to having a sudden cardiac arrest (SCA) or sudden cardiac death (SCD). Efforts have been made by multiple organizations to screen children for cardiac conditions, but the emphasis has been on screening before athletic competition. This article is an update of the previous American Academy of Pediatrics policy statement of 2012 that addresses prevention of SCA and SCD. This update includes a comprehensive review of conditions that should prompt more attention and cardiology evaluation. The role of the primary care provider is of paramount importance in the evaluation of children, particularly as they enter middle school or junior high. There is discussion about whether screening should find any cardiac condition or just those that are associated with SCA and SCD. This update reviews the 4 main screening questions that are recommended, not just for athletes, but for all children. There is also discussion about how to handle post-SCA and SCD situations as well as discussion about genetic

testing. It is the goal of this policy statement update to provide the primary care provider more assistance in how to screen for life-threatening conditions, regardless of athletic status. (6/21)

See full text on page 1053.

https://doi.org/10.1542/peds.2021-052044

SUICIDE AND SUICIDE ATTEMPTS IN ADOLESCENTS (CLINICAL REPORT)

Benjamin Shain, MD, PhD, and Committee on Adolescence

ABSTRACT. Suicide is the second leading cause of death for adolescents 15 to 19 years old. This report updates the previous statement of the American Academy of Pediatrics and is intended to assist pediatricians, in collaboration with other child and adolescent health care professionals, in the identification and management of the adolescent at risk for suicide. Suicide risk can only be reduced, not eliminated, and risk factors provide no more than guidance. Nonetheless, care for suicidal adolescents may be improved with the pediatrician's knowledge, skill, and comfort with the topic, as well as ready access to appropriate community resources and mental health professionals. (6/16, reaffirmed 10/20)

https://doi.org/10.1542/peds.2016-1420

SUPPLEMENTAL SECURITY INCOME (SSI) FOR CHILDREN AND YOUTH WITH DISABILITIES

Council on Children With Disabilities

ABSTRACT. The Supplemental Security Income (SSI) program remains an important source of financial support for low-income families of children with special health care needs and disabling conditions. In most states, SSI eligibility also qualifies children for the state Medicaid program, providing access to health care services. The Social Security Administration (SSA), which administers the SSI program, considers a child disabled under SSI if there is a medically determinable physical or mental impairment or combination of impairments that results in marked and severe functional limitations. The impairment(s) must be expected to result in death or have lasted or be expected to last for a continuous period of at least 12 months. The income and assets of families of children with disabilities are also considered when determining financial eligibility. When an individual with a disability becomes an adult at 18 years of age, the SSA considers only the individual's income and assets. The SSA considers an adult to be disabled if there is a medically determinable impairment (or combination of impairments) that prevents substantial gainful activity for at least 12 continuous months. SSI benefits are important for youth with chronic conditions who are transitioning to adulthood. The purpose of this statement is to provide updated information about the SSI medical and financial eligibility criteria and the disability-determination process. This statement also discusses how pediatricians can help children and youth when they apply for SSI benefits. (11/09, reaffirmed 2/15)

https://doi.org/10.1542/peds.2009-2557

SUPPORTING THE FAMILY AFTER THE DEATH OF A CHILD (CLINICAL REPORT)

Esther Wender, MD, and Committee on Psychosocial Aspects of Child and Family Health

ABSTRACT. The death of a child can have a devastating effect on the family. The pediatrician has an important role to play in supporting the parents and any siblings still in his or her practice after such a death. Pediatricians may be poorly prepared to provide this support. Also, because of the pain of confronting the grief of family members, they may be reluctant to become involved. This statement gives guidelines to help the pediatrician provide such support. It describes the grief reactions that can be expected in family members after the death of a child. Ways of supporting family members are suggested, and other helpful resources in the community are described. The goal of this guidance is to prevent outcomes that may impair the health and development of affected parents and children. (11/12, reaffirmed 12/16)

https://doi.org/10.1542/peds.2012-2772

SUPPORTING THE GRIEVING CHILD AND FAMILY (CLINICAL REPORT)

David J. Schonfeld, MD, FAAP; Thomas Demaria, PhD; Committee on Psychosocial Aspects of Child and Family Health; and Disaster Preparedness Advisory Council

ABSTRACT. The death of someone close to a child often has a profound and lifelong effect on the child and results in a range of both short- and long-term reactions. Pediatricians, within a patient-centered medical home, are in an excellent position to provide anticipatory guidance to caregivers and to offer assistance and support to children and families who are grieving. This clinical report offers practical suggestions on how to talk with grieving children to help them better understand what has happened and its implications and to address any misinformation, misinterpretations, or misconceptions. An understanding of guilt, shame, and other common reactions, as well an appreciation of the role of secondary losses and the unique challenges facing children in communities characterized by chronic trauma and cumulative loss, will help the pediatrician to address factors that may impair grieving and children's adjustment and to identify complicated mourning and situations when professional counseling is indicated. Advice on how to support children's participation in funerals and other memorial services and to anticipate and address grief triggers and anniversary reactions is provided so that pediatricians are in a better position to advise caregivers and to offer consultation to schools, early education and child care facilities, and other child congregate care sites. Pediatricians often enter their profession out of a profound desire to minimize the suffering of children and may find it personally challenging when they find themselves in situations in which they are asked to bear witness to the distress of children who are acutely grieving. The importance of professional preparation and self-care is therefore emphasized, and resources are recommended. (8/16)

https://doi.org/10.1542/peds.2016-2147

SUPPORTING THE HEALTH CARE TRANSITION FROM ADOLESCENCE TO ADULTHOOD IN THE MEDICAL HOME (CLINICAL REPORT)

Patience H. White, MD, MA, FAAP, FACP; W. Carl Cooley, MD, FAAP; American Academy of Pediatrics (joint with Transitions Clinical Report Authoring Group, American Academy of Family Physicians, and American College of Physicians)

ABSTRACT. Risk and vulnerability encompass many dimensions of the transition from adolescence to adulthood. Transition from pediatric, parent-supervised health care to more independent, patient-centered adult health care is no exception. The tenets and algorithm of the original 2011 clinical report, "Supporting the Health Care Transition from Adolescence to Adulthood in the Medical Home," are unchanged. This updated clinical report provides more practice-based quality improvement guidance on key elements of transition planning, transfer, and integration into adult care for all youth and young adults. It also includes new and updated sections on definition and guiding principles, the status of health care transition preparation among youth, barriers, outcome evidence, recommended health care transition processes and implementation strategies using quality improvement methods, special populations, education and training in pediatric onset conditions, and payment options. The clinical report also includes new recommendations pertaining to infrastructure, education and training, payment, and research. (10/18)

https://doi.org/10.1542/peds.2018-2587

SURFACTANT REPLACEMENT THERAPY FOR PRETERM AND TERM NEONATES WITH RESPIRATORY DISTRESS (CLINICAL REPORT)

Richard A. Polin, MD, FAAP; Waldemar A. Carlo, MD, FAAP; and Committee on Fetus and Newborn

ABSTRACT. Respiratory failure secondary to surfactant deficiency is a major cause of morbidity and mortality in preterm infants. Surfactant therapy substantially reduces mortality and respiratory morbidity for this population. Secondary surfactant deficiency also contributes to acute respiratory morbidity in late-preterm and term neonates with meconium aspiration syndrome, pneumonia/sepsis, and perhaps pulmonary hemorrhage; surfactant replacement may be beneficial for these infants. This statement summarizes the evidence regarding indications, administration, formulations, and outcomes for surfactant-replacement therapy. The clinical strategy of intubation, surfactant administration, and extubation to continuous positive airway pressure and the effect of continuous positive airway pressure on outcomes and surfactant use in preterm infants are also reviewed. (12/13)

https://doi.org/10.1542/peds.2013-3443

TACKLING IN YOUTH FOOTBALL

Council on Sports Medicine and Fitness

ABSTRACT. American football remains one of the most popular sports for young athletes. The injuries sustained during football, especially those to the head and neck, have been a topic of intense interest recently in both the public media and medical literature. The recognition of these injuries and the potential for long-term sequelae have led some physicians to call for a reduction in the number of contact practices, a postponement of tackling until a certain age, and even a ban on high school football. This statement reviews the literature regarding injuries in football, particularly those of the head and neck, the relationship between tackling and football-related injuries, and the potential effects of limiting or delaying tackling on injury risk. (10/15, reaffirmed 7/20)

https://doi.org/10.1542/peds.2013-3443

TARGETED REFORMS IN HEALTH CARE FINANCING TO IMPROVE THE CARE OF ADOLESCENTS AND YOUNG ADULTS

Arik V. Marcell, MD, MPH, FAAP; Cora C. Breuner, MD, MPH, FAAP; Lawrence Hammer, MD, FAAP; Mark L. Hudak, MD, FAAP; Committee on Adolescence; and Committee on Child Health Financing

ABSTRACT. Significant changes have occurred in the commercial and government insurance marketplace after the passage of 2 federal legislation acts, the Patient Protection and Affordable Care Act of 2010 and the Paul Wellstone and Pete Domenici Mental Health Parity and Addiction Equity Act of 2008. Despite the potential these 2 acts held to improve the health care of adolescents and young adults (AYAs), including the financing of care, there are barriers to achieving this goal. In the first quarter of 2016, 13.7% of individuals 18 to 24 years of age still lacked health insurance. Limitations in the scope of benefits coverage and inadequate provider payment can curtail access to health care for AYAs, particularly care related to sexual and reproductive health and mental and behavioral health. Some health plans impose financial barriers to access because they require families to absorb high cost-sharing expenses (eg, deductibles, copayments, and coinsurance). Finally, challenges of confidentiality inherent in the billing and insurance claim practices of some health insurance plans can discourage access to health care in the absence of other obstacles and interfere with provision of confidential care. This policy statement summarizes the current state of impediments that AYA, including those with special health care needs, face in accessing timely and appropriate health care and that providers face in serving these patients. These impediments include limited scope of benefits, high cost sharing, inadequate provider payment, and insufficient confidentiality protections. With this statement, we aim to improve both access to health care by AYAs and providers' delivery of developmentally appropriate health care for these patients through the presentation of an overview of the issues, specific recommendations for reform of health care financing for AYAs, and practical actions that pediatricians and other providers can take to advocate for appropriate payments for providing health care to AYAs. (11/18)

https://doi.org/10.1542/peds.2018-2998

THE TEEN DRIVER

Elizabeth M. Alderman, MD, FAAP, FSAHM; Brian D. Johnston, MD, MPH, FAAP; Committee on Adolescence; and Council on Injury, Violence, and Poison Prevention

ABSTRACT. For many teenagers, obtaining a driver's license is a rite of passage, conferring the ability to independently travel to school, work, or social events. However, immaturity, inexperience, and risky behavior put newly licensed teen drivers at risk. Motor vehicle crashes are the most common cause of mortality and injury for adolescents and young adults in developed countries. Teen drivers (15–19 years of age) have the highest rate of motor vehicle crashes among all age groups in the United States and contribute disproportionately to traffic fatalities. In addition to the deaths of teen drivers, more than half of 8- to 17-year-old children who die in car crashes are killed as passengers of drivers younger than 20 years of age. This policy statement, in which we update the previous 2006 iteration of this policy statement, is used to reflect new research on the risks faced by teen drivers and offer advice for pediatricians counseling teen drivers and their families. (9/18)

https://doi.org/10.1542/peds.2018-2163

TELEHEALTH: IMPROVING ACCESS TO AND QUALITY OF PEDIATRIC HEALTH CARE

Alison L. Curfman, MD, MBA, FAAP; Jesse M. Hackell, MD, FAAP; Neil E. Herendeen, MD, MS, FAAP; Joshua J. Alexander, MD, FAAP; James P. Marcin, MD, MPH, FAAP; William B. Moskowitz, MD, FAAP; Chelsea E. F. Bodnar, MD, MPhil, FAAP; Harold K. Simon, MD, MBA, FAAP; S. David McSwain, MD, FAAP; Section on Telehealth Care; Committee on Practice and Ambulatory Medicine; and Committee on Pediatric Workforce

ABSTRACT. All children and adolescents deserve access to quality health care regardless of their race/ethnicity, health conditions, financial resources, or geographic location. Despite improvements over the past decades, severe disparities in the availability and access to high-quality health care for children and adolescents continue to exist throughout the United States. Economic and racial factors, geographic maldistribution of primary care pediatricians, and limited availability of pediatric medical subspecialists and pediatric surgical specialists all contribute to inequitable access to pediatric care. Robust, comprehensive telehealth coverage is critical to improving pediatric access and quality of care and services, particularly for underresourced populations. (8/21)

See full text on page 1075.

https://doi.org/10.1542/peds.2021-053129

TELEMEDICINE FOR EVALUATION OF RETINOPATHY OF PREMATURITY (TECHNICAL REPORT)

Walter M. Fierson, MD, FAAP; Antonio Capone Jr, MD; and Section on Ophthalmology (joint with American Academy of Ophthalmology and American Association of Certified Orthoptists)

ABSTRACT. Retinopathy of prematurity (ROP) remains a significant threat to vision for extremely premature infants despite the availability of therapeutic modalities capable, in most cases, of managing this disorder. It has been shown in many controlled trials that application of therapies at the appropriate time is essential to successful outcomes in premature infants affected by ROP. Bedside binocular indirect ophthalmoscopy has been the standard technique for diagnosis and monitoring of ROP in these patients. However, implementation of routine use of this screening method for at-risk premature infants has presented challenges within our existing care systems, including relative local scarcity of qualified ophthalmologist examiners in some locations and the remote location of some NICUs. Modern technology, including the development of wide-angle ocular digital fundus photography, coupled with the ability to send digital images electronically to remote locations, has led to the development of telemedicine-based remote digital fundus imaging (RDFI-TM) evaluation techniques. These techniques have the potential to allow the diagnosis and monitoring of ROP to occur in lieu of the necessity for some repeated on-site examinations in NICUs. This report reviews the currently available literature on RDFI-TM evaluations for ROP and outlines pertinent practical and risk management considerations that should be used when including RDFI-TM in any new or existing ROP care structure. (12/14, reaffirmed 2/21)

https://doi.org/10.1542/peds.2014-0978

TELEMEDICINE: PEDIATRIC APPLICATIONS (TECHNICAL REPORT)

Bryan L. Burke Jr, MD, FAAP; R. W. Hall, MD, FAAP; and Section on Telehealth Care

ABSTRACT. Telemedicine is a technological tool that is improving the health of children around the world. This report chronicles the use of telemedicine by pediatricians and pediatric medical and surgical specialists to deliver inpatient and outpatient care, educate physicians and patients, and conduct medical research. It also describes the importance of telemedicine in responding to emergencies and disasters and providing access to pediatric care to remote and underserved populations. Barriers to telemedicine expansion are explained, such as legal issues, inadequate payment for services, technology costs and sustainability, and the lack of technology infrastructure on a national scale. Although certain challenges have constrained more widespread implementation, telemedicine's current use bears testimony to its effectiveness and potential. Telemedicine's widespread adoption will be influenced by the implementation of key provisions of the Patient Protection and Affordable Care Act, technological advances, and growing patient demand for virtual visits. (6/15)

https://doi.org/10.1542/peds.2015-1517

TESTING FOR DRUGS OF ABUSE IN CHILDREN AND ADOLESCENTS (CLINICAL REPORT)

Sharon Levy, MD, MPH, FAAP; Lorena M. Siqueira, MD, MSPH, FAAP; and Committee on Substance Abuse

ABSTRACT. Drug testing is often used as part of an assessment for substance use in children and adolescents. However, the indications for drug testing and guidance on how to use this procedure effectively are not clear. The complexity and invasiveness of the procedure and limitations to the information derived from drug testing all affect its utility. The objective of this clinical report is to provide guidance to pediatricians and other clinicians on the efficacy and efficient use of drug testing on the basis of a review of the nascent scientific literature, policy guidelines, and published clinical recommendations. (5/14)

https://doi.org/10.1542/peds.2014-0865

TOPICAL NASAL DECONGESTANT OXYMETAZOLINE: SAFETY CONSIDERATIONS FOR PERIOPERATIVE PEDIATRIC USE (CLINICAL REPORT)

Richard Cartabuke, MD, FAAP; Joseph D. Tobias, MD, FAAP; Kris R. Jatana, MD, FAAP; Section on Anesthesiology and Pain Medicine; and Section on Otolaryngology—Head and Neck Surgery

ABSTRACT. The over-the-counter nasal decongestant oxymetazoline (eg, Afrin) is used in the pediatric population for a variety of conditions in the operating room setting. Given its vasoconstrictive properties, it can have cardiovascular adverse effects when systemically absorbed. There have been several reports of cardiac and respiratory complications related to use of oxymetazoline in the pediatric population. Current US Food and Drug Administration approval for oxymetazoline is for patients ≥6 years of age, but medical professionals may elect to use it short-term and off label for younger children in particular clinical scenarios in which the potential benefit may outweigh risks (eg, active bleeding, acute respiratory distress from nasal obstruction, acute complicated sinusitis, improved surgical visualization, nasal decongestion for scope examination, other conditions, etc). To date, there have not been adequate pediatric pharmacokinetic studies of oxymetazoline, so caution should be exercised with both the quantity of dosing and the technique of administration. In the urgent care setting, emergency department, or inpatient setting, to avoid excessive administration of the medication, medical professionals should use the spray bottle in an upright position with the child upright. In addition, in the operating room setting, both monitoring the quantity used and effective communication between the surgeon and anesthesia team are important. Further studies are needed to understand the systemic absorption and effects in children in both nonsurgical and surgical nasal use of oxymetazoline. (10/21)

