

**KAPLAN** MEDICAL

# **PRECLINICAL BEHAVIORAL SCIENCE AND SOCIAL SCIENCES REVIEW 2023**



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**FOR USMLE® STEP 1 AND  
COMLEX-USA® LEVEL 1**

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# Table of Contents

## PART I: EPIDEMIOLOGY AND BIOSTATISTICS

**CHAPTER 1:** Epidemiology . . . . . 3

**CHAPTER 2:** Biostatistics . . . . . 25

## PART II: BEHAVIORAL SCIENCE

**CHAPTER 3:** Developmental Life Cycle . . . . . 53

**CHAPTER 4:** Theories of Learning and Behavioral Modification . . . . . 65

**CHAPTER 5:** Defense Mechanisms . . . . . 71

**CHAPTER 6:** Psychological Health and Testing . . . . . 77

**CHAPTER 7:** Substance Use Disorders . . . . . 83

**CHAPTER 8:** Sleep and Sleep Disorders . . . . . 93

**CHAPTER 9:** Psychiatric (DSM-5) Disorders . . . . . 99

**CHAPTER 10:** Psychopharmacology . . . . . 117

**CHAPTER 11:** Brain Function and Neurocognitive Disorders . . . . . 125

**CHAPTER 12:** Ethics, Law, and Physician Behavior . . . . . 135

**CHAPTER 13:** Health Care Delivery Systems . . . . . 157

## PART III: SOCIAL SCIENCES

**CHAPTER 14:** Basic Science of Patient Safety . . . . . 161

**INDEX** . . . . . 193





**PART I**

# **EPIDEMIOLOGY AND BIOSTATISTICS**



## LEARNING OBJECTIVES

- ❑ Answer questions about epidemiologic measures
- ❑ Use knowledge of screening tests
- ❑ Explain information related to study designs

## EPIDEMIOLOGIC MEASURES

Epidemiology is the study of the distribution and determinants of health-related states within a population. It refers to the patterns of disease and the factors that influence those patterns.

- **Endemic:** the usual, expected rate of disease over time; the disease is maintained without much variation within a region
- **Epidemic:** occurrence of disease in excess of the expected rate; usually presents in a larger geographic span than endemics (*epidemiology* is the study of epidemics)
- **Pandemic:** worldwide epidemic
- **Epidemic curve:** visual description (commonly histogram) of an epidemic curve is disease cases plotted against time; classic signature of an epidemic is a “spike” in time

The tools of epidemiology are numbers; the numbers in epidemiology are ratios converted into rates. The denominator is key: who is “at risk” for a particular event or disease state.

To determine the rate, compare the number of actual cases with the number of potential cases:

$$\frac{\text{Actual cases}}{\text{Potential cases}} = \frac{\text{Numerator}}{\text{Denominator}} = \text{RATE}$$

Rates are generally, though not always, per 100,000 persons by the Centers for Disease Control (CDC), but can be per any multiplier. (Vital statistics are usually per 1,000 persons.)

A disease may occur in a country at a regular annual rate, which makes it **endemic**. If there is a sudden rise in the number of cases in a specific month, we say that there is an **epidemic**. As the disease continues to rise and spread to other countries, it becomes a **pandemic**. Thus the terminology is related to both the number of cases and its geographical distribution.





Although the data is in 100,000 cases, the variation in disease 1 is still consistent when compared to disease 2.

The graph below represents the incidence of 2 diseases (cases in 100,000). Disease 1 is endemic as the rate of disease is consistent month to month with minor variation in the number of cases. Disease 2 experiences an epidemic in March and April in which the number of cases is in excess of what is expected.

January	February	March	April	May	June	July	August
3	4	3	4	4	4	3	3
5	5	8	8	5	5	5	5

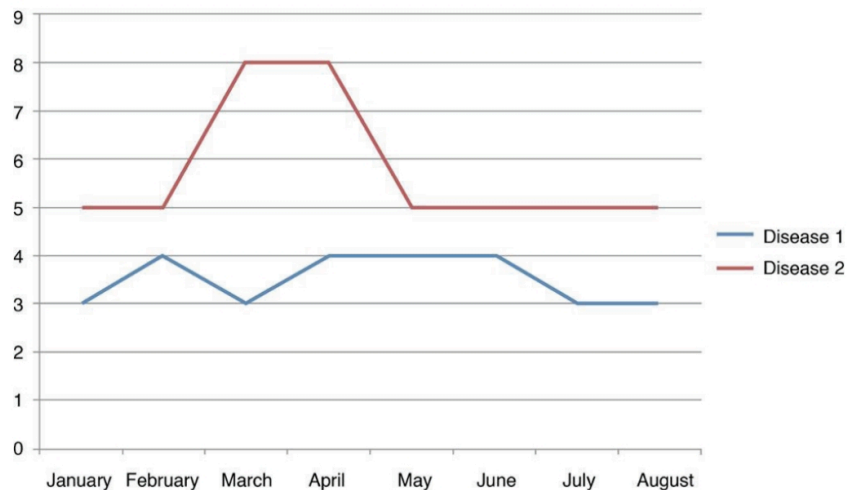


Figure I-1-1. Epidemic vs. Endemic Cases

Consider the following scenario. A rural farmer begins to sell meat that is infected with salmonella. Within 2 days, hundreds of nearby villagers begin to experience crampy abdominal pain. This is an example of an epidemic. The sudden rise of salmonella gastroenteritis in this village is much higher than the average incidence for the given time period.

Now what if the farmer ships 1,000 pounds of infected beef to other regions in the country before he realizes what happened? What can one anticipate would happen? The answer is there would be no change to the endemic rate of gastroenteritis. The farmer is only shipping out 1,000 pounds of beef to a few cities nationwide. Unlike the earlier scenario which addressed the population of a village, this would be the entire nation. Assuming that every person who consumes the beef gets gastroenteritis, that number would not significantly increase the national average of cases and would therefore not significantly change the incidence of the disease nationwide.

## Incidence and Prevalence

**Incidence rate (IR)** is the rate at which **new events** occur in a population.

- The numerator is the number of **new** events that occur in a defined period.
- The denominator is the population at risk of experiencing this new event during the same period.

$$\text{Incidence rate} = \frac{\text{Number of new events in a specified period}}{\text{Number of persons "exposed to risk" of becoming new cases during this period}} \times 10^n$$

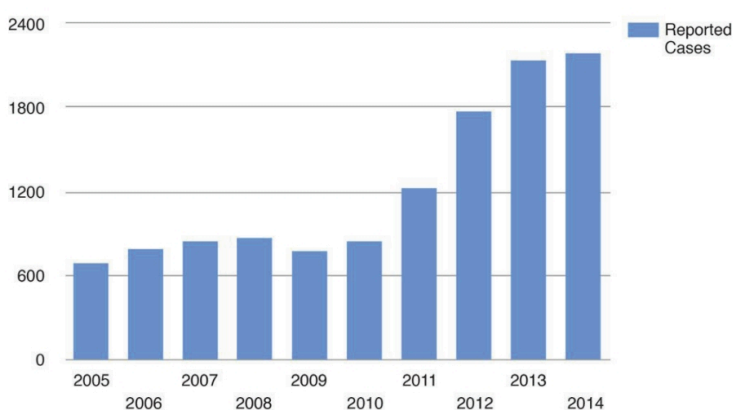
The IR includes only **new cases** of the disease that occurred during the specified period, not cases that were diagnosed earlier. This is especially important when working with infectious diseases such as TB and malaria.

If, over the course of a year, 5 men are diagnosed with prostate cancer, out of a total male study population of 200 (with no prostate cancer at the beginning of the study period), the IR of prostate cancer in this population would be 0.025 (or 2,500 per 100,000 men-years of study).