See full text on page 1083.

https://doi.org/10.1542/peds.2021-054271

TOWARD TRANSPARENT CLINICAL POLICIES

Steering Committee on Quality Improvement and Management

ABSTRACT. Clinical policies of professional societies such as the American Academy of Pediatrics are valued highly, not only by clinicians who provide direct health care to children but also by many others who rely on the professional expertise of these organizations, including parents, employers, insurers, and legislators. The utility of a policy depends, in large part, on the degree to which its purpose and basis are clear to policy users, an attribute known as the policy's transparency. This statement describes the critical importance and special value of transparency in clinical policies, guidelines, and recommendations; helps identify obstacles to achieving transparency; and suggests several approaches to overcome these obstacles. (3/08, reaffirmed 2/14)

https://doi.org/10.1542/peds.2007-3624

TRAMPOLINE SAFETY IN CHILDHOOD AND ADOLESCENCE

Council on Sports Medicine and Fitness

ABSTRACT. Despite previous recommendations from the American Academy of Pediatrics discouraging home use of trampolines, recreational use of trampolines in the home setting continues to be a popular activity among children and adolescents. This policy statement is an update to previous statements, reflecting the current literature on prevalence, patterns, and mechanisms of trampoline-related injuries. Most trampoline injuries occur with multiple simultaneous users on the mat. Cervical spine injuries often occur with falls off the trampoline or with attempts at somersaults or flips. Studies on the efficacy of trampoline safety measures are reviewed, and although there is a paucity of data, current implementation of safety measures have not appeared to mitigate risk substantially. Therefore, the home

use of trampolines is strongly discouraged. The role of trampoline as a competitive sport and in structured training settings is reviewed, and recommendations for enhancing safety in these environments are made. (9/12, reaffirmed 7/15, 3/20)
https://doi.org/10.1542/peds.2012-2082

THE TRANSFER OF DRUGS AND THERAPEUTICS INTO HUMAN BREAST MILK: AN UPDATE ON SELECTED TOPICS (CLINICAL REPORT)

Hari Cheryl Sachs, MD, FAAP, and Committee on Drugs

ABSTRACT. Many mothers are inappropriately advised to discontinue breastfeeding or avoid taking essential medications because of fears of adverse effects on their infants. This cautious approach may be unnecessary in many cases, because only a small proportion of medications are contraindicated in breastfeeding mothers or associated with adverse effects on their infants. Information to inform physicians about the extent of excretion for a particular drug into human milk is needed but may not be available. Previous statements on this topic from the American Academy of Pediatrics provided physicians with data concerning the known excretion of specific medications into breast milk. More current and comprehensive information is now available on the Internet, as well as an application for mobile devices, at LactMed (http://toxnet.nlm.nih.gov). Therefore, with the exception of radioactive compounds requiring temporary cessation of breastfeeding, the reader will be referred to LactMed to obtain the most current data on an individual medication. This report discusses several topics of interest surrounding lactation, such as the use of psychotropic therapies, drugs to treat substance abuse, narcotics, galactagogues, and herbal products, as well as immunization of breastfeeding women. A discussion regarding the global implications of maternal medications and lactation in the developing world is beyond the scope of this report. The World Health Organization offers several programs and resources that address the importance of breastfeeding (see http://www.who.int/topics/breastfeeding/en/). (8/13, reaffirmed 5/18)
https://doi.org/10.1542/peds.2013-1985

TRANSITION TO A SAFE HOME SLEEP ENVIRONMENT FOR THE NICU PATIENT

Michael H. Goodstein, MD, FAAP; Dan L. Stewart, MD, FAAP; Erin L. Keels, DNP, APRN-CNP, NNP-BC; Rachel Y. Moon, MD, FAAP; Committee on Fetus and Newborn; and Task Force on Sudden Infant Death Syndrome

ABSTRACT. Of the nearly 3.8 million infants born in the United States in 2018, 8.3% had low birth weight (ie, weight <2500 g) and 10% were born preterm (ie, gestational age of <37 weeks). Ten to fifteen percent of infants (approximately 500 000 annually), including low birth weight and preterm infants and others with congenital anomalies, perinatally acquired infections, and other diseases, require admission to a NICU. Every year, approximately 3600 infants in the United States die of sudden unexpected infant death (SUID), including sudden infant death syndrome (SIDS), unknown and undetermined causes, and accidental suffocation and strangulation in an unsafe sleep environment. Preterm and low birth weight infants are 2 to 3 times more likely than healthy term infants to die suddenly and unexpectedly. Thus, it is important that health care professionals prepare families to maintain their infant in a safe home sleep environment as per recommendations of the American Academy of Pediatrics. Medical needs of the NICU infant often require practices such as nonsupine positioning, which should be transitioned as soon as medically possible and well before hospital discharge to sleep practices that are safe and appropriate for the home environment. This clinical report outlines the establishment of appropriate NICU protocols for the timely transition of these infants to a safe home sleep environment. The rationale for these recommendations is discussed in the accompanying technical report "Transition to a Safe Home Sleep Environment for the NICU Patient," included in this issue of *Pediatrics.* (6/21)
See full text on page 1091.
https://doi.org/10.1542/peds.2021-052045

TRANSITION TO A SAFE HOME SLEEP ENVIRONMENT FOR THE NICU PATIENT (TECHNICAL REPORT)

Michael H. Goodstein, MD, FAAP; Dan L. Stewart, MD, FAAP; Erin L. Keels, DNP, APRN-CNP, NNP-BC; Rachel Y. Moon, MD, FAAP; Committee on Fetus and Newborn; and Task Force on Sudden Infant Death Syndrome

ABSTRACT. Of the nearly 3.8 million infants born in the United States in 2018, 8.3% had low birth weight (<2500 g [5.5 lb]) and 10% were born preterm (gestational age of <37 completed weeks). Many of these infants and others with congenital anomalies, perinatally acquired infections, and other disease require admission to a NICU. In the past decade, admission rates to NICUs have been increasing; it is estimated that between 10% and 15% of infants will spend time in a NICU, representing approximately 500 000 neonates annually. Approximately 3600 infants die annually in the United States from sleep-related deaths, including sudden infant death syndrome *International Classification of Diseases, 10th Revision* (R95), ill-defined deaths (R99), and accidental suffocation and strangulation in bed (W75). Preterm and low birth weight infants are particularly vulnerable, with an incidence of death 2 to 3 times greater than healthy term infants. Thus, it is important for health care professionals to prepare families to maintain their infant in a safe sleep environment, as per the recommendations of the American Academy of Pediatrics. However, infants in the NICU setting commonly require care that is inconsistent with infant sleep safety recommendations. The conflicting needs of the NICU infant with the necessity to provide a safe sleep environment before hospital discharge can create confusion for providers and distress for families. This technical report is intended to assist in the establishment of appropriate NICU protocols to achieve a consistent approach to transitioning NICU infants to a safe sleep environment as soon as medically possible, well before hospital discharge. (6/21)
See full text on page 1107.
https://doi.org/10.1542/peds.2021-052046

TRANSPORTING CHILDREN WITH SPECIAL HEALTH CARE NEEDS

Joseph O'Neil, MD, MPH, FAAP; Benjamin Hoffman, MD, FAAP; and Council on Injury, Violence, and Poison Prevention

ABSTRACT. Children with special health care needs should have access to proper resources for safe transportation as do typical children. This policy statement reviews important considerations for transporting children with special health care needs and provides current guidance for the protection of children with specific health care needs, including those with airway obstruction, orthopedic conditions or procedures, developmental delays, muscle tone abnormalities, challenging behaviors, and gastrointestinal disorders. (4/19)
https://doi.org/10.1542/peds.2019-0724

TRAUMA-INFORMED CARE (CLINICAL REPORT)

Heather Forkey, MD, FAAP; Moira Szilagyi, MD, PhD, FAAP; Erin T. Kelly, MD, FAAP, FACP; James Duffee, MD, MPH, FAAP; Council on Foster Care, Adoption, and Kinship Care; Council on Community Pediatrics; Council on Child Abuse and Neglect; and Committee on Psychosocial Aspects of Child and Family Health

ABSTRACT. Most children will experience some type of trauma during childhood, and many children suffer from significant adversities. Research in genetics, neuroscience, and epidemiology all provide evidence that these experiences have effects

at the molecular, cellular, and organ level, with consequences on physical, emotional, developmental, and behavioral health across the life span. Trauma-informed care translates that science to inform and improve pediatric care and outcomes. To practically address trauma and promote resilience, pediatric clinicians need tools to assess childhood trauma and adversity experiences as well as practical guidance, resources, and interventions. In this clinical report, we summarize current, practical advice for rendering trauma-informed care across varied medical settings. (7/21)

See full text on page 1135.

https://doi.org/10.1542/peds.2021-052580

TRAUMA-INFORMED CARE IN CHILD HEALTH SYSTEMS

James Duffee, MD, MPH, FAAP; Moira Szilagyi, MD, PhD, FAAP; Heather Forkey, MD, FAAP; Erin T. Kelly, MD, FAAP, FACP; Council on Community Pediatrics; Council on Foster Care, Adoption, and Kinship Care; Council on Child Abuse and Neglect; and Committee on Psychosocial Aspects of Child and Family Health

ABSTRACT. Recent progress in understanding the lifelong effects of early childhood adversities has clarified the need for an organized strategy to identify and intervene with children, adolescents, and families who may be at risk for maladaptive responses. Trauma-informed care (TIC) in child health care operationalizes the biological evidence of toxic stress with the insights of attachment and resilience to enhance health care delivery to mitigate the effects of trauma. The resulting pediatric health care delivery strategy promotes and restores resilience in children and adolescents, partners with families to support relational health, and reduces secondary trauma among pediatric health care clinicians. This policy statement summarizes what policy makers, legislators, and health care organizations need to consider in terms of infrastructure, resources, and financial support to facilitate the integration of TIC principles into all pediatric points of care. The accompanying clinical report describes the elements of TIC in the direct care of children, adolescents, and families and covers the spectrum from prevention to treatment. The recommendations in this statement and the clinical report build on other American Academy of Pediatrics policies that address the needs of special populations (such as children and adolescents in foster or kinship care, in immigrant and refugee families, or in poor or homeless families) and are congruent with American Academy of Pediatrics policies and technical reports concerning the role of pediatric clinicians in the promotion of lifelong health. (7/21)

See full text on page 1163.

https://doi.org/10.1542/peds.2021-052579

THE TREATMENT OF NEUROLOGICALLY IMPAIRED CHILDREN USING PATTERNING

Committee on Children With Disabilities

ABSTRACT. This statement reviews patterning as a treatment for children with neurologic impairments. This treatment is based on an outmoded and oversimplified theory of brain development. Current information does not support the claims of proponents that this treatment is efficacious, and its use continues to be unwarranted. (11/99, reaffirmed 11/02, 1/06, 8/10, 4/14, 5/18)

https://doi.org/10.1542/peds.104.5.1149

TRUTH, RECONCILIATION, AND TRANSFORMATION: CONTINUING ON THE PATH TO EQUITY

Board of Directors

ABSTRACT. One year ago, the American Academy of Pediatrics (AAP) published a landmark policy statement identifying racism as a core social determinant of health and a driver of health inequities. Seventy-five years ago, the AAP admitted its first Black members, Drs Alonzo deGrate Smith and Roland Boyd Scott. As the AAP continues to evolve its equity agenda, it is essential that the tortuous experiences of Drs deGrate Smith and Scott on their pathway to AAP membership be truthfully acknowledged and reckoned with. (8/20)

https://doi.org/10.1542/peds.2020-019794

TUBERCULOSIS INFECTION IN CHILDREN AND ADOLESCENTS: TESTING AND TREATMENT (CLINICAL REPORT)

Dawn Nolt, MD, MPH, FAAP; Jeffrey R. Starke, MD, FAAP; and Committee on Infectious Diseases

ABSTRACT. Tuberculosis (TB) remains an important problem among children in the United States and throughout the world. There is no diagnostic reference standard for latent tuberculosis infection (also referred to as tuberculosis infection [TBI]). The tuberculin skin test (TST) has many limitations, including difficulty in administration and interpretation, the need for a return visit by the patient, and false-positive results caused by cross-reaction with Mycobacterium bovis–bacille Calmette-Guerin vaccines and many nontuberculous mycobacteria. Interferon-gamma release assays (IGRAs) are blood tests that use antigens specific for M tuberculosis; as a result, IGRAs yield fewer false-positive results than the TST. Both IGRAs and the TST have reduced sensitivity in immunocompromised children, including children with severe TB disease. Both methods have high positive predictive value when applied to children with risk factors for TBI, especially recent contact with a person who has TB disease. The advantages of using IGRAs and diminished experience with the placement and interpretation of the TST favor expanded use of IGRAs in children in the United States. There are now several effective and safe regimens for the treatment of TBI in children. For improved adherence to therapy, the 3 rifamycin-based regimens are preferred because of their short duration. Daily isoniazid can be used if there is intolerance or drug interactions with rifamycins. A TB specialist should be involved when there are questions regarding testing interpretation, selection of an appropriate treatment regimen, or management of adverse effects. (11/21)

See full text on page 1177.

https://doi.org/10.1542/peds.2021-054663

ULTRAVIOLET RADIATION: A HAZARD TO CHILDREN AND ADOLESCENTS

Council on Environmental Health and Section on Dermatology

ABSTRACT. Ultraviolet radiation (UVR) causes the 3 major forms of skin cancer: basal cell carcinoma; squamous cell carcinoma; and cutaneous malignant melanoma. Public awareness of the risk is not optimal, overall compliance with sun protection is inconsistent, and melanoma rates continue to rise. The risk of skin cancer increases when people overexpose themselves to sun and intentionally expose themselves to artificial sources of UVR. Yet, people continue to sunburn, and teenagers and adults alike remain frequent visitors to tanning parlors. Pediatricians should provide advice about UVR exposure during health-supervision visits and at other relevant times. Advice includes avoiding sunburning, wearing clothing and hats, timing activities (when possible) before or after periods of peak sun exposure, wearing protective sunglasses, and applying and reapplying sunscreen. Advice should be framed in the context of promoting outdoor physical activity. Adolescents should be strongly discouraged from visiting tanning parlors. Sun exposure and vitamin D status are intertwined. Cutaneous vitamin D production requires sunlight exposure, and many factors, such as skin pigmentation, season, and time of day, complicate efficiency of cutaneous vitamin D production that results from sun exposure. Adequate vitamin D is needed for bone health. Accumulating information suggests a beneficial influence of vitamin D on many health conditions.