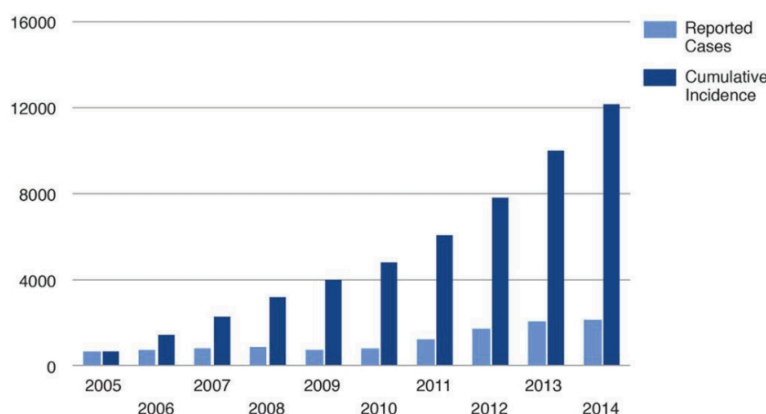
**Attack rate** is the cumulative incidence of infection in a group of people observed over a period of time during an epidemic, usually in relation to food-borne illness. It is measured from the beginning of an outbreak to the end of the outbreak.

$$\text{Attack rate} = \frac{\text{Number of exposed people infected with the disease}}{\text{Total number of exposed people}}$$

Attack rate is also called *attack ratio*; consider an outbreak of Norwalk virus in which 18 people in separate households become ill. If the population of the community is 1,000, the overall attack rate is  $\frac{18}{1,000} \times 100\% = 1.8\%$ .



**Figure I-1-2.** Reported Cases of Hepatitis C in the United States



**Figure I-1-3.** Cumulative Incidence 2005-2015

**NOTE**

**Prevalence** is a measurement of *all* individuals (new and old) affected by the disease at a particular time, whereas **incidence** is a measurement of the number of *new* individuals who contract a disease during a particular period of time.

**Prevalence** is all persons who experience an event in a population. The numerator is all individuals who have an attribute or disease at a particular point in time (or period of time). The denominator is the population at risk of having the attribute or disease at that point in time or midway through the period.

$$\text{Prevalence} = \frac{\text{All cases of a disease at a given point/period}}{\text{Total population "at risk" for being cases at a given point/period}} \times 10^n$$

Prevalence, in other words, is the proportion of people in a population who have a particular disease at a specified point in time (or over a specified period of time). The numerator includes both new cases and old cases (people who remained ill during the specified point or period in time). A case is counted in prevalence until death or recovery occurs. **This makes prevalence different from incidence, which includes only new cases in the numerator.**

Prevalence is most useful for measuring the burden of chronic disease in a population, such as TB, malaria and HIV. For example, the CDC estimated the prevalence of obesity among American adults in 2001 at approximately 20%. Since the number (20%) includes all cases of obesity in the United States, we are talking about *prevalence*.

**Point prevalence** is useful for comparing disease at different points in time in order to determine whether an outbreak is occurring. We know that the amount of disease present in a population changes over time, but we may need to know how much of a particular disease is present in a population at a single point in time ("snapshot view").

Perhaps we want to know the prevalence of TB in Community A today. To do that, we need to calculate the point prevalence on a given date. The numerator would include all known TB patients who live in Community A that day. The denominator would be the population of Community A that day.

**Period prevalence**, on the other hand, is prevalence during a specified period or span of time. The focus is on *chronic* conditions.

In the "**prevalence pot**," incident (or new) cases are monitored over time. New cases join pre-existing cases to make up total prevalence.

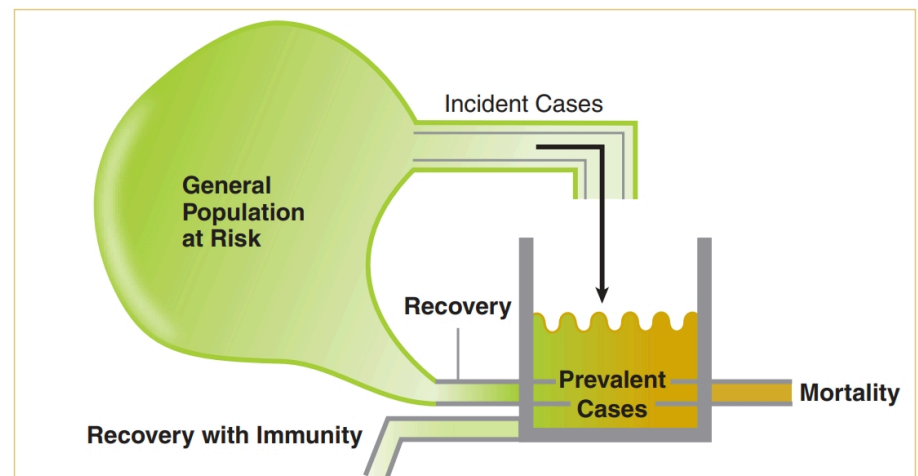


Figure I-1-4. Prevalence Pot

Prevalent cases leave the prevalence pot in one of 2 ways: recovery or death.

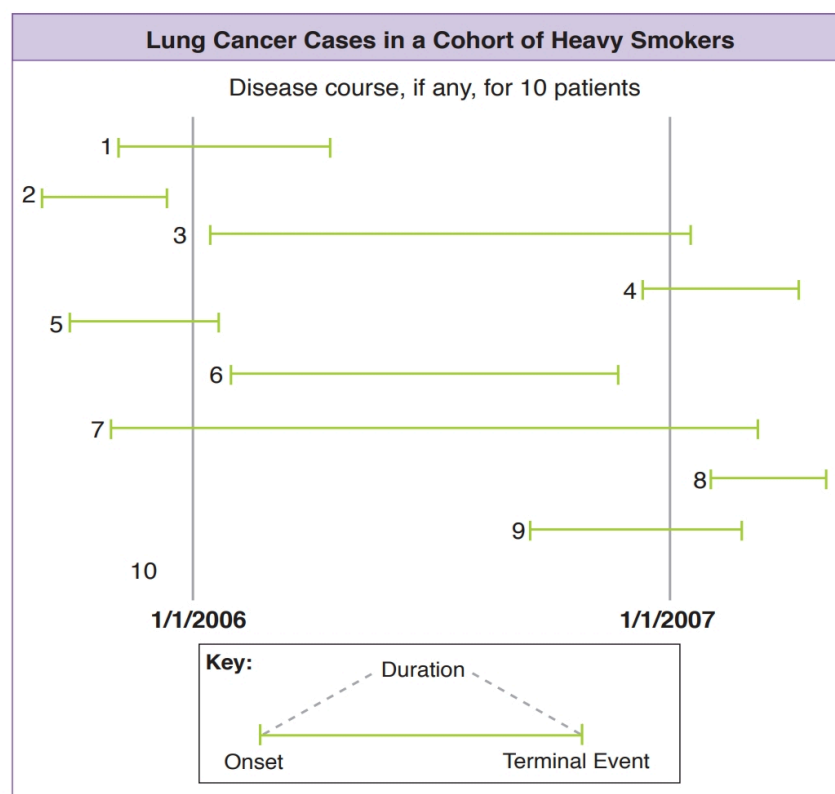


**Table I-1-1. Incidence and Prevalence**

What happens if:	Incidence	Prevalence
New effective treatment is initiated	no change	decrease
New effective vaccine gains widespread use	decrease	decrease
Number of persons dying from the condition increases	no change	decrease
Additional Federal research dollars are targeted to a specific condition	no change	no change
Behavioral risk factors are reduced in the population at large	decrease	decrease
Contacts between infected persons and noninfected persons are reduced	decrease	decrease
For airborne infectious disease?	no change	no change
For noninfectious disease?	no change	no change
Recovery from the disease is more rapid than it was one year ago	no change	decrease
Long-term survival rates for the disease are increasing	no change	increase

**NOTE**

**Morbidity rate** is the rate of disease in a population at risk (for both incident and prevalent cases), while **mortality rate** is the rate of death in a population at risk (incident cases only).

**Figure I-1-5. Calculating Incidence and Prevalence**



Based on the graph above, calculate the following:

- **Prevalence of lung cancer from 1/1/2006–1/1/2007**
  - Number of patients who “had” lung cancer in this time period from the graph: (7)
  - Number of patients at risk in this time period: (9) [exclude patient #2 who died before the time period]
  - Prevalence: (7/9)
  - Type of prevalence: (period prevalence)
- **Incidence of lung cancer from 1/1/2006–1/1/2007**
  - Number of patients who developed lung cancer in this time period: (4)
  - Number of patients at risk in this time period: (6) [exclude patients who were already sick at the start of the time period and those who died before the time period]
  - Incidence: (4/6)

### Recall Question

Prevalence can be defined as which of the following?

- A. Number of new events in a specified period over the number of persons at risk of becoming new cases during the same period
- B. Number of exposed people infected with a disease over the total number of exposed people
- C. All cases of a disease at a given point over the total population at risk for being cases at the same point
- D. Number of actual cases over potential cases
- E. Rate of death in a population at risk

Answer: C

### NOTE

Use **caution using the crude rate**. Imagine that in a given city, there are a lot of older, retired people—the crude rate of myocardial infarction will appear higher, even though the rate for each age group has not actually changed.

### Crude, Specific, and Standardized Rates

**Crude rate** is the actual measured rate for a **whole population**, e.g., rate of myocardial infarction for a whole population.

**Specific rate** is the actual measured rate for a **subgroup of population**, e.g., “age-specific” or “sex-specific” rate. For instance, the rate of myocardial infarction among people age >65 in the population or the rate of breast cancer among the female population.

If you are provided specific rates, you can calculate the crude rate. The crude rate of an entire population is a weighted sum of each of the specific rates. The weighted specific rates that are added together is calculated in the table below.

**Standardized rate (or adjusted rate)** is adjusted to make groups equal on some factor, e.g., age; an “as if” statistic for comparing groups. The standardized rate adjusts or removes any difference between two populations based on the standardized variable. This allows an “uncontaminated” or unconfounded comparison.

**Table I-1-2. Types of Mortality Rate**

<b>Crude mortality rate</b>	$\frac{\text{Deaths}}{\text{Population}}$	Deaths in a city in 2016 per population of the city	Crude rate of people dying in the population
<b>Cause-specific mortality rate</b>	$\frac{\text{Deaths from cause}}{\text{Population}}$	Deaths from lung cancer in a city in 2016 per population of the city	Specific rate of people dying from a particular disease in the population
<b>Case-fatality rate</b>	$\frac{\text{Deaths from cause}}{\text{Number of persons with the disease/cause}}$	Deaths from Ebola in a city per number of persons with Ebola	How likely you are to die from the disease, i.e., fatality
<b>Proportionate mortality rate (PMR)</b>	$\frac{\text{Deaths from cause}}{\text{All deaths}}$	Deaths from diabetes mellitus in a city per total deaths in the city	How much a disease contributes to the mortality rate, i.e., what proportion of the mortality rate is due to that disease

For example, the city of Hoboken, New Jersey has a population of 50,000. In 2016, the total number of deaths in Hoboken was 400. The number of deaths from lung cancer in Hoboken was 10, while the number of patients with lung cancer diagnosis was 30. Calculate the following:

- Mortality rate in Hoboken for 2016:  $(400/50,000 \times 1,000)$
- Cause specific mortality rate for lung cancer in Hoboken for 2016:  $(10/50,000 \times 100,000)$
- CFR for lung cancer in Hoboken in 2016:  $(10/30 \times 100)$
- PMR for lung cancer in Hoboken in 2016:  $(10/400 \times 100)$



## PREVENTION

The goals of prevention in medicine are to **promote health**, **preserve health**, **restore health when it is impaired**, and **minimize suffering and distress**. These goals aim to minimize both morbidity and mortality.

- **Primary prevention** promotes health at both individual and community levels by facilitating health-enhancing behaviors, preventing the onset of risk behaviors, and diminishing exposure to environmental hazards. Examples include implementation of exercise programs and healthy food programs in schools. Primary prevention efforts **decrease disease incidence**.
- **Secondary prevention** screens for risk factors and early detection of asymptomatic or mild disease, permitting timely and effective intervention and curative treatment. Examples include recommended annual colonoscopy for patients age >65 and HIV testing for health care workers with needlestick injuries. Secondary prevention efforts **decrease disease prevalence**.
- **Tertiary prevention** reduces long-term impairments and disabilities and prevents repeated episodes of clinical illness. Examples include physical therapy for spinal injury patients and daily low-dose aspirin for those with previous myocardial infarction. Tertiary prevention efforts **prevent recurrence and slow progression**.

Consider a new healthcare bill that is being funded to help wounded war veterans gain access to prosthetic limb replacement. That would be considered *tertiary* prevention. The patients who would have access to the service have already been injured. The prosthetic devices would help reduce complications of amputation and help their rehabilitation. By improving quality of life and reducing morbidity, that is an implementation of tertiary prevention.

Now consider a medical student who is asked to wear a nose and mouth mask before entering the room of a patient with meningococcal meningitis. That would be considered *primary* prevention. Because the bacteria in this case can be spread by respiratory contact, the use of the mask will prevent the student from being exposed.



## SCREENING TESTS

Screening tests help physicians to detect the presence of disease, e.g., an ELISA test for HIV, the results of which are either positive or negative for disease. The efficacy of a screening test is assessed by comparing the results to verified sick and healthy populations. For HIV, we would use a Western blot as a gold-standard.

The qualifier “true” or “false” is used to describe the correlation between the test results (positive or negative) and the disease (presence or absence).

**True-positive (TP):** tested positive, actually sick

- In other words, the positive result is true.

**False-positive (FP):** tested positive, is actually healthy

- In other words, the positive result is false.

**True-negative (TN):** tested negative, actually healthy

- In other words, the negative result is true.

**False-negative (FN):** tested negative, is actually sick

- In other words, the negative result is false.

**Table I-1-3. Screening Results in a  $2 \times 2$  Table**

		Disease				
		Present		Absent		Totals
Screening Test Results	Positive	TP	60	FP	70	TP + FP
	Negative	FN	40	TN	30	TN + FN
	Totals	TP + FN		TN + FP		TP + TN + FP + FN

## Measures of Test Performance

**Sensitivity** and **specificity** are measures of the test performance (and in some cases, physical findings and symptoms). They help to provide additional information in cases where it is not possible to use a gold-standard test and instead a cheaper and easier (yet imperfect) screening test is used. Think about what would happen if you called the cardiology fellow to do a cardiac catheterization (the gold standard test to diagnose acute myocardial ischemia) on a patient without first having an EKG.

**Sensitivity** is the probability of correctly identifying a case of disease. In other words, it is the **proportion of truly diseased persons** in the screened population who are **identified as diseased** by the screening test. This is also known as the “true positive rate.”

$\text{Sensitivity} = \text{TP} / (\text{TP} + \text{FN}) = \text{true positives} / (\text{true positives} + \text{false negatives})$

- Measures only the distribution of persons with disease
- Uses data from the left column of the  $2 \times 2$  table
- Note:  $1 - \text{sensitivity} = \text{false negative rate}$



If a test has a **high sensitivity**, then a **negative result** indicates the **absence of the disease**. For example, temporal arteritis (TA), a large vessel vasculitis that involves branches of the external carotid artery seen in those age >50, always shows elevated ESR. So 100% of patients with TA have elevated ESR. The sensitivity of an abnormal ESR for TA is 100%. If a patient you suspect of having TA has a normal ESR, then the patient does not have TA.

If there are 200 sick people, the sensitivity of a test tells us the capacity of the test to correctly identify these sick people. If a screening test identifies 160 of them as sick (they test positive), then the sensitivity of the test is  $160/200 = 80\%$ .

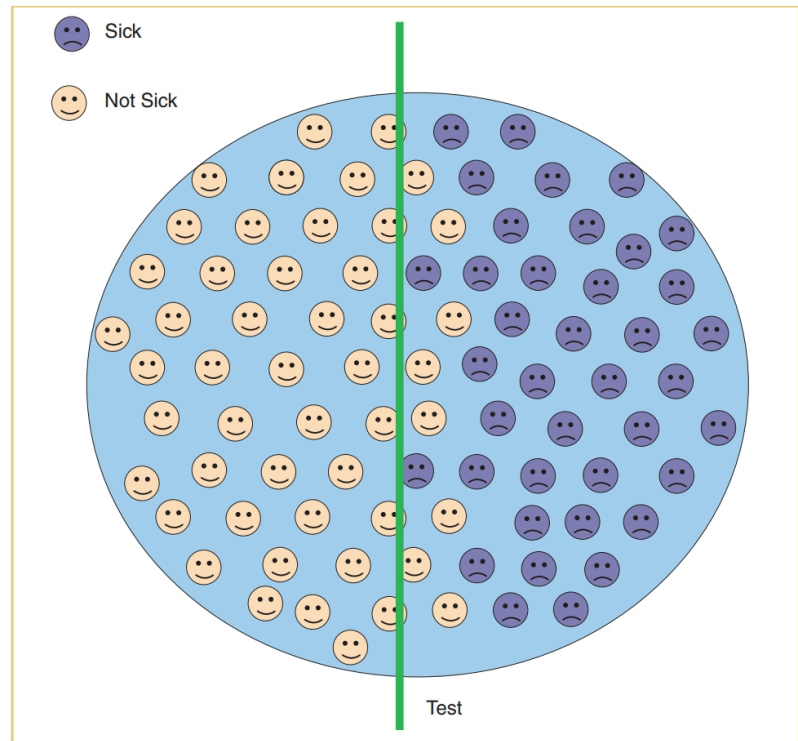


Figure I-1-6. Sensitive Test

## NOTE

### Mnemonics

- Clinical use of sensitivity:  
**SN-N-OUT** (sensitive test-negative rules out disease)
- Clinical use of specificity:  
**SP-I-N** (specific test-positive rules in disease)