Although vitamin D is available through the diet, supplements, and incidental sun exposure, many children have low vitamin D concentrations. Ensuring vitamin D adequacy while promoting sun-protection strategies will require renewed attention to children's use of dietary and supplemental vitamin D. (2/11, reaffirmed 9/16)
https://doi.org/10.1542/peds.2010-3501

ULTRAVIOLET RADIATION: A HAZARD TO CHILDREN AND ADOLESCENTS (TECHNICAL REPORT)

Sophie J. Balk, MD; Council on Environmental Health; and Section on Dermatology

ABSTRACT. Sunlight sustains life on earth. Sunlight is essential for vitamin D synthesis in the skin. The sun's ultraviolet rays can be hazardous, however, because excessive exposure causes skin cancer and other adverse health effects. Skin cancer is a major public health problem; more than 2 million new cases are diagnosed in the United States each year. Ultraviolet radiation (UVR) causes the 3 major forms of skin cancer: basal cell carcinoma; squamous cell carcinoma; and cutaneous malignant melanoma. Exposure to UVR from sunlight and artificial sources early in life elevates the risk of developing skin cancer. Approximately 25% of sun exposure occurs before 18 years of age. The risk of skin cancer is increased when people overexpose themselves to sun and intentionally expose themselves to artificial sources of UVR. Public awareness of the risk is not optimal, compliance with sun protection is inconsistent, and skin-cancer rates continue to rise in all age groups including the younger population. People continue to sunburn, and teenagers and adults are frequent visitors to tanning parlors. Sun exposure and vitamin D status are intertwined. Adequate vitamin D is needed for bone health in children and adults. In addition, there is accumulating information suggesting a beneficial influence of vitamin D on various health conditions. Cutaneous vitamin D production requires sunlight, and many factors complicate the efficiency of vitamin D production that results from sunlight exposure. Ensuring vitamin D adequacy while promoting sun-protection strategies, therefore, requires renewed attention to evaluating the adequacy of dietary and supplemental vitamin D. Daily intake of 400 IU of vitamin D will prevent vitamin D deficiency rickets in infants. The vitamin D supplementation amounts necessary to support optimal health in older children and adolescents are less clear. This report updates information on the relationship of sun exposure to skin cancer and other adverse health effects, the relationship of exposure to artificial sources of UVR and skin cancer, sun-protection methods, vitamin D, community skin-cancer–prevention efforts, and the pediatrician's role in preventing skin cancer. In addition to pediatricians' efforts, a sustained public health effort is needed to change attitudes and behaviors regarding UVR exposure. (2/11, reaffirmed 9/16)
https://doi.org/10.1542/peds.2010-3502

UMBILICAL CORD CARE IN THE NEWBORN INFANT (CLINICAL REPORT)

Dan Stewart, MD, FAAP; William Benitz, MD, FAAP; and Committee on Fetus and Newborn

ABSTRACT. Postpartum infections remain a leading cause of neonatal morbidity and mortality worldwide. A high percentage of these infections may stem from bacterial colonization of the umbilicus, because cord care practices vary in reflection of cultural traditions within communities and disparities in health care practices globally. After birth, the devitalized umbilical cord often proves to be an ideal substrate for bacterial growth and also provides direct access to the bloodstream of the neonate. Bacterial colonization of the cord not infrequently leads to omphalitis and associated thrombophlebitis, cellulitis, or necrotizing fasciitis. Various topical substances continue to be used for cord care around the world to mitigate the risk of serious infection. More recently, particularly in high-resource countries, the treatment paradigm has shifted toward dry umbilical cord care. This clinical report reviews the evidence underlying recommendations for care of the umbilical cord in different clinical settings. (8/16)
https://doi.org/10.1542/peds.2016-2149

UNDERSTANDING LIABILITY RISKS AND PROTECTIONS FOR PEDIATRIC PROVIDERS DURING DISASTERS

Robin L. Altman, MD, FAAP; Karen A. Santucci, MD, FAAP; Michael R. Anderson, MD, MBA, FAAP; William M. McDonnell, MD, JD, FAAP; and Committee on Medical Liability and Risk Management

ABSTRACT. Although most health care providers will go through their careers without experiencing a major disaster in their local communities, if one does occur, it can be life and career altering. The American Academy of Pediatrics has been at the forefront of providing education and advocacy on the critical importance of disaster preparedness. From experiences over the past decade, new evidence and analysis have broadened our understanding that the concept of preparedness is also applicable to addressing the unique professional liability risks that can occur when caring for patients and families during a disaster. In our recommendations in this policy statement, we target pediatric health care providers, advocates, and policy makers and address how individuals, institutions, and government can work together to strengthen the system of liability protections during disasters so that appropriate and timely care can be delivered with minimal fear of legal reprisal or confusion. (2/19)
https://doi.org/10.1542/peds.2018-3892

UNDERSTANDING LIABILITY RISKS AND PROTECTIONS FOR PEDIATRIC PROVIDERS DURING DISASTERS (TECHNICAL REPORT)

Robin L. Altman, MD, FAAP; Karen A. Santucci, MD, FAAP; Michael R. Anderson, MD, MBA, FAAP; William M. McDonnell, MD, JD, FAAP; and Committee on Medical Liability and Risk Management

ABSTRACT. Although most health care providers will go through their careers without experiencing a major disaster in their local communities, if one does occur, it can be life and career altering. The American Academy of Pediatrics has been in the forefront of providing education and advocacy on the critical importance of disaster preparedness. From experiences over the past decade, new evidence and analysis have broadened our understanding that the concept of preparedness is also applicable to addressing the unique professional liability risks that can occur when caring for patients and families during a disaster. Concepts explored in this technical report will help to inform pediatric health care providers, advocates, and policy makers about the complexities of how providers are currently protected, with a focus on areas of unappreciated liability. The timeliness of this technical report is emphasized by the fact that during the time of its development (ie, late summer and early fall of 2017), the United States went through an extraordinary period of multiple, successive, and overlapping disasters within a concentrated period of time of both natural and man-made causes. In a companion policy statement (www.pediatrics.org/cgi/doi/10.1542/peds.2018-3892), recommendations are offered on how individuals, institutions, and governments can work together to strengthen the system of liability protections during disasters so that appropriate and timely care can be delivered with minimal fear of legal reprisal or confusion. (2/19)
https://doi.org/10.1542/peds.2018-3893

UNIQUE NEEDS OF THE ADOLESCENT

Elizabeth M. Alderman, MD, FSAHM, FAAP; Cora C. Breuner, MD, MPH, FAAP; and Committee on Adolescence

ABSTRACT. Adolescence is the transitional bridge between childhood and adulthood; it encompasses developmental milestones that are unique to this age group. Healthy cognitive, physical, sexual, and psychosocial development is both a right and a responsibility that must be guaranteed for all adolescents to successfully enter adulthood. There is consensus among national and international organizations that the unique needs of adolescents must be addressed and promoted to ensure the health of all adolescents. This policy statement outlines the special health challenges that adolescents face on their journey and transition to adulthood and provides recommendations for those who care for adolescents, their families, and the communities in which they live. (11/19)

https://doi.org/10.1542/peds.2019-3150

UPDATE OF NEWBORN SCREENING AND THERAPY FOR CONGENITAL HYPOTHYROIDISM (CLINICAL REPORT)

Susan R. Rose, MD; Section on Endocrinology; and Committee on Genetics (joint with Rosalind S. Brown, MD; American Thyroid Association; and Lawson Wilkins Pediatric Endocrine Society)

ABSTRACT. Unrecognized congenital hypothyroidism leads to mental retardation. Newborn screening and thyroid therapy started within 2 weeks of age can normalize cognitive development. The primary thyroid-stimulating hormone screening has become standard in many parts of the world. However, newborn thyroid screening is not yet universal in some countries. Initial dosage of 10 to 15 μg/kg levothyroxine is recommended. The goals of thyroid hormone therapy should be to maintain frequent evaluations of total thyroxine or free thyroxine in the upper half of the reference range during the first 3 years of life and to normalize the serum thyroid-stimulating hormone concentration to ensure optimal thyroid hormone dosage and compliance.

Improvements in screening and therapy have led to improved developmental outcomes in adults with congenital hypothyroidism who are now in their 20s and 30s. Thyroid hormone regimens used today are more aggressive in targeting early correction of thyroid-stimulating hormone than were those used 20 or even 10 years ago. Thus, newborn infants with congenital hypothyroidism today may have an even better intellectual and neurologic prognosis. Efforts are ongoing to establish the optimal therapy that leads to maximum potential for normal development for infants with congenital hypothyroidism.

Remaining controversy centers on infants whose abnormality in neonatal thyroid function is transient or mild and on optimal care of very low birth weight or preterm infants. Of note, thyroid-stimulating hormone is not elevated in central hypothyroidism. An algorithm is proposed for diagnosis and management.

Physicians must not relinquish their clinical judgment and experience in the face of normal newborn thyroid test results. Hypothyroidism can be acquired after the newborn screening. When clinical symptoms and signs suggest hypothyroidism, regardless of newborn screening results, serum free thyroxine and thyroid-stimulating hormone determinations should be performed. (6/06, reaffirmed 12/11)

https://doi.org/10.1542/peds.2006-0915

UPDATED GUIDANCE FOR PALIVIZUMAB PROPHYLAXIS AMONG INFANTS AND YOUNG CHILDREN AT INCREASED RISK OF HOSPITALIZATION FOR RESPIRATORY SYNCYTIAL VIRUS INFECTION

Committee on Infectious Diseases and Bronchiolitis Guidelines Committee

ABSTRACT. Palivizumab was licensed in June 1998 by the Food and Drug Administration for the reduction of serious lower respiratory tract infection caused by respiratory syncytial virus (RSV) in children at increased risk of severe disease. Since that time, the American Academy of Pediatrics has updated its guidance for the use of palivizumab 4 times as additional data became available to provide a better understanding of infants and young children at greatest risk of hospitalization attributable to RSV infection. The updated recommendations in this policy statement reflect new information regarding the seasonality of RSV circulation, palivizumab pharmacokinetics, the changing incidence of bronchiolitis hospitalizations, the effect of gestational age and other risk factors on RSV hospitalization rates, the mortality of children hospitalized with RSV infection, the effect of prophylaxis on wheezing, and palivizumab-resistant RSV isolates. (7/14, reaffirmed 2/19)

https://doi.org/10.1542/peds.2014-1665

UPDATED GUIDANCE FOR PALIVIZUMAB PROPHYLAXIS AMONG INFANTS AND YOUNG CHILDREN AT INCREASED RISK OF HOSPITALIZATION FOR RESPIRATORY SYNCYTIAL VIRUS INFECTION (TECHNICAL REPORT)

Committee on Infectious Diseases and Bronchiolitis Guidelines Committee

ABSTRACT. Guidance from the American Academy of Pediatrics (AAP) for the use of palivizumab prophylaxis against respiratory syncytial virus (RSV) was first published in a policy statement in 1998. Guidance initially was based on the result from a single randomized, placebo-controlled clinical trial conducted in 1996–1997 describing an overall reduction in RSV hospitalization rate from 10.6% among placebo recipients to 4.8% among children who received prophylaxis. The results of a second randomized, placebo-controlled trial of children with hemodynamically significant heart disease were published in 2003 and revealed a reduction in RSV hospitalization rate from 9.7% in control subjects to 5.3% among prophylaxis recipients. Because no additional controlled trials regarding efficacy were published, AAP guidance has been updated periodically to reflect the most recent literature regarding children at greatest risk of severe disease. Since the last update in 2012, new data have become available regarding the seasonality of RSV circulation, palivizumab pharmacokinetics, the changing incidence of bronchiolitis hospitalizations, the effects of gestational age and other risk factors on RSV hospitalization rates, the mortality of children hospitalized with RSV infection, and the effect of prophylaxis on wheezing and palivizumab-resistant RSV isolates. These data enable further refinement of AAP guidance to most clearly focus on those children at greatest risk. (7/14)

https://doi.org/10.1542/peds.2014-1666

UPDATES ON AN AT-RISK POPULATION: LATE-PRETERM AND EARLY-TERM INFANTS (CLINICAL REPORT)

Dan L. Stewart, MD, FAAP; Wanda D. Barfield, MD, MPH, FAAP, RADM, USPHS; Committee on Fetus and Newborn

ABSTRACT. The American Academy of Pediatrics published a clinical report on late-preterm (LPT) infants in 2007 that was largely based on a summary of a 2005 workshop convened by the *Eunice Kennedy Shriver* National Institute of Child Health and

Human Development, at which a change in terminology from "near term" to "late preterm" was proposed. This paradigm-shifting recommendation had a remarkable impact: federal agencies (the Centers for Disease Control and Prevention), professional societies (the American Academy of Pediatrics and American College of Obstetricians and Gynecologists), and organizations (March of Dimes) initiated nationwide monitoring and educational plans that had a significant effect on decreasing the rates of iatrogenic LPT deliveries. However, there is now an evolving concern. After nearly a decade of steady decreases in the LPT birth rate that largely contributed to the decline in total US preterm birth rates, the birth rate in LPT infants has been inching upward since 2015. In addition, evidence revealed by strong population health research demonstrates that being born as an early-term infant poses a significant risk to an infant's survival, growth, and development. In this report, we summarize the initial progress and discuss the potential reasons for the current trends in LPT and early-term birth rates and propose research recommendations. (10/19)
https://doi.org/10.1542/peds.2019-2760

USE OF CHAPERONES DURING THE PHYSICAL EXAMINATION OF THE PEDIATRIC PATIENT

Committee on Practice and Ambulatory Medicine

ABSTRACT. Physicians should always communicate the scope and nature of the physical examination to be performed to the pediatric patient and his or her parent. This statement addresses the use of chaperones and issues of patient comfort, confidentiality, and privacy. The use of a chaperone should be a shared decision between the patient and physician. In some states, the use of a chaperone is mandated by state regulations. (4/11, 11/17)
https://doi.org/10.1542/peds.2011-0322

USE OF INHALED NITRIC OXIDE IN PRETERM INFANTS (CLINICAL REPORT)

Praveen Kumar, MD, FAAP, and Committee on Fetus and Newborn

ABSTRACT. Nitric oxide, an important signaling molecule with multiple regulatory effects throughout the body, is an important tool for the treatment of full-term and late-preterm infants with persistent pulmonary hypertension of the newborn and hypoxemic respiratory failure. Several randomized controlled trials have evaluated its role in the management of preterm infants ≤34 weeks' gestational age with varying results. The purpose of this clinical report is to summarize the existing evidence for the use of inhaled nitric oxide in preterm infants and provide guidance regarding its use in this population. (12/13)
https://doi.org/10.1542/peds.2013-3444

THE USE OF NONNUTRITIVE SWEETENERS IN CHILDREN

Carissa M. Baker-Smith, MD, MPH, FAAP; Sarah D. de Ferranti, MD, MPH, FAAP; William J. Cochran, MD, FAAP; Committee on Nutrition; and Section on Gastroenterology, Hepatology, and Nutrition

ABSTRACT. The prevalence of nonnutritive sweeteners (NNSs) in the food supply has increased over time. Not only are more children and adolescents consuming NNSs, but they are also consuming a larger quantity of NNSs in the absence of strong scientific evidence to refute or support the safety of these agents. This policy statement from the American Academy of Pediatrics is intended to provide the pediatric provider with a review of (1) previous steps taken for approved use of NNSs, (2) existing data regarding the safety of NNS use in the general pediatric population, (3) what is known regarding the potential benefits and/or adverse effects of NNS use in children and adolescents, (4) identified gaps in existing knowledge and potential areas of future research, and (5) suggested talking points that pediatricians may use when discussing NNS use with families. (10/19)
https://doi.org/10.1542/peds.2019-2765

USE OF PERFORMANCE-ENHANCING SUBSTANCES (CLINICAL REPORT)

Michele LaBotz, MD, FAAP; Bernard A. Griesemer, MD, FAAP; and Council on Sports Medicine and Fitness

ABSTRACT. Performance-enhancing substances (PESs) are used commonly by children and adolescents in attempts to improve athletic performance. More recent data reveal that these same substances often are used for appearance-related reasons as well. PESs include both legal over-the-counter dietary supplements and illicit pharmacologic agents. This report reviews the current epidemiology of PES use in the pediatric population, as well as information on those PESs in most common use. Concerns regarding use of legal PESs include high rates of product contamination, correlation with future use of anabolic androgenic steroids, and adverse effects on the focus and experience of youth sports participation. The physical maturation and endogenous hormone production that occur in adolescence are associated with large improvements in strength and athletic performance. For most young athletes, PES use does not produce significant gains over those seen with the onset of puberty and adherence to an appropriate nutrition and training program. (6/16, reaffirmed 8/20)
https://doi.org/10.1542/peds.2016-1300

USE OF PROBIOTICS IN PRETERM INFANTS (CLINICAL REPORT)

Brenda Poindexter, MD, MS, FAAP, and Committee on Fetus and Newborn

ABSTRACT. Probiotic products in the United States are available for use in the general category of dietary supplements, bypassing the rigor of the US Food and Drug Administration (FDA) approval process in safety, efficacy, and manufacturing standards. As a result, currently available probiotics lack FDA-approved drug labeling and cannot be marketed to treat or prevent disease in preterm infants, including necrotizing enterocolitis and late-onset sepsis. Despite lack of availability of a pharmaceutical-grade product, the number of preterm infants receiving probiotics in the United States and Canada is steadily increasing. According to recent reports from large collaborative databases in the United States, approximately 10% of extremely low gestational age neonates receive a probiotic preparation during their stay in the NICU, with wide variation in practice among units. In sum, more than 10 000 preterm infants have been enrolled in randomized clinical trials of probiotic supplementation worldwide. Methodologic differences among study protocols included different strains and combinations of therapy, masking of trials, and a priori definitions of the primary outcome measure. Large meta-analyses of these trials have demonstrated the efficacy of multiple-strain probiotics in reducing necrotizing enterocolitis and all-cause mortality, whereas the efficacy of single-strain probiotic preparations is less certain. In the absence of an appropriate medical-grade product in the United States, dietary supplement–grade probiotics, some of which have been the subject of recent recalls for contamination, are being prescribed. Given the lack of FDA-regulated pharmaceutical-grade products in the United States, conflicting data on safety and efficacy, and potential for harm in a highly vulnerable population, current evidence does not support the routine, universal administration of probiotics to preterm infants, particularly those with a birth weight of <1000 g. (5/21)
See full text on page 1203.
https://doi.org/10.1542/peds.2021-051485

THE USE OF SYSTEMIC AND TOPICAL FLUOROQUINOLONES (CLINICAL REPORT)

Mary Anne Jackson, MD, FAAP; Gordon E. Schutze, MD, FAAP; and Committee on Infectious Diseases