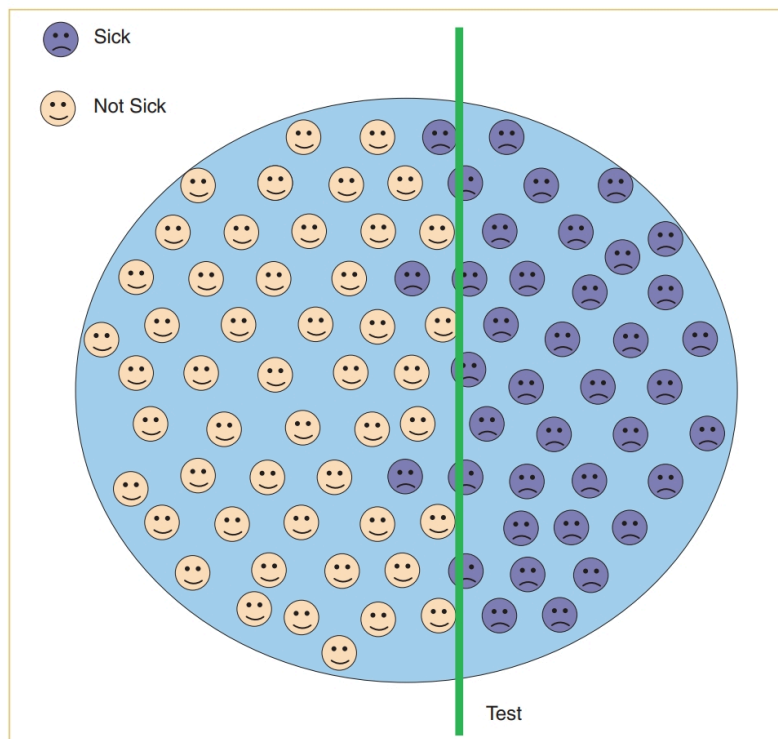
For any test, there is usually a trade-off between SN-N-OUT and SPIN. The trade-off can be represented graphically as the screening dimension curves and ROC curves.

**Specificity** is the probability of correctly identifying disease-free persons. Specificity is the **proportion of truly nondiseased persons** who are **identified as nondiseased** by the screening test. This is also known as the “true negative rate.”

$$\text{Specificity} = \text{TN} / (\text{TN} + \text{FP}) = \text{true negatives} / (\text{true negatives} + \text{false positives})$$

- Measures only the distribution of persons who are disease-free
- Uses data from the right column of the  $2 \times 2$  table
- Note:  $1 - \text{specificity} = \text{false positive rate}$

If a test has a **high specificity**, then a **positive result** indicates the **existence of the disease**. For example, CT angiogram has a very high specificity for pulmonary embolism (97%). A CT scan read as positive for pulmonary embolism is likely true.



**Figure I-1-7.** Specific Test

The separation between the sick and healthy in a given population isn't always clear; there is a measure of overlap, as in the figure above. In order to create a test that is specific and identifies only sick people as positive, it must do the following:

- Correctly identify all the healthy people
- Not inaccurately identify healthy people as sick

In other words, the more specific the test, the fewer false-positives (i.e., healthy people incorrectly identified as sick) it will have). Specificity is, therefore, the capacity of a test to correctly exclude healthy people with negative test results.

### Recall Question

A good screening test should have which of the following epidemiological properties?

- High specificity
- Low specificity
- Low sensitivity
- High sensitivity
- High positive predictive value
- Low negative predictive value

Answer: D



## Post-Test Probabilities

**Positive predictive value (PPV)** is the probability of disease in a person who receives a positive test result. The probability that a **person with a positive test is a true positive** (i.e., has the disease) is referred to as the “predictive value of a positive test.”

$$\begin{aligned}\text{PPV} &= \text{TP}/(\text{TP} + \text{FP}) \\ &= \text{true positives}/(\text{true positives} + \text{false positives})\end{aligned}$$

PPV measures only the distribution of persons who receive a positive test result.

**Negative predictive value (NPV)** is the probability of no disease in a person who receives a negative test result. The probability that a **person with a negative test is a true negative** (i.e., does not have the disease) is referred to as the “predictive value of a negative test.”

$$\begin{aligned}\text{NPV} &= \text{TN}/(\text{TN} + \text{FN}) \\ &= \text{true negatives}/(\text{true negatives} + \text{false negatives})\end{aligned}$$

NPV measures only the distribution of persons who receive a negative test result.

**Accuracy** is the total percentage correctly selected, the degree to which a measurement, or an estimate based on measurements, represents the true value of the attribute that is being measured.

$$\begin{aligned}\text{Accuracy} &= (\text{TP} + \text{TN})/(\text{TP} + \text{TN} + \text{FP} + \text{FN}) \\ &= (\text{true positives} + \text{true negatives})/\text{total screened patients}\end{aligned}$$

## Review Questions

### Questions 1–3

A screening test identifies 150 out of 1,000 patients to have tuberculosis. When tested with the gold standard diagnostic test, 200 patients test positive, including 100 of those identified by the screening test.

1. What is the sensitivity of the screening test?
2. What is the specificity of the screening test?
3. What is the positive predictive value?

## Answers and Explanations

1. **Answer: 50%.** Sensitivity would be true positives divided by all sick people. Only 100 of the 150 positive results were actually true, so true positives would be 100. Total sick people is 200. So we have 100/200, making sensitivity 50%.
2. **Answer: 93.75%.** Specificity would be true negatives divided by all healthy people. Only 100 of the 150 positive results were actually true, so false positives (healthy people with a positive result) would be 50. Total people is 1,000. So we have 1,000 – 200 sick, making 800 healthy. True negatives = 800 – 50 so 750. Specificity = 750/800 so 93.75%.



3. **Answer: 66%.** Positive predictive value is true positives divided by all positives. Only 100 of the 150 positive results were actually true, so true positives would be 100. The total who tested positive would be 150. Therefore, PPV is 100 divided by 150 so 66%.

## Effective Prevalence

**Prevalence**, which is a quantified measure of disease or cases in the population, is a relevant pre-test probability of disease within the population. The **more disease in a population, i.e., high prevalence**, the greater the probability that a positive test represents actual disease (= greater PPV). The **less disease in a population, i.e., lower prevalence**, the higher the probability that a negative result is true (= greater negative predictive value).

For example, 80-year-old patients with diabetes will have a higher prevalence of kidney failure than the general population. This increased prevalence makes a physician more likely to believe the results of a screening test that shows kidney failure for an 80-year-old patient with diabetes. We intuitively understand that the PPV is higher because this cohort of patients has a higher prevalence of disease.

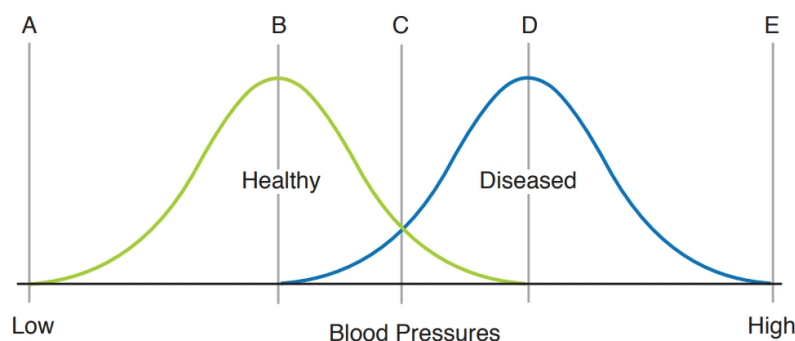
Conversely, if a 15-year-old girl tests positive for a myocardial infarction, a physician will find the results strange and will thus repeat the test to confirm the positive result is not a false-positive. That is because the prevalence of myocardial infarction among teenage girls is so low that a positive result is more likely to be a mistake than a case of an actual myocardial infarction. In a teenage girl, a negative result for myocardial infarction is more likely to be true (high negative predictive value) because there is a very low prevalence of disease in this age group population.

**Incidence** is a measure of new cases in a population. Increasing the incidence would have no effect on sensitivity or PPV because a screening test can only detect the current presence or absence of disease, not its onset.

Prevalence has no effect on the sensitivity or specificity of a test. Those are metrics of the test and can be changed only by changing the test itself.

## Double Hump Graph

In the graph below, which cutoff point provides optimal sensitivity?



**Figure I-1-8.** Healthy and Diseased Populations Along a Screening Dimension



Cutoff point B correctly identifies all the sick patients. It has the highest sensitivity (identifies all the sick patients). Cutoff D would be the most specific test (it identifies only sick people). Cutoff C where the 2 curves intersect is the most accurate. Note, the point of optimum sensitivity equals the point of optimum negative predictive value, while the point of optimum specificity equals the point of optimum positive predictive value.

Consider another example. Which of the following curves indicates the best screening test?

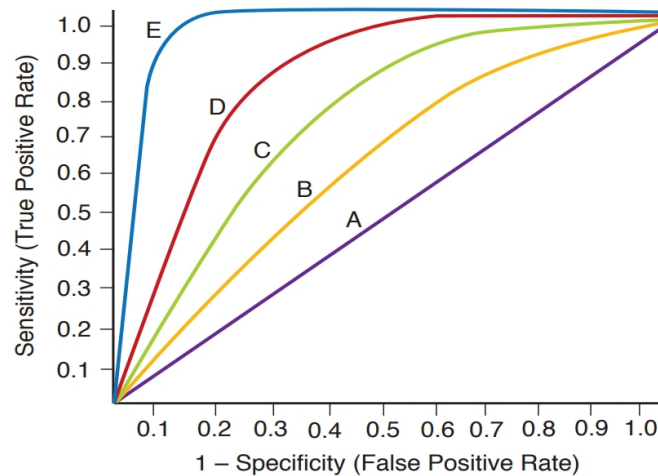


Figure I-1-9. Receiver Operating Characteristic (ROC) Curves

Curve E achieves the highest sensitivity ( $y$ -axis) without including too many false-positives ( $x$ -axis).

## STUDY DESIGNS

### Bias in Research

Bias in research is a deviation from the truth of inferred results. It can be done intentionally or unintentionally.

**Reliability** is the ability of a test to **measure something consistently**, either across testing situations (test-retest reliability), within a test (split-half reliability), or across judges (inter-rater reliability). Think of the clustering of rifle shots at a target (precision).

**Validity** is the degree to which a test **measures that which was intended**. Think of a marksman hitting the bull's-eye. Reliability is a necessary, but insufficient, condition for validity (accuracy).

## Types of bias

When there is **selection bias** (sampling bias), the sample selected is **not representative** of the population. Examples:

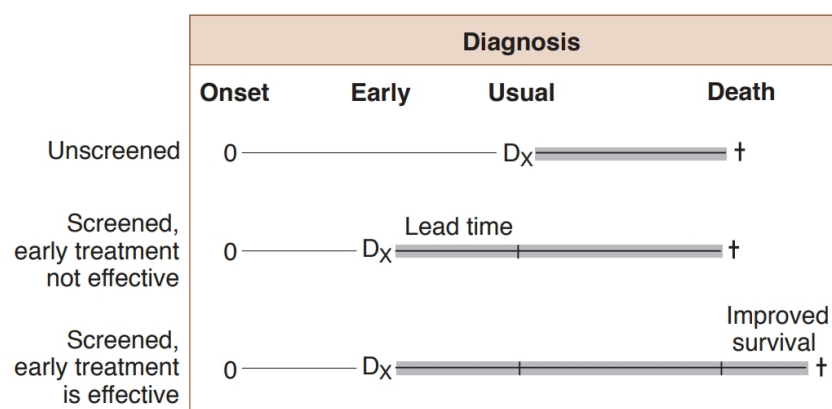
- Predicting rates of heart disease by gathering subjects from a local health club
- Using only hospital records to estimate population prevalence (Berkson bias)
- Including people in a study who are different from those who are not included (nonrespondent bias)
- **Solution:** random, independent sample; weight data

When there is **measurement bias**, information is gathered in a manner that **distorts the information**. Examples:

- Measuring patient satisfaction with their physicians by using leading questions, e.g., “You don’t like your doctor, do you?”
- Subjects’ behavior is altered because they are being studied; this is only a factor when there is no control group in a prospective study (Hawthorne effect).
- **Solution:** have a control group

When there is **experimenter expectancy** (Pygmalion effect), **experimenters’ expectations are inadvertently communicated** to subjects, who then produce the desired effects. **Solution:** use **double-blind** design, where neither the subject nor the investigators know which group receives the intervention.

**Lead-time bias** gives a **false estimate of survival rates**, e.g., patients seem to live longer with the disease after it is uncovered by a screening test. Actually, there is no increased survival, but because the disease is discovered sooner, patients who are diagnosed *seem* to live longer. **Solution:** use life-expectancy to assess benefit.



**Figure I-1-10.** Diagnosis, Time, and Survival

When there is **recall bias**, subjects **fail to accurately recall events** in the past. For example: “How many times last year did you kiss your mother?” This is a likely problem in retrospective studies. **Solution:** confirmation.



When there is **late-look bias**, individuals with **severe disease are less likely to be uncovered** in a survey **because they die first**. For example, a recent survey found that persons with AIDS reported only mild symptoms. **Solution:** stratify by disease severity.

When there is **confounding bias**, the factor being examined **is related to other factors of less interest**. Unanticipated factors obscure a relationship or make it seem like there is one when there is not. More than one explanation can be found for the presented results. For example, compare the relationship between exercise and heart disease in 2 populations when one population is younger and the other is older. Are differences in heart disease due to exercise or to age? **Solution:** combine the results from multiple studies, meta-analysis.

When there is **design bias**, parts of the study **do not fit together** to answer the question of interest. The most common issue is a non-comparable control group. For example, compare the effects of an anti-hypertensive drug in hypertensives versus normotensives. **Solution:** random assignment, i.e., subjects assigned to treatment or control group by a random process.

**Table I-1-4. Type of Bias in Research**

Type of Bias	Definition	Important Associations	Solutions
Selection	Sample not representative	Berkson's bias, nonrespondent bias	Random, independent sample
Measurement	Gathering the information distorts it	Hawthorne effect	Control group/placebo group
Experimenter expectancy	Researcher's beliefs affect outcome	Pygmalion effect	Double-blind design
Lead-time	Early detection confused with increased survival	Benefits of screening	Measure "back-end" survival
Recall	Subjects cannot remember accurately	Retrospective studies	Multiple sources to confirm information
Late-look	Severely diseased individuals are not uncovered	Early mortality	Stratify by severity
Confounding	Unanticipated factors obscure results	Hidden factors affect results	Multiple studies, good research design
Design	Parts of study do not fit together	Non-comparable control group	Random assignment



## TYPES OF RESEARCH STUDIES

### Observational Study

In an observational study, nature is allowed to take its course, i.e., there is no intervention.

- **Case report:** brief, objective report of a clinical characteristic/outcome from a single clinical subject or event,  $n = 1$ , e.g., 23-year-old man with treatment-resistant TB; there is no control group
- **Case series report:** objective report of a clinical characteristic/outcome from a group of clinical subjects,  $n > 1$ , e.g., patients at local hospital with treatment-resistant TB; there is no control group
- **Cross-sectional study:** the presence or absence of disease (and other variables) are determined in each member of the study population or representative sample at a particular time; co-occurrence of a variable and the disease can be examined
  - Disease prevalence, not incidence, is recorded
  - Cannot usually determine temporal sequence of cause and effect, e.g., who in the community now has treatment-resistant TB
- **Case-control study:** a group of people with the disease is identified and compared with a suitable comparison group without the disease; almost always retrospective, e.g., compares cases of treatment-resistant TB with those of nonresistant TB
  - Cannot usually assess incidence or prevalence of disease, but it can help determine causal relationships
  - Useful for studying conditions with very low incidence or prevalence
- **Cohort study:** population group of those who have been **exposed to risk factor** is identified and followed over time and **compared with a group not exposed to the risk factor**. Outcome is disease incidence in each group, e.g., following a prison inmate population and marking the development of treatment-resistant TB
  - Prospective, meaning that subjects are tracked forward in time
  - Can determine incidence and causal relationships, and must follow population long enough for incidence to appear

### NOTE

- Random error is unfortunate but okay and expected (a threat to reliability).
- Systematic error is bad and biases result (a threat to validity).