ABSTRACT. Appropriate prescribing practices for fluoroquinolones, as well as all antimicrobial agents, are essential as evolving resistance patterns are considered, additional treatment indications are identified, and the toxicity profile of fluoroquinolones in children has become better defined. Earlier recommendations for systemic therapy remain; expanded uses of fluoroquinolones for the treatment of certain infections are outlined in this report. Prescribing clinicians should be aware of specific adverse reactions associated with fluoroquinolones, and their use in children should continue to be limited to the treatment of infections for which no safe and effective alternative exists or in situations in which oral fluoroquinolone treatment represents a reasonable alternative to parenteral antimicrobial therapy. (10/16, reaffirmed 3/21)

https://doi.org/10.1542/peds.2016-2706

THE USE OF TELEMEDICINE TO ADDRESS ACCESS AND PHYSICIAN WORKFORCE SHORTAGES

Committee on Pediatric Workforce

ABSTRACT. The use of telemedicine technologies by primary care pediatricians, pediatric medical subspecialists, and pediatric surgical specialists (henceforth referred to as "pediatric physicians") has the potential to transform the practice of pediatrics. The purpose of this policy statement is to describe the expected and potential impact that telemedicine will have on pediatric physicians' efforts to improve access and physician workforce shortages. The policy statement also describes how the American Academy of Pediatrics can advocate for its members and their patients to best use telemedicine technologies to improve access to care, provide more patient- and family-centered care, increase efficiencies in practice, enhance the quality of care, and address projected shortages in the clinical workforce. As the use of telemedicine increases, it is likely to impact health care access, quality, and education and costs of care. Telemedicine technologies, applied to the medical home and its collaborating providers, have the potential to improve current models of care by increasing communication among clinicians, resulting in more efficient, higher quality, and less expensive care. Such a model can serve as a platform for providing more continuous care, linking primary and specialty care to support management of the needs of complex patients. In addition, telemedicine technologies can be used to efficiently provide pediatric physicians working in remote locations with ongoing medical education, increasing their ability to care for more complex patients in their community, reducing the burdens of travel on patients and families, and supporting the medical home. On the other hand, telemedicine technologies used for episodic care by nonmedical home providers have the potential to disrupt continuity of care and to create redundancy and imprudent use of health care resources. Fragmentation should be avoided, and telemedicine, like all primary and specialty services, should be coordinated through the medical home. (6/15, reaffirmed 5/19)

https://doi.org/10.1542/peds.2015-1253

VENTRICULAR FIBRILLATION AND THE USE OF AUTOMATED EXTERNAL DEFIBRILLATORS ON CHILDREN

Committee on Pediatric Emergency Medicine and Section on Cardiology and Cardiac Surgery

ABSTRACT. The use of automated external defibrillators (AEDs) has been advocated in recent years as one part of the chain of survival to improve outcomes for adult cardiac arrest victims. When AEDs first entered the market, they had not been tested for pediatric usage and rhythm interpretation. In addition, the presumption was that children do not experience ventricular fibrillation, so they would not benefit from the use of AEDs. Recent literature has shown that children do experience ventricular fibrillation, which has a better outcome than do other cardiac arrest rhythms. At the same time, the arrhythmia software on AEDs has become more extensive and validated for children, and attenuation devices have become available to downregulate the energy delivered by AEDs to allow their use on children. Pediatricians are now being asked whether AED programs should be implemented, and where they are being implemented, pediatricians are being asked to provide guidance on the use of them on children. As AED programs expand, pediatricians must advocate on behalf of children so that their needs are accounted for. For pediatricians to be able to provide guidance and ensure that children are included in AED programs, it is important for pediatricians to know how AEDs work, be up-to-date on the literature regarding pediatric fibrillation and energy delivery, and understand the role of AEDs as life-saving interventions for children. (5/07, reaffirmed 1/20)

https://doi.org/10.1542/peds.2007-2676

VIRTUAL VIOLENCE

Council on Communications and Media

ABSTRACT. In the United States, exposure to media violence is becoming an inescapable component of children's lives. With the rise in new technologies, such as tablets and new gaming platforms, children and adolescents increasingly are exposed to what is known as "virtual violence." This form of violence is not experienced physically; rather, it is experienced in realistic ways via new technology and ever more intense and realistic games. The American Academy of Pediatrics continues to be concerned about children's exposure to virtual violence and the effect it has on their overall health and well-being. This policy statement aims to summarize the current state of scientific knowledge regarding the effects of virtual violence on children's attitudes and behaviors and to make specific recommendations for pediatricians, parents, industry, and policy makers. (7/16)

https://doi.org/10.1542/peds.2016-1298

VISUAL SYSTEM ASSESSMENT IN INFANTS, CHILDREN, AND YOUNG ADULTS BY PEDIATRICIANS

Committee on Practice and Ambulatory Medicine and Section on Ophthalmology (joint with American Association of Certified Orthoptists, American Association for Pediatric Ophthalmology and Strabismus, and American Academy of Ophthalmology)

ABSTRACT. Appropriate visual assessments help identify children who may benefit from early interventions to correct or improve vision. Examination of the eyes and visual system should begin in the nursery and continue throughout both childhood and adolescence during routine well-child visits in the medical home. Newborn infants should be examined using inspection and red reflex testing to detect structural ocular abnormalities, such as cataract, corneal opacity, and ptosis. Instrument-based screening, if available, should be first attempted between 12 months and 3 years of age and at annual well-child visits until acuity can be tested directly. Direct testing of visual acuity can often begin by 4 years of age, using age-appropriate symbols (optotypes). Children found to have an ocular abnormality or who fail a vision assessment should be referred to a pediatric ophthalmologist or an eye care specialist appropriately trained to treat pediatric patients. (12/15)

https://doi.org/10.1542/peds.2015-3596

WEB SERVICES AND CLOUD COMPUTING IN PEDIATRIC CARE (TECHNICAL REPORT)

Michael G. Leu, MD, MS, MHS, FAAP, FAMIA; Stuart T. Weinberg, MD, FAAP, FAMIA; Craig Monsen, MD, MS; Christoph U. Lehmann, MD, FAAP, FACMI, FIAHSI; and Council on Clinical Information Technology

ABSTRACT. Electronic health record (EHR) systems do not uniformly implement pediatric-supportive functionalities. One method of adding these capabilities across EHR platforms is to integrate Web services and Web applications that may perform decision support and store data in the cloud when the EHR platform is able to integrate Web services. Specific examples of these services are described, such as immunization clinical decision support services, consumer health resources, and bilirubin nomograms. Health care providers, EHR vendors, and developers share responsibilities in the appropriate development, integration, and use of Web services and Web applications as they relate to best practices in the areas of data security and confidentiality, technical availability, audit trails, terminology and messaging standards, compliance with the Health Insurance Portability and Accountability Act, testing, usability, and other considerations. It is desirable for health care providers to have knowledge of Web services and Web applications that can improve pediatric capabilities in their own EHRs because this will naturally inform discussions concerning EHR features and facilitate implementation and subsequent use of these capabilities by clinicians caring for children. (6/21)

See full text on page 1213.

https://doi.org/10.1542/peds.2021-052048

WITHHOLDING OR TERMINATION OF RESUSCITATION IN PEDIATRIC OUT-OF-HOSPITAL TRAUMATIC CARDIOPULMONARY ARREST

Committee on Pediatric Emergency Medicine (joint with American College of Surgeons Committee on Trauma and National Association of EMS Physicians)

ABSTRACT. This multiorganizational literature review was undertaken to provide an evidence base for determining whether recommendations for out-of-hospital termination of resuscitation could be made for children who are victims of traumatic cardiopulmonary arrest. Although there is increasing acceptance of out-of-hospital termination of resuscitation for adult traumatic cardiopulmonary arrest when there is no expectation of a good outcome, children are routinely excluded from state termination-of-resuscitation protocols. The decision to withhold resuscitative efforts in a child under specific circumstances (decapitation or dependent lividity, rigor mortis, etc) is reasonable. If there is any doubt as to the circumstances or timing of the traumatic cardiopulmonary arrest, under the current status of limiting termination of resuscitation in the field to persons older than 18 years in most states, resuscitation should be initiated and continued until arrival to the appropriate facility. If the patient has arrested, resuscitation has already exceeded 30 minutes, and the nearest facility is more than 30 minutes away, involvement of parents and family of these children in the decision-making process with assistance and guidance from medical professionals should be considered as part of an emphasis on family-centered care because the evidence suggests that either death or a poor outcome is inevitable. (3/14, reaffirmed 6/20)

https://doi.org/10.1542/peds.2014-0176

YOUTH PARTICIPATION AND INJURY RISK IN MARTIAL ARTS (CLINICAL REPORT)

Rebecca A. Demorest, MD, FAAP; Chris Koutures, MD, FAAP; and Council on Sports Medicine and Fitness

ABSTRACT. The martial arts can provide children and adolescents with vigorous levels of physical exercise that can improve overall physical fitness. The various types of martial arts encompass noncontact basic forms and techniques that may have a lower relative risk of injury. Contact-based sparring with competitive training and bouts have a higher risk of injury. This clinical report describes important techniques and movement patterns in several types of martial arts and reviews frequently reported injuries encountered in each discipline, with focused discussions of higher risk activities. Some of these higher risk activities include blows to the head and choking or submission movements that may cause concussions or significant head injuries. The roles of rule changes, documented benefits of protective equipment, and changes in training recommendations in attempts to reduce injury are critically assessed. This information is intended to help pediatric health care providers counsel patients and families in encouraging safe participation in martial arts. (11/16)

https://doi.org/10.1542/peds.2016-3022

Section 5

Endorsed Policies

The American Academy of Pediatrics endorses and accepts as its policy the following documents from other organizations.

AMERICAN ACADEMY OF PEDIATRICS

Endorsed Policies

2015 SPCTPD/ACC/AAP/AHA TRAINING GUIDELINES FOR PEDIATRIC CARDIOLOGY FELLOWSHIP PROGRAMS (REVISION OF THE 2005 TRAINING GUIDELINES FOR PEDIATRIC CARDIOLOGY FELLOWSHIP PROGRAMS)

Robert D. Ross, MD, FAAP, FACC; Michael Brook, MD; Jeffrey A. Feinstein, MD; et al (8/15)

INTRODUCTION

Robert D. Ross, MD, FAAP, FACC; Michael Brook, MD; Peter Koenig, MD, FACC, FASE; et al (8/15)

TASK FORCE 1: GENERAL CARDIOLOGY

Alan B. Lewis, MD, FAAP, FACC; Gerard R. Martin, MD, FAAP, FACC, FAHA; Peter J. Bartz, MD, FASE; et al (8/15)

TASK FORCE 2: NONINVASIVE CARDIAC IMAGING

Shubhika Srivastava, MBBS, FAAP, FACC, FASE; Beth F. Printz, MD, PhD, FAAP, FASE; Tal Geva, MD, FACC; et al (8/15)

TASK FORCE 3: CARDIAC CATHETERIZATION

Laurie B. Armsby, MD, FAAP, FSCAI; Robert N. Vincent, MD, CM, FACC, FSCAI; Susan R. Foerster, MD, FSCAI; et al (8/15)

TASK FORCE 4: ELECTROPHYSIOLOGY

Anne M. Dubin, MD, FHRS; Edward P. Walsh, MD, FHRS; Wayne Franklin, MD, FAAP, FACC, FAHA; et al (8/15)

TASK FORCE 5: CRITICAL CARE CARDIOLOGY

Timothy F. Feltes, MD, FAAP, FACC, FAHA; Stephen J. Roth, MD, MPH, FAAP; Melvin C. Almodovar, MD; et al (8/15)

TASK FORCE 6: ADULT CONGENITAL HEART DISEASE

Karen Stout, MD, FACC; Anne Marie Valente, MD, FACC; Peter J. Bartz, MD, FASE; et al (8/15)

TASK FORCE 7: PULMONARY HYPERTENSION, ADVANCED HEART FAILURE, AND TRANSPLANTATION

Steven A. Webber, MB, ChB; Daphne T. Hsu, MD, FAAP, FACC, FAHA; D. Dunbar Ivy, MD, FAAP, FACC; et al (8/15)

TASK FORCE 8: RESEARCH AND SCHOLARLY ACTIVITY

William T. Mahle, MD, FAAP, FACC, FAHA; Anne M. Murphy, MD, FACC, FAHA; Jennifer S. Li, MD; et al (8/15)

THE 21ST CENTURY CURES ACT & ADOLESCENT CONFIDENTIALITY

North American Society for Pediatric and Adolescent Gynecology and Society for Adolescent Health and Medicine

INTRODUCTION. In 2020 the Office of the National Coordinator for Heath Information Technology (ONC) issued a Final Rule to implement specific requirements of the 21st Century Cures Act. The goal of the Final Rule is to increase access, use, and exchange of electronic health information. The North American Society for Pediatric and Adolescent Gynecology (NASPAG) and the Society for Adolescent Health and Medicine (SAHM) agree that sharing health information with patients and families allows for improved medical care. We believe it is equally important to recognize the right of adolescent minors to access confidential care, which is protected to some degree in every U.S. state. As experts in the care of adolescents, NASPAG and SAHM are in a unique position to inform institutional policies around release of information for this population. (2/21)

ADVANCED PRACTICE REGISTERED NURSE: ROLE, PREPARATION, AND SCOPE OF PRACTICE

National Association of Neonatal Nurses

ABSTRACT. In recent years, the National Association of Neonatal Nurses (NANN) and the National Association of Neonatal Nurse Practitioners (NANNP) have developed several policy statements on neonatal advanced practice registered nurse (APRN) workforce, education, competency, fatigue, safety, and scope of practice. This position paper is a synthesis of previous efforts and discusses the role, preparation, and scope of practice of the neonatal APRN. (1/14)

ANTENATAL CORTICOSTEROID THERAPY FOR FETAL MATURATION

American College of Obstetricians and Gynecologists

ABSTRACT. Corticosteroid administration before anticipated preterm birth is one of the most important antenatal therapies available to improve newborn outcomes. A single course of corticosteroids is recommended for pregnant women between 24 0/7 weeks and 33 6/7 weeks of gestation who are at risk of preterm delivery within 7 days, including for those with ruptured membranes and multiple gestations. It also may be considered for pregnant women starting at 23 0/7 weeks of gestation who are at risk of preterm delivery within 7 days, based on a family's decision regarding resuscitation, irrespective of membrane rupture status and regardless of fetal number. Administration of betamethasone may be considered in pregnant women between 34 0/7 weeks and 36 6/7 weeks of gestation who are at risk of preterm birth within 7 days, and who have not received a previous course of antenatal corticosteroids. A single repeat course of antenatal corticosteroids should be considered in women who are less than 34 0/7 weeks of gestation who are at risk of preterm delivery within 7 days, and whose prior course of antenatal corticosteroids was administered more than 14 days previously. Rescue course corticosteroids could be provided as early as 7 days from the prior dose, if indicated by the clinical scenario. Continued surveillance of long-term outcomes after in utero corticosteroid exposure should be supported. Quality improvement strategies to optimize appropriate and timely antenatal corticosteroid administration are encouraged. (8/17)

APPROPRIATE USE CRITERIA FOR INITIAL TRANSTHORACIC ECHOCARDIOGRAPHY IN OUTPATIENT PEDIATRIC CARDIOLOGY

American College of Cardiology Appropriate Use Task Force

ABSTRACT. The American College of Cardiology (ACC) participated in a joint project with the American Society of Echocardiography, the Society of Pediatric Echocardiography, and several other subspecialty societies and organizations to establish and evaluate Appropriate Use Criteria (AUC) for the initial use of outpatient pediatric echocardiography. Assumptions for the AUC were identified, including the fact that all indications assumed a first-time transthoracic echocardiographic study in an outpatient setting for patients without previously known heart disease. The definitions for frequently used terminology in outpatient pediatric cardiology were established using published guidelines and standards and expert opinion. These AUC serve as a guide to help clinicians in the care of children with possible heart disease, specifically in terms of when a transthoracic echocardiogram is warranted as an initial diagnostic modality in the outpatient setting. They are also a useful tool

for education and provide the infrastructure for future quality improvement initiatives as well as research in healthcare delivery, outcomes, and resource utilization.

To complete the AUC process, the writing group identified 113 indications based on common clinical scenarios and/or published clinical practice guidelines, and each indication was classified into 1 of 9 categories of common clinical presentations, including palpitations, syncope, chest pain, and murmur. A separate, independent rating panel evaluated each indication using a scoring scale of 1 to 9, thereby designating each indication as "Appropriate" (median score 7 to 9), "May Be Appropriate" (median score 4 to 6), or "Rarely Appropriate" (median score 1 to 3). Fifty-three indications were identified as Appropriate, 28 as May Be Appropriate, and 32 as Rarely Appropriate. (11/14)

CHILDREN'S SURGERY VERIFICATION

OPTIMAL RESOURCES FOR CHILDREN'S SURGICAL CARE

American College of Surgeons

EXECUTIVE SUMMARY. The Task Force for Children's Surgical Care, an ad hoc multidisciplinary group of invited leaders in relevant disciplines, assembled initially from April 30 to May 1, 2012, in Rosemont, IL, and subsequently in 2013, 2014, and 2015 to consider approaches to optimize the delivery of children's surgical care in today's competitive national health care environment. Specifically, a mismatch between individual patient needs and available clinical resources for some infants and children receiving surgical care is recognized as a problem in the United States and elsewhere. Although this phenomenon is apparent to most practitioners involved with children's surgical care, comprehensive data are not available, and relevant data are imperfect. The scope of this problem is unknown at present. However, the situation does periodically, and possibly systematically, result in suboptimal patient outcomes.

The composition of the task force is detailed in Appendix 4. The Children's Hospital Association and the American College of Surgeons (ACS) provided support. The group represented key disciplines and perspectives. Published literature and data were used when available, and expert opinion when not, as the basis for these recommendations. The objective was to develop consensus recommendations that would be of use to relevant policymakers and to providers.

Principles regarding resource standards, quality-improvement and safety processes, data collection, and a verification process were initially published in March 2014 [*J Am Coll Surg.* 2014;218(3):479–487]. This document details those principles in a specific manner designed to inform and direct a verification process to be conducted by the ACS and the ACS Children's Surgery Verification Committee.

Notably, there are a number of excellent children's specialty hospitals in the United States whose scope of service is more narrow than delineated in this document. A separate process will be used to develop relevant standards for those institutions to achieve the vision of prospectively matching institutional resources with individual patient needs. (12/15)

COLLABORATION IN PRACTICE: IMPLEMENTING TEAM-BASED CARE

American College of Obstetricians and Gynecologists Task Force on Collaborative Practice

INTRODUCTION. Quality, efficiency, and value are necessary characteristics of our evolving health care system. Team-based care will work toward the Triple Aim of 1) improving the experience of care of individuals and families; 2) improving the health of populations; and 3) lowering per capita costs. It also should respond to emerging demands and reduce undue burdens on health care providers. Team-based care has the ability to more effectively meet the core expectations of the health care system proposed by the Institute of Medicine. These expectations require that care be safe, effective, patient centered, timely, efficient, and equitable. This report outlines a mechanism that all specialties and practices can use to achieve these expectations.

The report was written by the interprofessional Task Force on Collaborative Practice and is intended to appeal to multiple specialties (eg, internal medicine, pediatrics, family medicine, and women's health) and professions (eg, nurse practitioners, certified nurse–midwives/certified midwives, physician assistants, physicians, clinical pharmacists, and advanced practice registered nurses). This document provides a framework for organizations or practices across all specialties to develop team-based care. In doing so, it offers a map to help practices navigate the increasingly complex and continuously evolving health care system. The guidance presented is a result of the task force's work and is based on current evidence and expert consensus. The task force challenges and welcomes all medical specialties to gather additional data on how and what types of team-based care best accomplish the Triple Aim and the Institute of Medicine's expectations of health care. (3/16)

CONFIDENTIALITY PROTECTIONS FOR ADOLESCENTS AND YOUNG ADULTS IN THE HEALTH CARE BILLING AND INSURANCE CLAIMS PROCESS

Society for Adolescent Health and Medicine

ABSTRACT. The importance of protecting confidential health care for adolescents and young adults is well documented. State and federal confidentiality protections exist for both minors and young adults, although the laws vary among states, particularly for minors. However, such confidentiality is potentially violated by billing practices and in the processing of health insurance claims. To address this problem, policies and procedures should be established so that health care billing and insurance claims processes do not impede the ability of providers to deliver essential health care services on a confidential basis to adolescents and young adults covered as dependents on a family's health insurance plan. (3/16)

CONSENSUS COMMUNICATION ON EARLY PEANUT INTRODUCTION AND THE PREVENTION OF PEANUT ALLERGY IN HIGH-RISK INFANTS

Primary contributors: David M. Fleischer, MD; Scott Sicherer, MD; Matthew Greenhawt, MD; Dianne Campbell, MB BS, FRACP, PhD; Edmond Chan, MD; Antonella Muraro, MD, PhD; Susanne Halken, MD; Yitzhak Katz, MD; Motohiro Ebisawa, MD, PhD; Lawrence Eichenfield, MD; Hugh Sampson, MD; Gideon Lack, MB, BCh; and George Du Toit, MB, BCh

INTRODUCTION AND RATIONALE. Peanut allergy is an increasingly troubling global health problem affecting between 1% and 3% of children in many westernized countries. Although multiple methods of measurement have been used and specific estimates differ, there appears to have been a sudden increase in the number of cases in the past 10- to 15-year period, suggesting that the prevalence might have tripled in some countries, such as the United States. Extrapolating the currently estimated prevalence, this translates to nearly 100 000 new cases annually (in the United States and United Kingdom), affecting some 1 in 50 primary school-aged children in the United States, Canada, the United Kingdom, and Australia. A similar increase in incidence is now being noted in developing countries, such as Ghana.

The purpose of this brief communication is to highlight emerging evidence for existing allergy prevention guidelines regarding potential benefits of supporting early rather than delayed peanut introduction during the period of complementary food introduction in infants. A recent study entitled ''Randomized trial of peanut consumption in infants at risk for peanut allergy'' demonstrated a successful 11% to 25% absolute

reduction in the risk of peanut allergy in high-risk infants (and a relative risk reduction of up to 80%) if peanut was introduced between 4 and 11 months of age. In light of the significance of these findings, this document serves to better inform the decision-making process for health care providers regarding such potential benefits of early peanut introduction. More formal guidelines regarding early-life, complementary feeding practices and the risk of allergy development will follow in the next year from the National Institute of Allergy and Infectious Diseases (NIAID)–sponsored Working Group and the European Academy of Allergy and Clinical Immunology (EAACI), and thus this document should be considered interim guidance. (8/15)

CONSENSUS STATEMENT: ABUSIVE HEAD TRAUMA IN INFANTS AND YOUNG CHILDREN

Arabinda Kumar Choudhary; Sabah Servaes; Thomas L. Slovis; Vincent J. Palusci; Gary L. Hedlund; Sandeep K. Narang; Joëlle Anne Moreno; Mark S. Dias; Cindy W. Christian; Marvin D. Nelson Jr; V. Michelle Silvera; Susan Palasis; Maria Raissaki; Andrea Rossi; and Amaka C. Offiah

ABSTRACT. Abusive head trauma (AHT) is the leading cause of fatal head injuries in children younger than 2 years. A multidisciplinary team bases this diagnosis on history, physical examination, imaging and laboratory findings. Because the etiology of the injury is multifactorial (shaking, shaking and impact, impact, etc.) the current best and inclusive term is AHT. There is no controversy concerning the medical validity of the existence of AHT, with multiple components including subdural hematoma, intracranial and spinal changes, complex retinal hemorrhages, and rib and other fractures that are inconsistent with the provided mechanism of trauma. The workup must exclude medical diseases that can mimic AHT. However, the courtroom has become a forum for speculative theories that cannot be reconciled with generally accepted medical literature. There is no reliable medical evidence that the following processes are causative in the constellation of injuries of AHT: cerebral sinovenous thrombosis, hypoxic-ischemic injury, lumbar puncture or dysphagic choking/vomiting. There is no substantiation, at a time remote from birth, that an asymptomatic birth-related subdural hemorrhage can result in rebleeding and sudden collapse. Further, a diagnosis of AHT is a medical conclusion, not a legal determination of the intent of the perpetrator or a diagnosis of murder. We hope that this consensus document reduces confusion by recommending to judges and jurors the tools necessary to distinguish genuine evidence-based opinions of the relevant medical community from legal arguments or etiological speculations that are unwarranted by the clinical findings, medical evidence and evidence-based literature. (5/18)

DEFINING PEDIATRIC MALNUTRITION: A PARADIGM SHIFT TOWARD ETIOLOGY-RELATED DEFINITIONS

American Society for Parenteral and Enteral Nutrition

ABSTRACT. Lack of a uniform definition is responsible for underrecognition of the prevalence of malnutrition and its impact on outcomes in children. A pediatric malnutrition definitions workgroup reviewed existing pediatric age group English-language literature from 1955 to 2011, for relevant references related to 5 domains of the definition of *malnutrition* that were *a priori* identified: anthropometric parameters, growth, chronicity of malnutrition, etiology and pathogenesis, and developmental/functional outcomes. Based on available evidence and an iterative process to arrive at multidisciplinary consensus in the group, these domains were included in the overall construct of a new definition. Pediatric malnutrition (undernutrition) is defined as an imbalance between nutrient requirements and intake that results in cumulative deficits of energy, protein, or micronutrients that may negatively affect growth, development, and other relevant outcomes. A summary of the literature is presented and a new classification scheme is proposed that incorporates chronicity, etiology, mechanisms of nutrient imbalance, severity of malnutrition, and its impact on outcomes. Based on its etiology, malnutrition is either *illness related* (secondary to 1 or more diseases/injury) or *non–illness related,* (caused by environmental/behavioral factors), or both. Future research must focus on the relationship between inflammation and illness-related malnutrition. We anticipate that the definition of malnutrition will continue to evolve with improved understanding of the processes that lead to and complicate the treatment of this condition. A uniform definition should permit future research to focus on the impact of pediatric malnutrition on functional outcomes and help solidify the scientific basis for evidence-based nutrition practices. (3/13)

DELAYED UMBILICAL CORD CLAMPING AFTER BIRTH

American College of Obstetricians and Gynecologists

ABSTRACT. Delayed umbilical cord clamping appears to be beneficial for term and preterm infants. In term infants, delayed umbilical cord clamping increases hemoglobin levels at birth and improves iron stores in the first several months of life, which may have a favorable effect on developmental outcomes. There is a small increase in jaundice that requires phototherapy in this group of infants. Consequently, health care providers adopting delayed umbilical cord clamping in term infants should ensure that mechanisms are in place to monitor for and treat neonatal jaundice. In preterm infants, delayed umbilical cord clamping is associated with significant neonatal benefits, including improved transitional circulation, better establishment of red blood cell volume, decreased need for blood transfusion, and lower incidence of necrotizing enterocolitis and intraventricular hemorrhage. Delayed umbilical cord clamping was not associated with an increased risk of postpartum hemorrhage or increased blood loss at delivery, nor was it associated with a difference in postpartum hemoglobin levels or the need for blood transfusion. Given the benefits to most newborns and concordant with other professional organizations, the American College of Obstetricians and Gynecologists now recommends a delay in umbilical cord clamping in vigorous term and preterm infants for at least 30–60 seconds after birth. The ability to provide delayed umbilical cord clamping may vary among institutions and settings; decisions in those circumstances are best made by the team caring for the mother–infant dyad. (1/17)

DIABETES CARE FOR EMERGING ADULTS: RECOMMENDATIONS FOR TRANSITION FROM PEDIATRIC TO ADULT DIABETES CARE SYSTEMS

American Diabetes Association (11/11)

DIETARY REFERENCE INTAKES FOR CALCIUM AND VITAMIN D

Institute of Medicine (2011)

EMERGENCY EQUIPMENT AND SUPPLIES IN THE SCHOOL SETTING

National Association of School Nurses (1/12)

ENHANCING THE WORK OF THE HHS NATIONAL VACCINE PROGRAM IN GLOBAL IMMUNIZATIONS

National Vaccine Advisory Committee (9/13)

EPIDEMIOLOGY IN FIREARM VIOLENCE PREVENTION

Amy B. Davis; James A. Gaudino; Colin L. Soskolne; Wael K. Al-Delaimy; and International Network for Epidemiology in Policy

INTRODUCTION. Firearm violence has reached pandemic levels, with some countries experiencing high injury and death rates

from privately owned guns and firearms (hereinafter collectively referred to as 'firearms'). Significant factors in the increase in deaths and injuries from privately held firearms include the ease of obtaining these arms and, most importantly, the growing lethality of these weapons.

Society cannot be satisfied with reactive responses only in treating victims' physical and psychological wounds after these occurrences; more must be done proactively to prevent firearm violence and address societal circumstances that either facilitate or impede it. Where they exist, well-intended policies fail to adequately protect people from firearm violence, often because they mainly focus on the purchase and illegal uses of guns while neglecting underlying social determinants of the violent uses of firearms.

Laws intended to curb firearm violence are often not enforced, are inadequate or do not address local societal factors of crime, mental well-being, poverty or low education in the relevant communities. These considerations point to the need for a multisectoral approach in which the public health sciences would play a pivotal role in preventing harms relating to firearm violence with a greater focus on its causes. Evidence-based multicomponent interventions, often shown by systematic reviews to be the most effective to address complex, community-level health issues, are needed but are not well-defined to address firearm violence. To both advance understanding of and to guide community-level public health services and actions needed to prevent firearm violence, decision-makers need to rely more on surveillance, research and programme evaluation by public health organizations, schools and universities.

Epidemiologists have unique interdisciplinary tools for addressing the contributors and barriers to preventing and mitigating injury, including firearm violence. These include quantitative, qualitative and social epidemiological methods. Interventions to prevent and mitigate the problem are currently under-developed, under-funded and under-utilized, particularly in the USA. The problem could be addressed by putting in place a robust evidence base to inform policy decisions. Additionally, public health can create, scale up and evaluate interventions designed to address social and behavioural factors associated with firearm violence. We call on governments, community leaders and community members to take meaningful action to support public health in addressing the problem of firearm violence. (4/18)

ETHICAL CONSIDERATION FOR INCLUDING WOMEN AS RESEARCH PARTICIPANTS

American College of Obstetricians and Gynecologists

ABSTRACT. Inclusion of women in research studies is necessary for valid inferences about health and disease in women. The generalization of results from trials conducted in men may yield erroneous conclusions that fail to account for the biologic differences between men and women. Although significant changes in research design and practice have led to an increase in the proportion of women included in research trials, knowledge gaps remain because of a continued lack of inclusion of women, especially those who are pregnant, in premarketing research trials. This document provides a historical overview of issues surrounding women as participants in research trials, followed by an ethical framework and discussion of the issues of informed consent, contraception requirements, intimate partner consent, and the appropriate inclusion of pregnant women in research studies. (11/15)

EVIDENCE-BASED MANAGEMENT OF SICKLE CELL DISEASE: EXPERT PANEL REPORT, 2014

National Heart, Lung, and Blood Institute (2014)

FACULTY COMPETENCIES FOR GLOBAL HEALTH

Academic Pediatric Association Global Health Task Force

International partnerships among medical professionals from different countries are an increasingly common form of clinical and academic collaboration. Global health partnerships can include a variety of activities and serve multiple purposes in the areas of research, medical education and training, health system improvement, and clinical care. Competency domains, introduced by the Accreditation Council for Graduate Medical Education and the American Board of Medical Specialties in 1999, are now widely accepted to provide an organized, structured set of interrelated competencies, mostly for medical trainees. Although there are now competency domains and specific competencies recommended for pediatric trainees pursuing further professional training in global child health, none of these addresses competencies for faculty in global health.

In 2010 the Academic Pediatric Association established a Global Health Task Force to provide a forum for communication and collaboration for diverse pediatric academic societies and groups to advance global child health. Given the burgeoning demand for global health training, and particularly in light of a new global perspective on health education, as outlined in a Lancet Commission Report: *Health Professionals for a New Century: Transforming Education to Strengthen Health Systems in an Interdependent World,* in 2012 the Global Health Task Force noted the lack of defined faculty competencies and decided to develop a set of global health competencies for pediatric faculty engaged in the teaching and practice of global health. Using some of the principles suggested by Milner, et al. to define a competency framework, four domains were chosen, adapted from existing collaborative practice competencies. A fifth domain was added to address some of the unique challenges of global health practice encountered when working outside of one's own culture and health system. The domains are described below and specific competencies are provided for faculty working in global health research, education, administration, and clinical practice. (6/14)

GUIDELINES FOR FIELD TRIAGE OF INJURED PATIENTS

Centers for Disease Control and Prevention (1/12)

IMPORTANCE AND IMPLEMENTATION OF TRAINING IN CARDIOPULMONARY RESUSCITATION AND AUTOMATED EXTERNAL DEFIBRILLATION IN SCHOOLS

American Heart Association Emergency Cardiovascular Care Committee; Council on Cardiopulmonary, Critical Care, Perioperative and Resuscitation; Council on Cardiovascular Diseases in the Young; Council on Cardiovascular Nursing; Council on Clinical Cardiology; and Advocacy Coordinating Committee

ABSTRACT. In 2003, the International Liaison Committee on Resuscitation published a consensus document on education in resuscitation that strongly recommended that "…instruction in CPR [cardiopulmonary resuscitation] be incorporated as a standard part of the school curriculum." The next year the American Heart Association (AHA) recommended that schools "…establish a goal to train every teacher in CPR and first aid and train all students in CPR" as part of their preparation for a response to medical emergencies on campus.