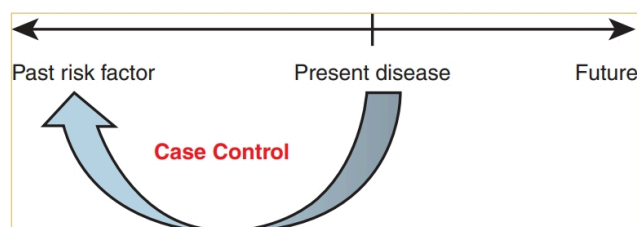


Figure I-1-11. Retrospective Study

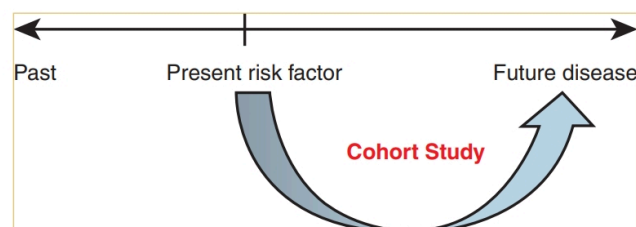


Figure I-1-12. Prospective Study

**NOTE**

Both RR and AR tell us if there are differences, but they do not tell us *why* those differences exist.

**Cohort Study**

**Relative risk (RR)** is a comparative probability asking, “How much more likely?” To find it, calculate the IR of the **exposed group divided by** the IR of the **unexposed group**. How much greater chance does one group have of contracting the disease compared with the other group?

**Attributable risk (AR)** is a comparative probability asking “How many more cases in one group?” To find it, calculate the IR of the **exposed group minus the IR of the unexposed group**.

Cohort Study		
Risk Factor	Disease	No Disease
	60 A	240 B
No Risk Factor	60 C	540 D

For the **RR** in the cohort study above, you take the **IR of the exposed group divided by the IR of the unexposed group**.

$$\begin{aligned}
 &= \frac{A/(A+B)}{C/(C+D)} \\
 &= \frac{60/(60+240)}{60/(60+540)} \\
 &= \frac{60/300}{60/600} \\
 &= 2
 \end{aligned}$$

Thus, the RR for this cohort study is 2, and the exposed group has twice as much chance of contracting the disease as the unexposed group.

For the **AR** in the cohort study above, you take the **IR of the exposed group minus the IR of the unexposed group**.

$$\begin{aligned}
 &= \frac{A}{A+B} - \frac{C}{C+D} \\
 &= \frac{60}{60+240} - \frac{60}{60+540} \\
 &= \frac{60}{300} - \frac{60}{600} \\
 &= 0.2 - 0.1 \\
 &= 0.1
 \end{aligned}$$

Thus, the AR of this cohort study is 0.1, and 10% of the disease occurrences are due to the exposure.

**Number needed to treat (NNT)** is the number of patients you need to treat to prevent one additional bad outcome (disease, death, etc.). The NNT is the **inverse of the absolute risk reduction (ARR)**. The ARR is the absolute difference in rates of events between a treatment relative to a control, e.g., the control even rate (CER) minus the experimental event rate (EER). Thus, **ARR = CER – EER**.

Consider this data:

	Bad Outcome	Good Outcome
Treatment	55	45
Control	56	44

$$\begin{aligned}
 \text{CER} - \text{EER} &= \text{AAR} \\
 &= \frac{56}{56 + 44} - \frac{55}{55 + 45} \\
 &= \frac{56}{100} - \frac{55}{100} \\
 &= 1/100 \\
 &= 0.01
 \end{aligned}$$

Thus, the ARR is 0.01, and there is a 1% difference between bad outcomes and good outcomes between the treatment and the controls.

$$\begin{aligned}
 \text{NNT} &= 1/\text{ARR} \\
 &= 1/0.01 \\
 &= 100
 \end{aligned}$$

Thus, the NNT is 100.

**Interpretation:** for every 100 people treated, 1 case (bad outcome) will be prevented.

Let's first consider **RR**. If we compare 100 children who live near a chemical plant (risk factor) to 100 children who do not (no risk factor), and follow them over time to see who develops asthma, we can calculate how much more likely it is for those exposed to the risk factor to develop disease, i.e., RR. Suppose 20 children near the chemical plant and 5 children not living near the plant all develop asthma.

$$\begin{aligned}
 \text{RR} &= \frac{\text{Incidence in exposed group (risk factor)}}{\text{Incidence in unexposed group (no risk factor)}} \\
 &= \frac{20}{100} \div \frac{5}{100} = 4
 \end{aligned}$$

**Interpretation:** a child living near the chemical plant is 4x more likely to develop asthma than a child not living near the plant

Now let's consider **AR**. Are all 20 cases among those living near the plant due to the proximity of the plant? We know that 5 children developed asthma even though they did not live next to plant, meaning that some of the 20 cases are not necessarily due to the risk factor itself (in this case, the chemical plant).

How many of the 20 cases are due to the risk factor or, in other words, are attributable to the risk factor?

As we know, **AR** = Incidence in the exposed group minus incidence in the unexposed group.

$$\frac{20}{100} - \frac{5}{100} = \frac{15}{100}$$



**Interpretation:** for every 100 children exposed to the risk factor, 15 cases are attributable to the risk factor itself; in other words, when we expose 100 children, 15 cases of asthma will be caused by the exposure.

So what is the **NNH**? NNH is the inverse of the attributable risk.

$$= \frac{100}{15} = 6.66 = 7 \text{ (always round up)}$$

**Interpretation:** for every 7 people exposed to the risk factor, there will be 1 case.

### Recall Question

Which of the following is a solution for sampling bias?

- A. Have a control group
- B. Select participants randomly
- C. Do a double-blind study
- D. Use life-expectancy to assess benefit
- E. Stratify the study groups by disease severity

Answer: B

### Case Control Study

For a case-control study, use **odds ratio (OR)**, which looks at the increased odds of getting a disease with exposure to a risk factor versus nonexposure to that factor. Find the odds of **exposure for cases divided by odds of exposure for controls**, e.g., the odds that a person with lung cancer was a smoker versus the odds that a person without lung cancer was a smoker.

**Table I-1-5. Case-Control Study: Lung Cancer and Smoking**

	Lung Cancer	No Lung Cancer
Smokers	659 (A)	984 (B)
Nonsmokers	25 (C)	348 (D)

$$\text{Odds ratio} = \frac{A/C}{B/D} = \frac{AD}{BC}$$

Use  $OR = AD/BC$  as the working formula. For the above example:

$$OR = \frac{AD}{BC} = \frac{659 \times 348}{984 \times 25} = 9.32$$

**Interpretation:** the odds of having been a smoker are over 9x greater for someone with lung cancer compared with someone without lung cancer.

How would you analyze the data from the following case-control study?

### NOTE

**Odds ratio** does not so much predict disease as it does estimate the strength of a risk factor.



**Case-Control Study: Colorectal Cancer and Family History**

	No Colorectal Cancer	Colorectal Cancer	TOTALS
Family History of Colorectal Cancer	120	60	180
No Family History of Colorectal Cancer	200	20	220
TOTALS	320	80	400
ANSWER:	$\frac{AD}{BC}$	$\frac{(60)(200)}{(120)(20)}$	OR = 5.0

**Interpretation:** the odds of having a family history of colorectal cancer are 5x greater for those who have the disease than for those who do not.

**Table I-1-6. Differentiating Observational Studies**

Characteristic	Cross-Sectional Studies	Case-Control Studies	Cohort Studies
<b>Time</b>	One time point	Retrospective	Prospective
<b>Incidence</b>	NO	NO	YES
<b>Prevalence</b>	YES	NO	NO
<b>Causality</b>	NO	YES	YES
<b>Role of disease</b>	Prevalence of disease	Begin with disease	End with disease
<b>Assesses</b>	Association of risk factor and disease	Many risk factors for single disease	Single risk factor affecting many diseases
<b>Data analysis</b>	<i>Chi-square</i> to assess association	Odds ratio to estimate risk	Relative risk to estimate risk

**Clinical Trials**

Researchers design clinical trials to answer specific research questions related to a medical product. A **control group** (often the *placebo* group) will include subjects who **do not receive the intervention under study**, used as a **source of comparison** to be certain the experiment group is being affected by the intervention and not by other factors. Control group subjects must be **as similar as possible to intervention group** subjects.