Since that time, there has been an increased interest in legislation that would mandate that school curricula include training in CPR or CPR and automated external defibrillation. Laws or curriculum content standards in 36 states (as of the 2009–2010 school year) now encourage the inclusion of CPR training programs in school curricula. The language in those laws and standards varies greatly, ranging from a suggestion that students "recognize" the steps of CPR to a requirement for certification in CPR. Not surprisingly, then, implementation is not uniform among states,

even those whose laws or standards encourage CPR training in schools in the strongest language. This statement recommends that training in CPR and familiarization with automated external defibrillators (AEDs) should be required elements of secondary school curricula and provides the rationale for implementation of CPR training, as well as guidance in overcoming barriers to implementation. (2/11)

INITIAL RESUSCITATION ALGORITHM FOR CHILDREN

Society of Critical Care Medicine (2020)

INTER-ASSOCIATION CONSENSUS STATEMENT ON BEST PRACTICES FOR SPORTS MEDICINE MANAGEMENT FOR SECONDARY SCHOOLS AND COLLEGES

National Athletic Trainers Association, National Interscholastic Athletic Administrators Association, College Athletic Trainers' Society, National Federation of State High School Associations, American College Health Association, American Orthopaedic Society for Sports Medicine, National Collegiate Athletic Association, American Medical Society for Sports Medicine, National Association of Collegiate Directors of Athletics, and National Association of Intercollegiate Athletics (7/13)

LONG-TERM CARDIOVASCULAR TOXICITY IN CHILDREN, ADOLESCENTS, AND YOUNG ADULTS WHO RECEIVE CANCER THERAPY: PATHOPHYSIOLOGY, COURSE, MONITORING, MANAGEMENT, PREVENTION, AND RESEARCH DIRECTIONS; A SCIENTIFIC STATEMENT FROM THE AMERICAN HEART ASSOCIATION

American Heart Association (5/13)

MEETING OF THE STRATEGIC ADVISORY GROUP OF EXPERTS ON IMMUNIZATION, APRIL 2012–CONCLUSIONS AND RECOMMENDATIONS

World Health Organization (5/12) (The AAP endorses the recommendation pertaining to the use of thimerosal in vaccines.)

MENSTRUATION IN GIRLS AND ADOLESCENTS: USING THE MENSTRUAL CYCLE AS A VITAL SIGN

American College of Obstetricians and Gynecologists Committee on Adolescent Health Care

ABSTRACT. Despite variations worldwide and within the U.S. population, median age at menarche has remained relatively stable—between 12 years and 13 years—across well-nourished populations in developed countries. Environmental factors, including socioeconomic conditions, nutrition, and access to preventive health care, may influence the timing and progression of puberty. A number of medical conditions can cause abnormal uterine bleeding, characterized by unpredictable timing and variable amount of flow. Clinicians should educate girls and their caretakers (eg, parents or guardians) about what to expect of a first menstrual period and the range for normal cycle length of subsequent menses. Identification of abnormal menstrual patterns in adolescence may improve early identification of potential health concerns for adulthood. It is important for clinicians to have an understanding of the menstrual patterns of adolescent girls, the ability to differentiate between normal and abnormal menstruation, and the skill to know how to evaluate the adolescent girl patient. By including an evaluation of the menstrual cycle as an additional vital sign, clinicians reinforce its importance in assessing overall health status for patients and caretakers. (12/15)

MULTILINGUAL CHILDREN: BEYOND MYTHS AND TOWARD BEST PRACTICES

Society for Research in Child Development

ABSTRACT. Multilingualism is an international fact of life and increasing in the United States. Multilingual families are exceedingly diverse, and policies relevant to them should take this into account. The quantity and quality of a child's exposure to responsive conversation spoken by fluent adults predicts both monolingual and multilingual language and literacy achievement. Contexts supporting optimal multilingualism involve early exposure to high quality conversation in each language, along with continued support for speaking both languages. Parents who are not fluent in English should not be told to speak English instead of their native language to their children; children require fluent input, and fluent input in another language will transfer to learning a second or third language. Messages regarding optimal multilingual practices should be made available to families using any and all available methods for delivering such information, including home visitation programs, healthcare settings, center-based early childhood programs, and mass media. (2013)

NATIONAL ADOPTION CENTER: OPEN RECORDS

National Adoption Center

The National Adoption Center believes that it is an inalienable right of all citizens, including adopted adults, to have unencumbered access to their original birth certificates. In keeping with this position, we believe that copies of both the original and the amended birth certificate should be given to the adoptive family at the time of finalization unless specifically denied by the birthparents. In any case, the National Adoption Center advocates that the adoptee, at age 18, be granted access to his/her original birth certificate. (6/00)

NEONATAL ENCEPHALOPATHY AND NEUROLOGIC OUTCOME, SECOND EDITION

American College of Obstetricians and Gynecologists Task Force on Neonatal Encephalopathy

In the first edition of this report, the Task Force on Neonatal Encephalopathy and Cerebral Palsy outlined criteria deemed essential to establish a causal link between intrapartum hypoxic events and cerebral palsy. It is now known that there are multiple potential causal pathways that lead to cerebral palsy in term infants, and the signs and symptoms of neonatal encephalopathy may range from mild to severe, depending on the nature and timing of the brain injury. Thus, for the current edition, the Task Force on Neonatal Encephalopathy determined that a broader perspective may be more fruitful. This conclusion reflects the sober recognition that knowledge gaps still preclude a definitive test or set of markers that accurately identifies, with high sensitivity and specificity, an infant in whom neonatal encephalopathy is attributable to an acute intrapartum event. The information necessary for assessment of likelihood can be derived from a comprehensive evaluation of all potential contributing factors in cases of neonatal encephalopathy. This is the broader perspective championed in the current report. If a comprehensive etiologic evaluation is not possible, the term hypoxic–ischemic encephalopathy should best be replaced by neonatal encephalopathy because neither hypoxia nor ischemia can be assumed to have been the unique initiating causal mechanism. The title of this report has been changed from *Neonatal Encephalopathy and Cerebral Palsy: Defining the Pathogenesis and Pathophysiology* to *Neonatal Encephalopathy and Neurologic Outcome* to indicate that an array of developmental outcomes may arise after neonatal encephalopathy in addition to cerebral palsy. (4/14)

NEURODEVELOPMENTAL OUTCOMES IN CHILDREN WITH CONGENITAL HEART DISEASE: EVALUATION AND MANAGEMENT; A SCIENTIFIC STATEMENT FROM THE AMERICAN HEART ASSOCIATION

American Heart Association (7/12)

THE NEUROLOGIST'S ROLE IN SUPPORTING TRANSITION TO ADULT HEALTH CARE

Lawrence W. Brown, MD; Peter Camfield, MD, FRCPC; Melissa Capers, MA; Greg Cascino, MD; Mary Ciccarelli, MD; Claudio M. de Gusmao, MD; Stephen M. Downs, MD; Annette Majnemer, PhD, FCAHS; Amy Brin Miller, MSN; Christina SanInocencio, MS; Rebecca Schultz, PhD; Anne Tilton, MD; Annick Winokur, BS; and Mary Zupanc, MD

ABSTRACT. The child neurologist has a critical role in planning and coordinating the successful transition from the pediatric to adult health care system for youth with neurologic conditions. Leadership in appropriately planning a youth's transition and in care coordination among health care, educational, vocational, and community services providers may assist in preventing gaps in care, delayed entry into the adult care system, and/or health crises for their adolescent patients. Youth whose neurologic conditions result in cognitive or physical disability and their families may need additional support during this transition, given the legal and financial considerations that may be required. Eight common principles that define the child neurologist's role in a successful transition process have been outlined by a multidisciplinary panel convened by the Child Neurology Foundation are introduced and described. The authors of this consensus statement recognize the current paucity of evidence for successful transition models and outline areas for future consideration. *Neurology.* 2016;87:1–6. (7/16)

NONINHERITED RISK FACTORS AND CONGENITAL CARDIOVASCULAR DEFECTS: CURRENT KNOWLEDGE

American Heart Association

ABSTRACT. Prevention of congenital cardiovascular defects has been hampered by a lack of information about modifiable risk factors for abnormalities in cardiac development. Over the past decade, there have been major breakthroughs in the understanding of inherited causes of congenital heart disease, including the identification of specific genetic abnormalities for some types of malformations. Although relatively less information has been available on noninherited modifiable factors that may have an adverse effect on the fetal heart, there is a growing body of epidemiological literature on this topic. This statement summarizes the currently available literature on potential fetal exposures that might alter risk for cardiovascular defects. Information is summarized for periconceptional multivitamin or folic acid intake, which may reduce the risk of cardiac disease in the fetus, and for additional types of potential exposures that may increase the risk, including maternal illnesses, maternal therapeutic and nontherapeutic drug exposures, environmental exposures, and paternal exposures. Information is highlighted regarding definitive risk factors such as maternal rubella; phenylketonuria; pregestational diabetes; exposure to thalidomide, vitamin A cogeners, or retinoids; and indomethacin tocolysis. Caveats regarding interpretation of possible exposure-outcome relationships from case-control studies are given because this type of study has provided most of the available information. Guidelines for prospective parents that could reduce the likelihood that their child will have a major cardiac malformation are given. Issues related to pregnancy monitoring are discussed. Knowledge gaps and future sources of new information on risk factors are described. (*Circulation.* 2007;115:2995–3014.) (6/07)

NUSINERSEN USE IN SPINAL MUSCULAR ATROPHY

David Michelson, MD; Emma Ciafaloni, MD; Stephen Ashwal, MD; Elliot Lewis, Pushpa Narayanaswami, MBBS; Maryam Oskoui, MD, MSc; Melissa J. Armstrong, MD, MSc; and American Academy of Neurology

ABSTRACT. *Objective.* To identify the level of evidence for use of nusinersen to treat spinal muscular atrophy (SMA) and review clinical considerations regarding use.

Methods. The author panel systematically reviewed nusinersen clinical trials for patients with SMA and assigned level of evidence statements based on the American Academy of Neurology's 2017 therapeutic classification of evidence scheme. Safety information, regulatory decisions, and clinical context were also reviewed.

Results. Four published clinical trials were identified, 3 of which were rated above Class IV. There is Class III evidence that in infants with homozygous deletions or mutations of *SMN1,* nusinersen improves the probability of permanent ventilation-free survival at 24 months vs a well-defined historical cohort. There is Class I evidence that in term infants with SMA and 2 copies of *SMN2,* treatment with nusinersen started in individuals younger than 7 months results in a better motor milestone response and higher rates of event-free survival than sham control. There is Class I evidence that in children aged 2–12 years with SMA symptom onset after 6 months of age, nusinersen results in greater improvement in motor function at 15 months than sham control. Nusinersen was safe and well-tolerated.

Clinical context. Evidence of efficacy is currently highest for treatment of infantile- and childhood-onset SMA in the early and middle symptomatic phases. While approved indications for nusinersen use in North America and Europe are broad, payer coverage for populations outside those in clinical trials remain variable. Evidence, availability, cost, and patient preferences all influence decision-making regarding nusinersen use. (10/18)

ORTHOPTISTS AS PHYSICIAN EXTENDERS

American Association for Pediatric Ophthalmology and Strabismus (5/15)

PERINATAL PALLIATIVE CARE

American College of Obstetricians and Gynecologists

ABSTRACT. Perinatal palliative care refers to a coordinated care strategy that comprises options for obstetric and newborn care that include a focus on maximizing quality of life and comfort for newborns with a variety of conditions considered to be life-limiting in early infancy. With a dual focus on ameliorating suffering and honoring patient values, perinatal palliative care can be provided concurrently with life-prolonging treatment. The focus of this document, however, involves the provision of exclusively palliative care without intent to prolong life in the context of a life-limiting condition, otherwise known as perinatal palliative comfort care. Once a life-limiting diagnosis is suspected antenatally, the tenets of informed consent require that the pregnant patient be given information of sufficient depth and breadth to make an informed, voluntary choice for her care. Health care providers are encouraged to model effective, compassionate communication that respects patient cultural beliefs and values and to promote shared decision making with patients. Perinatal palliative comfort care is one of several options along a spectrum of care, which includes pregnancy termination (abortion) and full neonatal resuscitation and treatment, that should be presented to pregnant patients faced with pregnancies complicated by life-limiting fetal conditions. If a patient opts to pursue perinatal palliative comfort care, a multidisciplinary team should be identified with the infrastructure and support to administer this care. The perinatal palliative care team should prepare families for the possibility that there may be differences of opinion between family members before and after the delivery of the infant, and that there may be differences between parents and the neonatal care providers about appropriate postnatal therapies, especially if the postnatal diagnosis and prognosis differ substantially from antenatal predictions. Procedures for resolving such differences should be discussed with families ahead of time. (8/19)

A PRACTICAL GUIDE FOR PRIMARY CARE PHYSICIANS: INSTRUMENT-BASED VISION SCREENING IN CHILDREN

Children's Eye Foundation

SUMMARY. In January 2016 a new joint policy statement from the American Academy of Pediatrics (AAP), American Academy of Ophthalmology (AAO), American Association for Pediatric Ophthalmology and Strabismus (AAPOS) and American Association of Certified Orthoptists (AACO) regarding the pediatric eye examination was published. The updated policy statement, published in the journal *Pediatrics,* incorporates earlier and routine visual assessments using instrument-based screening to help identify children who may benefit from early intervention to improve vision (or correct vision problems). Instrument-based screening technology is revolutionizing early detection and prevention of amblyopia by allowing screening of more children and at a younger age.

This guide for primary care physicians is produced by the Children's Eye Foundation of AAPOS to provide information regarding instrument-based screening. Early detection and treatment of amblyopia is key to preventing unnecessary blindness, and primary care physicians play a critical role in its detection through vision screening in the preschool and school age groups. (2016)

PREVENTION AND CONTROL OF MENINGOCOCCAL DISEASE: RECOMMENDATIONS OF THE ADVISORY COMMITTEE ON IMMUNIZATION PRACTICES (ACIP)

Centers for Disease Control and Prevention

SUMMARY. Meningococcal disease describes the spectrum of infections caused by *Neisseria meningitidis,* including meningitidis, bacteremia, and bacteremic pneumonia. Two quadrivalent meningococcal polysaccharide-protein conjugate vaccines that provide protection against meningococcal serogroups A, C, W, and Y (MenACWY-D [Menactra, manufactured by Sanofi Pasteur, Inc., Swiftwater, Pennsylvania] and MenACWY-CRM [Menveo, manufactured by Novartis Vaccines, Cambridge, Massachusetts]) are licensed in the United States for use among persons aged 2 through 55 years. MenACWY-D also is licensed for use among infants and toddlers aged 9 through 23 months. Quadrivalent meningococcal polysaccharide vaccine (MPSV4 [Menommune, manufactured by Sanofi Pasteur, Inc., Swiftwater, Pennsylvania]) is the only vaccine licensed for use among persons aged ≥56 years. A bivalent meningococcal polysaccharide protein conjugate vaccine that provides protection against meningococcal serogroups C and Y along with *Haemophilus influenzae* type b (Hib) (Hib-MenCY-TT [MenHibrix, manufactured by GlaxoSmithKline Biologicals, Rixensart, Belgium]) is licensed for use in children aged 6 weeks through 18 months.

This report compiles and summarizes all recommendations from CDC's Advisory Committee on Immunization Practices (ACIP) regarding prevention and control of meningococcal disease in the United States, specifically the changes in the recommendations published since 2005 (CDC. Prevention and control of meningococcal disease: recommendations of the Advisory Committee on Immunization Practices [ACIP]. *MMWR* 2005;54 Adobe PDF file [No. RR-7]). As a comprehensive summary of previously published recommendations, this report does not contain any new recommendations; it is intended for use by clinicians as a resource. ACIP recommends routine vaccination with a quadrivalent meningococcal conjugate vaccine (MenACWY) for adolescents aged 11 or 12 years, with a booster dose at age 16 years. ACIP also recommends routine vaccination for persons at increased risk for meningococcal disease (i.e., persons who have persistent complement component deficiencies, persons who have anatomic or functional asplenia, microbiologists who routinely are exposed to isolates of *N. meningitidis,* military recruits, and persons who travel to or reside in areas in which meningococcal disease is hyperendemic or epidemic). Guidelines for antimicrobial chemoprophylaxis and for evaluation and management of suspected outbreaks of meningococcal disease also are provided. (3/13)

PREVENTION OF GROUP B STREPTOCOCCAL EARLY-ONSET DISEASE IN NEWBORNS

American College of Obstetricians and Gynecologists Committee on Obstetric Practice

ABSTRACT. Group B streptococcus (GBS) is the leading cause of newborn infection (1). The primary risk factor for neonatal GBS early-onset disease (EOD) is maternal colonization of the genitourinary and gastrointestinal tracts. Approximately 50% of women who are colonized with GBS will transmit the bacteria to their newborns. Vertical transmission usually occurs during labor or after rupture of membranes. In the absence of intrapartum antibiotic prophylaxis, 1–2% of those newborns will develop GBS EOD. Other risk factors include gestational age of less than 37 weeks, very low birth weight, prolonged rupture of membranes, intraamniotic infection, young maternal age, and maternal black race. The key obstetric measures necessary for effective prevention of GBS EOD continue to include universal prenatal screening by vaginal–rectal culture, correct specimen collection and processing, appropriate implementation of intrapartum antibiotic prophylaxis, and coordination with pediatric care providers. The American College of Obstetricians and Gynecologists now recommends performing universal GBS screening between 36 0/7 and 37 6/7 weeks of gestation. All women whose vaginal–rectal cultures at 36 0/7 and 37 6/7 weeks of gestation are positive for GBS should receive appropriate intrapartum antibiotic prophylaxis unless a prelabor cesarean birth is performed in the setting of intact membranes. Although a shorter duration of recommended intrapartum antibiotics is less effective than 4 or more hours of prophylaxis, 2 hours of antibiotic exposure has been shown to reduce GBS vaginal colony counts and decrease the frequency of a clinical neonatal sepsis diagnosis. Obstetric interventions, when necessary, should not be delayed solely to provide 4 hours of antibiotic administration before birth. This Committee Opinion, including Table 1, Box 2, and Figures 1–3, updates and replaces the obstetric components of the CDC 2010 guidelines, "Prevention of Perinatal Group B Streptococcal Disease: Revised Guidelines From CDC, 2010." (6/19)

RECOMMENDED AMOUNT OF SLEEP FOR PEDIATRIC POPULATIONS: A CONSENSUS STATEMENT OF THE AMERICAN ACADEMY OF SLEEP MEDICINE

Shalini Paruthi, MD; Lee J. Brooks, MD; Carolyn D'Ambrosio, MD; Wendy A. Hall, PhD, RN; Suresh Kotagal, MD; Robin M. Lloyd, MD; Beth A. Malow, MD, MS; Kiran Maski, MD; Cynthia Nichols, PhD; Stuart F. Quan, MD; Carol L. Rosen, MD; Matthew M. Troester, DO; and Merrill S. Wise, MD

Background and Methodology. Healthy sleep requires adequate duration, appropriate timing, good quality, regularity, and the absence of sleep disturbances or disorders. Sleep duration is a frequently investigated sleep measure in relation to health. A panel of 13 experts in sleep medicine and research used a modified RAND Appropriateness Method to develop recommendations regarding the sleep duration range that promotes optimal health in children aged 0–18 years. The expert panel reviewed published scientific evidence addressing the relationship between sleep duration and health using a broad set of National Library of Medicine Medical Subject Headings (MeSH) terms and no date restrictions, which resulted in a total of 864 scientific articles. The process was further guided by the Oxford grading system. The panel focused on seven health categories with the best available evidence in relation to sleep duration: general health, cardiovascular health, metabolic health, mental health,

immunologic function, developmental health, and human performance. Consistent with the RAND Appropriateness Method, multiple rounds of evidence review, discussion, and voting were conducted to arrive at the final recommendations. The process to develop these recommendations was conducted over a 10-month period and concluded with a meeting held February 19–21, 2016, in Chicago, Illinois. (6/16)

RESTRICTIVE HOUSING IN JUVENILE CORRECTIONAL SETTINGS

National Commission on Correctional Health Care

INTRODUCTION. NCCHC asserts that "juveniles, mentally ill individuals, and pregnant women should be excluded from solitary confinement of any duration" (NCCHC, 2016). However, the practice of juvenile solitary confinement and broader forms of restrictive housing still occurs today. A 2015 survey of solitary confinement rules in juvenile justice systems revealed that 47% of juvenile detention centers reported locking youth in some type of isolation for more than 4 hours at a time (Lowenstein Center, 2016). Given the widespread use of restrictive housing and the well-understood negative health impacts of these practices, it is imperative that juvenile correctional facilities work to reduce or eliminate the use of restrictive housing and establish clear protocols for the rare instances when isolation is deemed essential (e.g., medical necessity) to ensure safety for youth. (2/21)

SCREENING CHILDREN AT RISK FOR RETINOBLASTOMA: CONSENSUS REPORT FROM THE AMERICAN ASSOCIATION OF OPHTHALMIC ONCOLOGISTS AND PATHOLOGISTS

Alison H. Skalet, MD, PhD; Dan S. Gombos, MD; Brenda L. Gallie, MD; Jonathan W. Kim, MD; Carol L. Shields, MD; Brian P. Marr, MD; Sharon E. Plon, MD, PhD; and Patricia Chévez-Barrios, MD

Purpose: To provide a set of surveillance guidelines for children at risk for development of retinoblastoma.

Design: Consensus panel.

Participants: Expert panel of ophthalmic oncologists, pathologists, and geneticists.

Methods: A group of members of the American Association of Ophthalmic Oncologists and Pathologists (AAOOP) with support of the American Association for Pediatric Ophthalmology and Strabismus and the American Academy of Pediatrics (AAP) was convened. The panel included representative ophthalmic oncologists, pathologists, and geneticists from retinoblastoma referral centers located in various geographic regions who met and discussed screening approaches for retinoblastoma. A patient "at risk" was defined as a person with a family history of retinoblastoma in a parent, sibling, or first- or second-degree relative.

Main Outcome Measures: Screening recommendations for children at risk for retinoblastoma.

Results: Consensus statement from the panel: (1) Dedicated ophthalmic screening is recommended for all children at risk for retinoblastoma above the population risk. (2) Frequency of examinations is adjusted on the basis of expected risk for *RB1* mutation. (3) Genetic counseling and testing clarify the risk for retinoblastoma in children with a family history of the disease. (4) Examination schedules are stratified on the basis of high-, intermediate-, and low-risk children. (5) Children at high risk for retinoblastoma require more frequent screening, which may preferentially be examinations under anesthesia.

Conclusions: Risk stratification including genetic testing and counseling serves as the basis for screening of children at elevated risk for development of retinoblastoma. (10/17)

SCREENING FOR IDIOPATHIC SCOLIOSIS IN ADOLESCENTS—POSITION STATEMENT

American Academy of Orthopedic Surgeons, Scoliosis Research Society, and Pediatric Orthopedic Society of North America

ABSTRACT. The Scoliosis Research Society (SRS), American Academy of Orthopedic Surgeons (AAOS), Pediatric Orthopedic Society of North America (POSNA), and American Academy of Pediatrics (AAP) believe that there has been additional useful research in the early detection and management of adolescent idiopathic scoliosis (AIS) since the review performed by the United States Preventive Services Task Force (USPSTF) in 2004. This information should be available for use by patients, treating health care providers, and policy makers in assessing the relative risks and benefits of the early identification and management of AIS.

The AAOS, SRS, POSNA, and AAP believe that there are documented benefits of earlier detection and non-surgical management of AIS, earlier identification of severe deformities that are surgically treated, and of incorporating screening of children for AIS by knowledgeable health care providers as a part of their care. (9/15)

SKIING AND SNOWBOARDING INJURY PREVENTION

Canadian Paediatric Society

ABSTRACT. Skiing and snowboarding are popular recreational and competitive sport activities for children and youth. Injuries associated with both activities are frequent and can be serious. There is new evidence documenting the benefit of wearing helmets while skiing and snowboarding, as well as data refuting suggestions that helmet use may increase the risk of neck injury. There is also evidence to support using wrist guards while snowboarding. There is poor uptake of effective preventive measures such as protective equipment use and related policy. Physicians should have the information required to counsel children, youth and families regarding safer snow sport participation, including helmet use, wearing wrist guards for snowboarding, training and supervision, the importance of proper equipment fitting and binding adjustment, sun safety and avoiding substance use while on the slopes. (1/12, reaffirmed 1/20)

SPINAL MOTION RESTRICTION IN THE TRAUMA PATIENT—A JOINT POSITION STATEMENT

Peter E. Fischer, MD, MS; Debra G. Perina, MD; Theodore R. Delbridge, MD, MPH; Mary E. Fallat, MD; Jeffrey P. Salomone, MD; Jimm Dodd, MS, MA; Eileen M. Bulger, MD; and Mark L. Gestring, MD

ABSTRACT. The American College of Surgeons Committee on Trauma (ACS-COT), American College of Emergency Physicians (ACEP), and the National Association of EMS Physicians (NAEMSP) have previously offered varied guidance on the role of backboards and spinal immobilization in out-of-hospital situations. This updated consensus statement on spinal motion restriction in the trauma patient represents the collective positions of the ACS-COT, ACEP and NAEMSP. It has further been formally endorsed by a number of national stakeholder organizations. This updated uniform guidance is intended for use by emergency medical services (EMS) personnel, EMS medical directors, emergency physicians, trauma surgeons, and nurses as they strive to improve the care of trauma victims within their respective domains. (8/18)

SUPPLEMENT TO THE JCIH 2007 POSITION STATEMENT: PRINCIPLES AND GUIDELINES FOR EARLY INTERVENTION AFTER CONFIRMATION THAT A CHILD IS DEAF OR HARD OF HEARING

Joint Committee on Infant Hearing

PREFACE. This document is a supplement to the recommendations in the year 2007 position statement of the Joint Committee

on Infant Hearing (JCIH) and provides comprehensive guidelines for early hearing detection and intervention (EHDI) programs on establishing strong early intervention (EI) systems with appropriate expertise to meet the needs of children who are deaf or hard of hearing (D/HH).

EI services represent the purpose and goal of the entire EHDI process. Screening and confirmation that a child is D/HH are largely meaningless without appropriate, individualized, targeted and high-quality intervention. For the infant or young child who is D/HH to reach his or her full potential, carefully designed individualized intervention must be implemented promptly, utilizing service providers with optimal knowledge and skill levels and providing services on the basis of research, best practices, and proven models.

The delivery of EI services is complex and requires individualization to meet the identified needs of the child and family. Because of the diverse needs of the population of children who are D/HH and their families, well-controlled intervention studies are challenging. At this time, few comparative effectiveness studies have been conducted. Randomized controlled trials are particularly difficult for ethical reasons, making it challenging to establish causal links between interventions and outcomes. EI systems must partner with colleagues in research to document what works for children and families and to strengthen the evidence base supporting practices.

Despite limitations and gaps in the evidence, the literature does contain research studies in which all children who were D/HH had access to the same well-defined EI service. These studies indicate that positive outcomes are possible, and they provide guidance about key program components that appear to promote these outcomes. This EI services document, drafted by teams of professionals with extensive expertise in EI programs for children who are D/HH and their families, relied on literature searches, existing systematic reviews, and recent professional consensus statements in developing this set of guidelines.

Terminology presented a challenge throughout document development. The committee noted that many of the frequently occurring terms necessary within the supplement may not reflect the most contemporary understanding and/or could convey inaccurate meaning. Rather than add to the lack of clarity or consensus and to avoid introducing new terminology to stakeholders, the committee opted to use currently recognized terms consistently herein and will monitor the emergence and/or development of new descriptors before the next JCIH consensus statement.

For purposes of this supplement:

- *Language* refers to all spoken and signed languages.
- *Early intervention* (EI), according to part C of the Individuals with Disabilities Education Improvement Act (IDEA) of 2004, is the process of providing services, education, and support to young children who are deemed to have an established condition, those who are evaluated and deemed to have a diagnosed physical or mental condition (with a high probability of resulting in a developmental delay), those who have an existing delay, or those who are at risk of developing a delay or special need that may affect their development or impede their education.
- *Communication* is used in lieu of terms such as communication options, methods, opportunities, approaches, etc.
- *Deaf or hard of hearing* (D/HH) is intended to be inclusive of all children with congenital and acquired hearing loss, unilateral and bilateral hearing loss, all degrees of hearing loss from minimal to profound, and all types of hearing loss (sensorineural, auditory neuropathy spectrum disorder, permanent conductive, and mixed).
- *Core knowledge and skills* is used to describe the expertise needed to provide appropriate EI that will optimize the development and well-being of infants/children and their families. Core knowledge and skills will differ according to the roles of individuals within the EI system (eg, service coordinator or EI provider).

This supplement to JCIH 2007 focuses on the practices of EI providers outside of the primary medical care and specialty medical care realms, rather than including the full spectrum of necessary medical, audiologic, and educational interventions. For more information about the recommendations for medical follow-up, primary care surveillance for related medical conditions, and specialty medical care and monitoring, the reader is encouraged to reference the year 2007 position statement of the JCIH as well as any subsequent revision. When an infant is confirmed to be D/HH, the importance of ongoing medical and audiologic management and surveillance both in the medical home and with the hearing health professionals, the otolaryngologist and the audiologist, cannot be overstated. A comprehensive discussion of those services is beyond the scope of this document. (3/13)

TIMING OF UMBILICAL CORD CLAMPING AFTER BIRTH

American College of Obstetricians and Gynecologists Committee on Obstetric Practice (12/12)

WEIGHING ALL PATIENTS IN KILOGRAMS

Emergency Nurses Association (2021)

YEAR 2007 POSITION STATEMENT: PRINCIPLES AND GUIDELINES FOR EARLY HEARING DETECTION AND INTERVENTION PROGRAMS

Joint Committee on Infant Hearing

ABSTRACT. The Joint Committee on Infant Hearing (JCIH) endorses early detection of and intervention for infants with hearing loss. The goal of early hearing detection and intervention (EHDI) is to maximize linguistic competence and literacy development for children who are deaf or hard of hearing. Without appropriate opportunities to learn language, these children will fall behind their hearing peers in communication, cognition, reading, and social-emotional development. Such delays may result in lower educational and employment levels in adulthood. To maximize the outcome for infants who are deaf or hard of hearing, the hearing of all infants should be screened at no later than 1 month of age. Those who do not pass screening should have a comprehensive audiological evaluation at no later than 3 months of age. Infants with confirmed hearing loss should receive appropriate intervention at no later than 6 months of age from health care and education professionals with expertise in hearing loss and deafness in infants and young children. Regardless of previous hearing-screening outcomes, all infants with or without risk factors should receive ongoing surveillance of communicative development beginning at 2 months of age during well-child visits in the medical home. EHDI systems should guarantee seamless transitions for infants and their families through this process. (10/07)

APPENDIX 1

PPI: AAP Partnership for Policy Implementation

BACKGROUND

The American Academy of Pediatrics (AAP) develops policies that promote optimal physical, mental, and social health and well-being for all infants, children, adolescents, and young adults. These documents are valued highly not only by clinicians who provide direct health care to children but by members of other organizations who share similar goals and by parents, payers, and legislators. To increase clarity and action of AAP clinical guidance and recommendations for physicians at the point of care, the AAP formed the Partnership for Policy Implementation (PPI). The PPI is a group of medical informaticians who partner with authors of AAP clinical practice guidelines and clinical reports to assure that clinical recommendations are stated with the precision needed to implement them in an electronic health record (EHR) system. This also makes recommendations easier for humans to follow. Partnership for Policy Implementation volunteers focus on helping content experts develop clinical guidance that specifies exactly who is to do what, for whom, and under what circumstances.

VISION

The vision of the PPI is that all AAP clinical recommendations include clear guidance on how pediatricians can implement those recommendations into their patient care and that AAP clinical guidance can be easily incorporated within EHR decision-support systems.

MISSION

The mission of the PPI is to facilitate implementation of AAP recommendations at the point of care by ensuring that AAP documents are written in a practical, action-oriented fashion with unambiguous recommendations.

WHAT THE PPI IS

The PPI is a network of pediatric informaticians who work with AAP authors and clinical practice guideline subcommittees throughout the writing process.

Contributions of the PPI to the AAP writing process include disambiguation and specification; development of clear definitions; clearly defined logic; implementation techniques; action-oriented recommendations, including clinical algorithms; transparency of the evidence base for recommendations; and use of health information technology (HIT) standards.

WHAT THE PPI HAS ACCOMPLISHED

Since inception of the PPI, more than 30 statements have been published using the PPI process, covering a wide variety of child health topics, including well-appearing febrile infants (*Pediatrics.* 2021;148[2]:e2021052228), influenza prevention and control (*Pediatrics.* 2021;148[4]:e2021053744), attention-deficit/hyperactivity disorder in children and adolescents (*Pediatrics.* 2019;144[4]:e20192528), infantile hemangiomas (*Pediatrics.* 2019;143[1]:e20183475), maintenance intravenous fluids (*Pediatrics.* 2018;142[6]:e20183083), child passenger safety (*Pediatrics.* 2018;142[5]:e20182460), and high blood pressure in children and adolescents (*Pediatrics.* 2018;142[3]:e20182096).

One example of how a statement developed using the PPI process has gained broader acceptance is the AAP annual influenza statement. Since 2007, the Centers for Disease Control and Prevention has adopted components of the PPI statement (specifically, the clinical algorithm) within its own statement on the same topic.

WHAT THE PPI IS DOING NOW

In addition to creating practical, action-oriented guidance that pediatricians can use at the point of care, the PPI works to make it easier for these recommendations to be incorporated into electronic systems. To date, the PPI has focused its involvement on the statement development process. Involvement of the PPI during the writing process helps produce a clear, more concise document. As these standards of care become well documented, the PPI can begin to focus on building or mapping pediatric vocabulary; once solidified, this vocabulary can be built into EHR systems. The standards of care can also be matched to various logical and functional HIT standards that already exist today. Through this work, the PPI improves AAP policy documents by providing specific guidance to pediatricians at the point of care, helping ensure that EHRs are designed to assist pediatricians in providing optimal care for children. The PPI developed a short video that provides an overview of its mission and process. This video is available on the AAP YouTube channel at www.youtube.com/watch?v=woTfeoNcxn4.