For a medical product to receive approval by the Food and Drug Administration (FDA), 3 phases must be passed.

- **Phase 1:** testing safety in healthy volunteers
- **Phase 2:** testing protocol and dose levels in a small group of patient volunteers
- **Phase 3 (definitive test):** testing efficacy and occurrence of side effects in a larger group of patient volunteers



Post-FDA approval, marketing surveys will collect reports of drug side effects among populations commonly using the product.

In a **randomized controlled clinical trial (RCT)**, subjects are **randomly allocated** into “intervention” and “control” groups to receive or not receive an experimental/preventive/therapeutic procedure or intervention. This is generally regarded as the **most scientifically rigorous** type of study available in epidemiology.

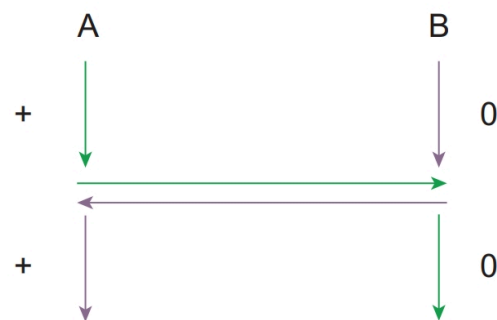
A **double-blind RCT** is the type of study **least subject to bias**, but also the **most expensive** to conduct. Double-blind means that neither subjects nor researchers know whether the subjects are in the treatment or comparison group.

A double-blind study has 2 types of control groups:

- Placebos (25–40% often show improvement in placebo group)
- Standard of care (current treatment versus new treatment)

A **community trial** is an experiment in which the unit of allocation to receive a preventive or therapeutic regimen is an **entire community or political subdivision**. Does the treatment work in real-world circumstances?

A **cross-over study** is one in which, for ethical reasons, no group involved can remain untreated. **All subjects receive the intervention** but at different times (making recruitment of subjects easier). Assume double-blind design. For example, an AZT trial, where group A receives AZT for 3 months while group B is the control. For the second 3 months, group B receives AZT and group A is the control.



**Figure I-1-13.** Cross-Over Study

### Recall Question

What study type is least susceptible to bias?

- A. Double-blind randomized controlled trial
- B. Single-blind randomized controlled trial
- C. Case-control study
- D. Cohort study
- E. Cross-sectional study

Answer: A

## LEARNING OBJECTIVES

- ❑ Demonstrate understanding of key probability rules
- ❑ Summarize data
- ❑ Solve problems using inferential statistics
- ❑ Use knowledge of nominal, ordinal, interval, and ratio scales
- ❑ Answer questions about statistical tests

## KEY PROBABILITY RULES

### Independent Events

Events are **independent** if the **occurrence of one tells you nothing about the occurrence of the other**. Combine probabilities for independent events by **multiplication**.

The issue here is the intersection of 2 sets; e.g., if the chance of having blond hair is 0.3 and the chance of having a cold is 0.2, the chance of meeting a blond-haired person with a cold is:  $0.3 \times 0.2 = 0.06$  (or 6%).

If events are **nonindependent**, multiply the probability of one event by the probability of the second, assuming that the first has occurred; e.g., if a box has 5 white balls and 5 black balls, the chance of picking 2 black balls is:

$$\frac{5}{10} \times \frac{4}{9} = 0.5 \times 0.44 = 0.22 \text{ (or 22\%)}$$

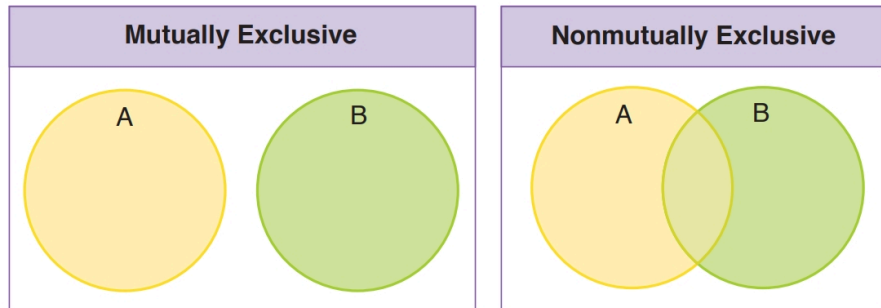
### Mutually Exclusive Events

Events are mutually exclusive if the **occurrence of one event precludes the occurrence of the other**. Combine probabilities for mutually exclusive outcomes by **addition**.

The issue here is the union of two sets; e.g., if a coin lands on heads, it cannot be tails; the events are **mutually exclusive**. If a coin is flipped, the chance that it will be either heads or tails is  $0.5 + 0.5 = 1.0$  (or 100%).



If 2 events are **not mutually exclusive**, add them together and subtract out the multiplied probabilities to get the combination of probabilities. For example, if the chance of having diabetes is 10% and the chance of being obese is 30%, the chance of meeting someone who is obese or has diabetes or both is  $0.1 + 0.3 - (0.1 \times 0.3) = 0.37$  (or 37%).



**Figure I-2-1.** Venn Diagram of Mutually Exclusive and Nonmutually Exclusive Events

### Review Questions

1. If the prevalence of diabetes is 10%, what is the chance that 3 people selected at random from the population will all have diabetes?
2. Chicago has a population of 10,000,000. If 25% of the population is Latino, 30% is African American, 5% is Arab American, and 40% is of European extraction, how many people in Chicago are classified as other than of European extraction?
3. At age 65, the probability of surviving for the next 5 years is 0.8 for a white man and 0.9 for a white woman. For a married couple who are both white and age 65, the probability that the wife will be a living widow 5 years later is:
  - A. 90%
  - B. 72%
  - C. 18%
  - D. 10%
  - E. 8%
4. If the chance of surviving for 1 year after being diagnosed with prostate cancer is 80% and the chance of surviving for 2 years after diagnosis is 60%, what is the chance of surviving for 2 years after diagnosis, given that the patient is alive at the end of the first year?
  - A. 20%
  - B. 48%
  - C. 60%
  - D. 75%
  - E. 80%

## Answers and Explanations

1. **Answer: 0.001.**  $0.1 \times 0.1 \times = 0.001$
2. **Answer: 6,000,000.**  $25\% + 30\% + 5\% = 60\%$ .  $60\% \times 10,000,000 = 6,000,000$
3. **Answer: C.** You're being asked for the joint probability of independent events; therefore, the probabilities are multiplied. Chance of the wife being alive: 90%, and chance of the husband being dead:  $100\% - 80\% = 20\%$ . Therefore,  $0.9 \times 0.2 = 18\%$ .
4. **Answer: D.** The question tests knowledge of "conditional probability." Out of 100 patients, 80 are alive at the end of 1 year and 60 at the end of 2 years. The 60 patients alive after 2 years are a subset of those that make it to the first year. Therefore,  $60/80 = 75\%$ .





## DESCRIPTIVE STATISTICS

### Distributions

Statistics deals with the world as *distributions*. These distributions are summarized by a **central tendency** and **variation around that center**. The most important distribution is the **normal** or **Gaussian curve**. This “bell-shaped” curve is **symmetric**, with one side the mirror image of the other.

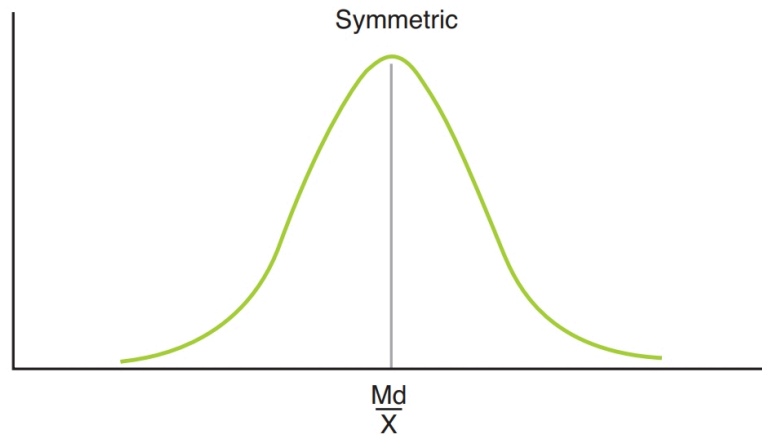


Figure I-2-2. Measures of Central Tendency

### Measures of central tendency

**Central tendency** describes a single value which attempts to describe a set of data by identifying the central (or middle) value within that set. (Colloquially, measures of central tendency are often called *averages*.) There are several valid measures:

- **Mean ( $\bar{X}$ )** (or *average*): sum of the values of the observations divided by the numbers of observations
- **Median (Md)**: point on the scale which divides a group into 2 parts (upper and lower half); the measurement below which half the observations fall is *50th percentile*
- **Mode**: **most frequently occurring value** in a set of observations

Given the distribution of numbers: 3, 6, 7, 7, 9, 10, 12, 15, 16, the **mode is 7**, the **median is 9**, and the **mean is 9.4**.