The PPI continues to expand and mentor new members. For more information on the application process and about the PPI, please contact Kymika Okechukwu (kokechukwu@aap.org or 630/626-6317).

APPENDIX 2

American Academy of Pediatrics Acronyms

AACAP	American Academy of Child and Adolescent Psychiatry
AAFP	American Academy of Family Physicians
AAMC	Association of American Medical Colleges
AAOS	American Academy of Orthopaedic Surgeons
AAP	American Academy of Pediatrics
AAPD	American Academy of Pediatric Dentistry
ABM	Academy of Breastfeeding Medicine
ABMS	American Board of Medical Specialties
ABP	American Board of Pediatrics
ACCME	Accreditation Council for Continuing Medical Education
ACEP	American College of Emergency Physicians
ACGME	Accreditation Council for Graduate Medical Education
ACIP	Advisory Committee on Immunization Practices
ACMG	American College of Medical Genetics
ACO	Accountable Care Organization
ACOG	American College of Obstetricians and Gynecologists
ACOP	American College of Osteopathic Pediatricians
ACP	American College of Physicians
ADAMHA	Alcohol, Drug Abuse, and Mental Health Administration
AG-M	Action Group—Multidisciplinary (Section Forum)
AG-M1	Action Group—Medical 1 (Section Forum)
AG-M2	Action Group—Medical 2 (Section Forum)
AG-S	Action Group—Surgical (Section Forum)
AHA	American Heart Association
AHA	American Hospital Association
AHRQ	Agency for Healthcare Research and Quality
ALF	Annual Leadership Forum
AMA	American Medical Association
AMCHP	Association of Maternal and Child Health Programs
AMSA	American Medical Student Association
AMSPDC	Association of Medical School Pediatric Department Chairs
AMWA	American Medical Women's Association
APA	Academic Pediatric Association
APHA	American Public Health Association
APLS	Advanced Pediatric Life Support
APPD	Association of Pediatric Program Directors
APQ	Alliance for Pediatric Quality
APS	American Pediatric Society
AQA	Ambulatory Care Quality Alliance
ASHG	American Society of Human Genetics
ASPHO	American Society of Pediatric Hematology/Oncology
ASPN	American Society of Pediatric Nephrology
ASTM	American Society of Testing and Materials
BHP	Bureau of Health Professions
BIA	Bureau of Indian Affairs
BLAST	Babysitter Lessons and Safety Training
BOD	Board of Directors
BPC	Breastfeeding Promotion Consortium
CAG	Corporate Advisory Group
CAMLWG	Children, Adolescents, and Media Leadership Workgroup
CAP	College of American Pathologists
CAQI	Chapter Alliance for Quality Improvement
CATCH	Community Access to Child Health
CDC	Centers for Disease Control and Prevention
CESP	Confederation of European Specialty Pediatrics
CFMC	Chapter Forum Management Committee
CFT	Cross Functional Team
CHA	Children's Hospital Association
CHIC	Child Health Informatics Center
CHIP	Children's Health Insurance Program
CISP	Childhood Immunization Support Program
CMC	Council Management Committee
CME	Continuing Medical Education
CMS	Centers for Medicare & Medicaid Services
CMSS	Council of Medical Specialty Societies
CnF	Council Forum
COA	Committee on Adolescence
COB	Committee on Bioethics
COCAN	Council on Child Abuse and Neglect
COCHF	Committee on Child Health Financing
COCIT	Council on Clinical Information Technology
COCM	Council on Communications and Media
COCME	Committee on Continuing Medical Education
COCN	Committee on Coding and Nomenclature
COCP	Council on Community Pediatrics
COCWD	Council on Children With Disabilities
COD	Committee on Drugs
CODe	Committee on Development
COEC	Council on Early Childhood
COEH	Council on Environmental Health
CoF	Committee Forum
COFCAKC	Council on Foster Care, Adoption, and Kinship Care
COFGA	Committee on Federal Government Affairs
CoFMC	Committee Forum Management Committee
COFN	Committee on Fetus and Newborn
COG	Committee on Genetics
COGME	Council on Graduate Medical Education (DHHS/HRSA)
COHC	Committee on Hospital Care
COICFH	Council on Immigrant Child and Family Health
COID	Committee on Infectious Diseases
COIVPP	Council on Injury, Violence, and Poison Prevention

COMLRM	Committee on Medical Liability and Risk Management
COMSEP	Council on Medical Student Education in Pediatrics (AMSPDC)
CON	Committee on Nutrition
CONACH	Committee on Native American Child Health
COPA	Committee on Pediatric AIDS
COPACFH	Committee on Psychosocial Aspects of Child and Family Health
COPAM	Committee on Practice and Ambulatory Medicine
COPE	Committee on Pediatric Education
COPEM	Committee on Pediatric Emergency Medicine
COPR	Committee on Pediatric Research
COPW	Committee on Pediatric Workforce
COQIPS	Council on Quality Improvement and Patient Safety
CORS	Committee on Residency Scholarships
COSGA	Committee on State Government Affairs
COSH	Council on School Health
COSMF	Council on Sports Medicine and Fitness
COSUP	Committee on Substance Use and Prevention
CPS	Canadian Paediatric Society
CPTI	Community Pediatrics Training Initiative
CQN	Chapter Quality Network
CSHCN	Children With Special Health Care Needs
DHHS	Department of Health and Human Services
DOD	Department of Defense
DVC	District Vice Chairperson
EBCDLWG	Early Brain and Child Development Leadership Workgroup
EC	Executive Committee
ECHO	Expanding Capacity for Health Outcomes
ELWG	Epigenetics Leadership Workgroup
EMSC	Emergency Medical Services for Children
EPA	Environmental Protection Agency
EQIPP	Education in Quality Improvement for Pediatric Practice
eTACC	Electronic Translation of Academy Clinical Content
FAAN	Federal Advocacy Action Network
FASD	Fetal Alcohol Spectrum Disorder
FCF	Friends of Children Fund
FDA	Food and Drug Administration
FERPA	Family Educational Rights and Privacy Act
FOPE II	Future of Pediatric Education II
FOPO	Federation of Pediatric Organizations
FTC	Federal Trade Commission
GME	Graduate Medical Education
HAAC	Historical Archives Advisory Committee
HBB	Helping Babies Breathe
HCCA	Healthy Child Care America
HEDIS	Healthcare Effectiveness Data and Information Set
HHS	Health and Human Services
HIPAA	Health Insurance Portability and Accountability Act of 1996
HMO	Health Maintenance Organization
HOF	Headquarters of the Future
HQA	Hospital Quality Alliance
HRSA	Health Resources and Services Administration
HTC	Help the Children
HTPCP	Healthy Tomorrows Partnership for Children Program
IHS	Indian Health Service
IMG	International Medical Graduate
IPA	International Pediatric Association
IPC	International Pediatric Congress
IRB	Institutional Review Board
LLLI	La Leche League International
LWG	Leadership Workgroup
MCAN	Merck Childhood Asthma Network
MCH	Maternal and Child Health
MCHB	Maternal and Child Health Bureau
MCN	Migrant Clinicians Network
MHICSN-PAC	Medical Home Initiatives for Children With Special Needs Project Advisory Committee
MHLWG	Mental Health Leadership Work Group
MOC	Maintenance of Certification
MRT	Media Resource Team
NACHC	National Association of Community Health Centers
NAEMSP	National Association of EMS Physicians
NAEPP	National Asthma Education and Prevention Program
NAM	National Academy of Medicine
NAPNAP	National Association of Pediatric Nurse Practitioners
NASPGHAN	North American Society for Pediatric Gastroenterology, Hepatology, and Nutrition
NAWD	National Association of WIC Directors
NBME	National Board of Medical Examiners
NCBDDD	National Center on Birth Defects and Developmental Disabilities
NCE	National Conference & Exhibition
NCEPG	National Conference & Exhibition Planning Group
NCQA	National Committee for Quality Assurance
NHLBI	National Heart, Lung, and Blood Institute
NHMA	National Hispanic Medical Association
NHTSA	National Highway Traffic Safety Administration
NIAAA	National Institute on Alcohol Abuse and Alcoholism
NICHD	National Institute of Child Health and Human Development
NICHQ	National Initiative for Children's Health Quality
NIDA	National Institute on Drug Abuse
NIH	National Institutes of Health
NIMH	National Institute of Mental Health
NMA	National Medical Association
NNC	National Nominating Committee
NQF	National Quality Forum
NRHA	National Rural Health Association
NRMP	National Resident Matching Program
NRP	Neonatal Resuscitation Program
NSC	National Safety Council
NVAC	National Vaccine Advisory Committee
ODPHP	Office of Disease Prevention and Health Promotion
OED	Office of the Executive Director
OHISC	Oral Health Initiative Steering Committee
OLWG	Obesity Leadership Workgroup
P4P	Pay for Performance
PAAC	Payer Advocacy Advisory Committee
PAC	Project Advisory Committee
PAHO	Pan American Health Organization
PALS	Pediatric Advanced Life Support
PAS	Pediatric Academic Societies
PCO	*Pediatric Care Online*™
PCOC	Primary Care Organizations Consortium
PCPCC	Patient-Centered Primary Care Collaborative
PCPI	Physician Consortium on Performance Improvement

PEAC	Practice Expense Advisory Committee
PECOS	Pediatric Education in Community and Office Settings
PECS	Pediatric Education in Community Settings
PEPP	Pediatric Education for Prehospital Professionals
PIR	*Pediatrics in Review*
PLA	Pediatric Leadership Alliance
PPAAC	Private Payer Advocacy Advisory Committee (COCHF Subcommittee)
PPAC	Past President's Advisory Committee
PPC-PCMH	Physician Practice Connections—Patient-Centered Medical Home (NCQA)
PPI	Partnership for Policy Implementation
PREP	Pediatric Review and Education Program
PROS	Pediatric Research in Office Settings
PUPVS	Project Universal Preschool Vision Screening
QA	Quality Assurance
QI	Quality Improvement
QuIIN	Quality Improvement Innovation Network
RBPE	Resource-Based Practice Expense
RBRVS	Resource-Based Relative Value Scale
RCAC	Richmond Center Advisory Committee
RCE	Richmond Center of Excellence
RRC	Residency Review Committee (ACGME)
RUC	AMA/Specialty Society Relative Value Scale Update Committee
RVU	Relative Value Unit
SAM	Society for Adolescent Medicine
SAMHSA	Substance Abuse and Mental Health Services Administration
SCHIP	State Children's Health Insurance Program
SDBP	Society for Developmental and Behavioral Pediatrics
SF	Section Forum
SFMC	Section Forum Management Committee
SLGBTHW	Section on Lesbian, Gay, Bisexual, and Transgender Health and Wellness
SOA	Section on Anesthesiology and Pain Medicine
SOAC	Subcommittee on Access to Care
SOAH	Section on Adolescent Health
SOAI	Section on Allergy and Immunology
SOAPM	Section on Administration and Practice Management
SOATT	Section on Advances in Therapeutics and Technology
SOB	Section on Bioethics
SOBr	Section on Breastfeeding
SOCAN	Section on Child Abuse and Neglect
SOCC	Section on Critical Care
SOCCS	Section on Cardiology and Cardiac Surgery
SOCDRP	Section on Child Death Review and Prevention
SOCPT	Section on Clinical Pharmacology and Therapeutics
SOD	Section on Dermatology
SODBP	Section on Developmental and Behavioral Pediatrics
SOECP	Section on Early Career Physicians
SOEM	Section on Emergency Medicine
SOEn	Section on Endocrinology
SOEPHE	Section on Epidemiology, Public Health, and Evidence
SOGBD	Section on Genetics and Birth Defects
SOGHN	Section on Gastroenterology, Hepatology, and Nutrition
SOHCa	Section on Home Care
SOHM	Section on Hospital Medicine
SOHO	Section on Hematology/Oncology
SOHPM	Section on Hospice and Palliative Medicine
SOICH	Section on International Child Health
SOID	Section on Infectious Diseases
SOIM	Section on Integrative Medicine
SOIMG	Section on International Medical Graduates
SOMHEI	Section on Minority Health, Equity, and Inclusion
SOMP	Section on Medicine-Pediatrics
SONp	Section on Nephrology
SONPM	Section on Neonatal-Perinatal Medicine
SONS	Section on Neurological Surgery
SONu	Section on Neurology
SOOb	Section on Obesity
SOOH	Section on Oral Health
SOOHNS	Section on Otolaryngology—Head and Neck Surgery
SOOp	Section on Ophthalmology
SOOPe	Section on Osteopathic Pediatricians
SOOr	Section on Orthopaedics
SOPPSM	Section on Pediatric Pulmonology and Sleep Medicine
SOPS	Section on Plastic Surgery
SOPT	Section on Pediatric Trainees
SORa	Section on Radiology
SORh	Section on Rheumatology
SOSILM	Section on Simulation and Innovative Learning Methods
SOSM	Section on Senior Members
SOSu	Section on Surgery
SOTC	Section on Telehealth Care
SOTCo	Section on Tobacco Control
SOTM	Section on Transport Medicine
SOU	Section on Urology
SOUCM	Section on Urgent Care Medicine
SOUS	Section on Uniformed Services
SPR	Society for Pediatric Research
SPWG	Strategic Planning Work Group
TA	Technical Assistance
TA	Technology Assessment
TFOA	Task Force on Access (also known as Task Force on Health Insurance Coverage and Access to Care)
TFOC	Task Force on Circumcision
TFOSIDS	Task Force on Sudden Infant Death Syndrome
TIPP	The Injury Prevention Program
TJC	The Joint Commission
UNICEF	United Nations Children's Fund
UNOS	United Network for Organ Sharing
USDA	US Department of Agriculture
VIP	Value in Inpatient Pediatrics
WHO	World Health Organization
WIC	Special Supplemental Nutrition Program for Women, Infants, and Children

Subject Index

Page numbers followed by *f* indicate a figure.
Page numbers followed by *t* indicate a table.

A

B

C

D

E

F

G

H

I

J

K

L

M

N

O

P

Q

R

S

T

U

V

W

X

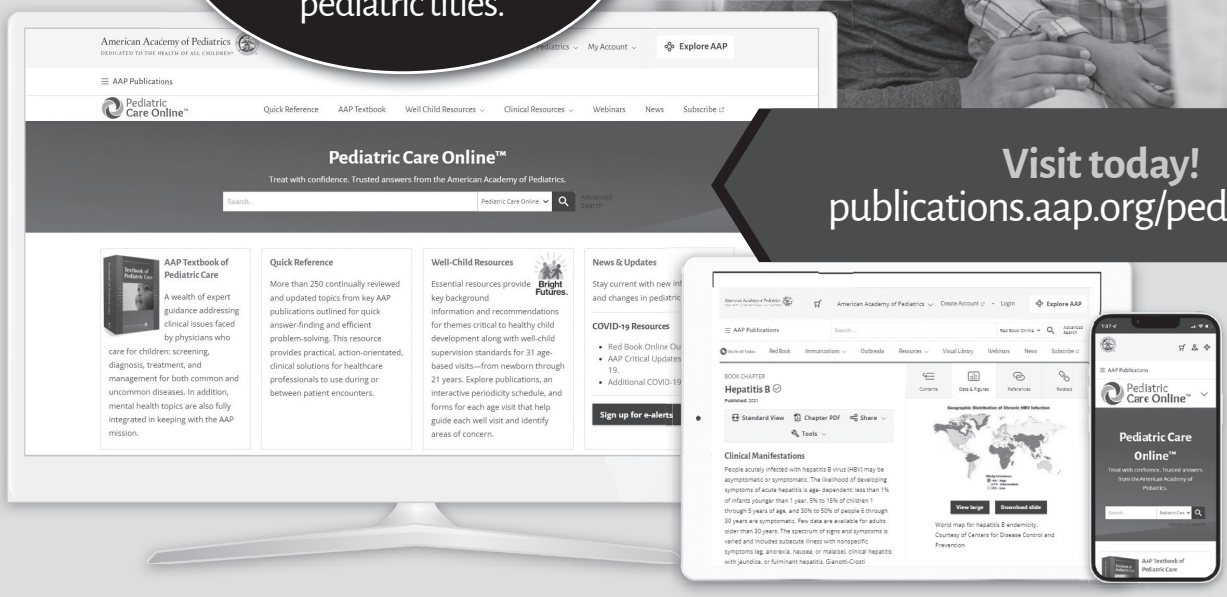
Z

Pediatric Care Online™

One click for...*Pediatric Care Online*™

Instant access to the best resources in pediatrics because your patients deserve the best care.

Look for PCO on **AAP Publications**—the **NEW** home for quality content and essential pediatric titles.



Visit today!
publications.aap.org/pediatriccare

Don't wait—Subscribe today!
shop.aap.org/solutions

One subscription provides access to

- Point-of-Care Quick Reference
- *Red Book® Online*
- *Pediatric Patient Education*™
- *AAP Textbook of Pediatric Care*
- AAP Toolkits (Bright Futures, ADHD, Autism, and Mental Health)

American Academy of Pediatrics
DEDICATED TO THE HEALTH OF ALL CHILDREN®