Not all curves are normal; sometimes the curve is **skewed** positively or negatively.

- A **positive skew** has the tail to the right, and the mean greater than the median.
- A **negative skew** has the tail to the left, and the median greater than the mean.

For skewed distributions, the **median** is a better representation of central tendency than is the mean.

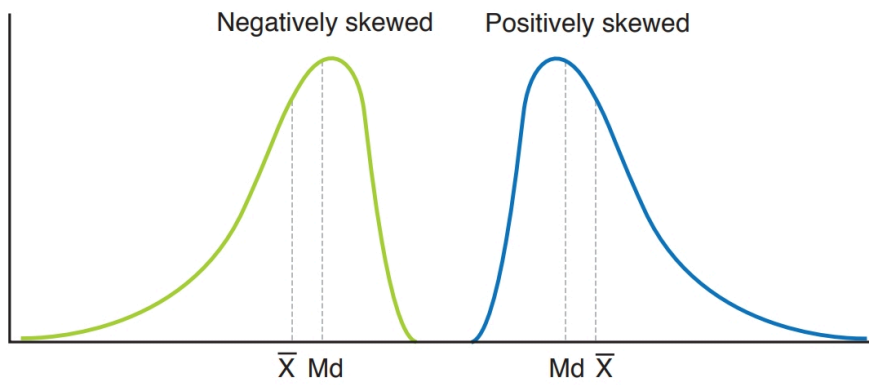


Figure I-2-3. Skewed Distribution Curves

### Measures of variability

The simplest measure of variability in statistics is the **range**, the difference between the highest and the lowest score. However, the range is unstable and can change easily. A more stable and more useful measure of dispersion is the **standard deviation (S or SD)**. To calculate the SD:

- First subtract the mean from each score to obtain **deviations from the mean**. This will give us both positive and negative values.
- Then square the deviations to make them all positive.
- Add the squared deviations together and divide by the number of cases.
- Take the square root of this average, and the result is the SD:

$$s = \sqrt{\frac{\sum(X - \bar{X})^2}{n - 1}}$$

The square of the SD ( $s^2$ ) equals the **variance**.

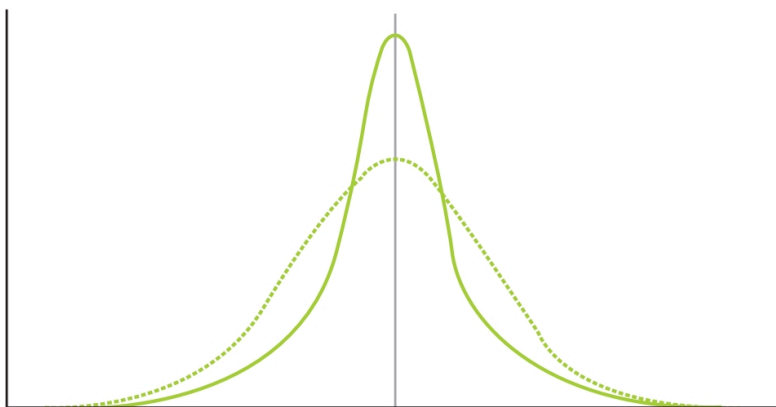
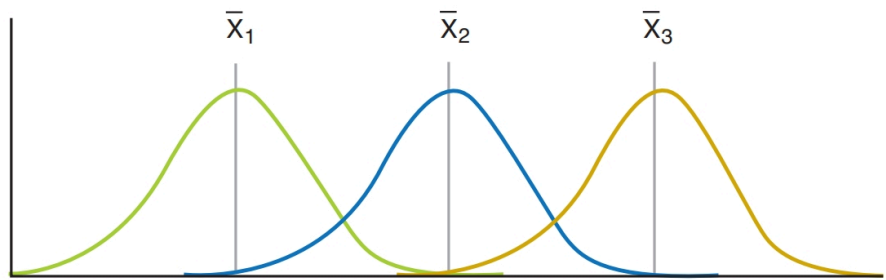


Figure I-2-4. Two Normal Curves with the Same Mean but Different SDs

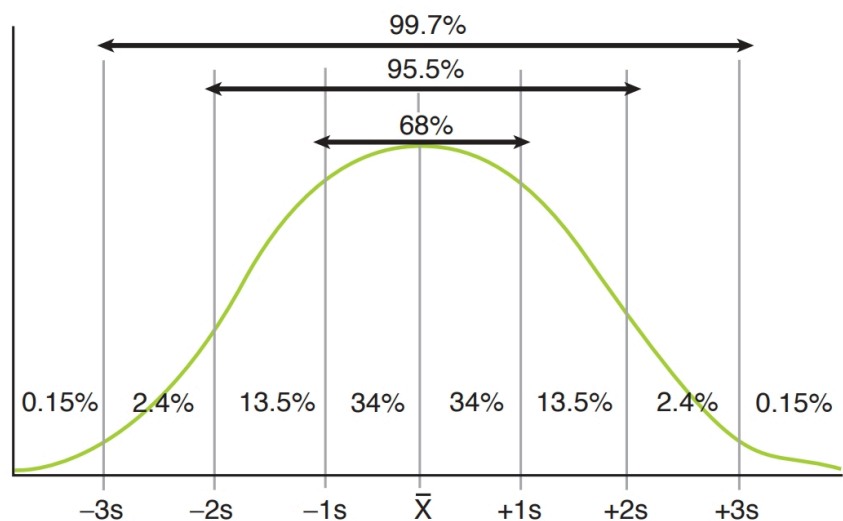
**NOTE**

On the exam you will not be asked to calculate SD and variance, but you will need to understand how they relate to the normal curve. Also, be able to combine the given SD constants to answer basic questions.



**Figure I-2-5.** Three Normal Curves with Same SD but Different Means

In any normal curve, a constant proportion of the cases fall within 1, 2, and 3 SDs of the mean: within 1 SD 68%; within 2 SDs 95.5%; and within 3 SDs 99.7%.



**Figure I-2-6.** Percentage of Cases within 1, 2, and 3 SDs of the Mean in a Normal Distribution

**Review Questions**

5. In a normal distribution curve, what percent of the cases are below 2 SDs below the mean?
6. In a normal distribution curve, what percent of the cases are above 1 SD below the mean?
7. A student who scores at the 97.5 percentile falls where on the curve?
8. A student took 2 tests: On test A his results were score 45%, mean 30%, and SD 5%. On test B the results were score 60%, mean 40%, and SD 10%. On which test did the student do better, relative to his classmates?



## Answers and Explanations

5. **Answer:** 2.5%
6. **Answer:** 84%
7. **Answer:** 2 SDs above the mean
8. **Answer:** On test A, he scored 3 SDs above the mean versus only 2 SDs above the mean for test B.

## INFERENCEAL STATISTICS

The purpose of inferential statistics is to designate **how likely it is that a given finding is simply the result of chance**. Inferential statistics would not be necessary if investigators could study all members of a population. However, because that can rarely be done, using select samples that are representative of an entire population allows us to **generalize the results from the sample to the population**.

### Confidence Interval

Confidence interval is a way of admitting that any measurement from a sample is only an **estimate** of the population, i.e., although the estimate given from the sample is likely to be close, the true values for the population may be above or below the sample values. A confidence interval **specifies how far above or below a sample-based value the population value lies** within a given range, from a possible high to a possible low. Reality, therefore, is most likely to be somewhere within the specified range.

To calculate the confidence interval: **study result  $\pm$  Z score  $\times$  standard error**

**Study result** might be a mean, a relative risk or any other relevant measure that is the result of the data from the study itself. **Z score** depends on the level of confidence required. In medicine, the requirement is **at least a 95% confidence interval**. So the options are as follows:

- Z score for 95% confidence interval = 1.96 = 2
- Z score for 99% confidence interval = 2.58 = 2.5

While the SD measures the variability within a single sample, the **standard error** estimates the variability *between* samples. The standard error is usually provided. The smaller the standard error, the better and more precise the study. The standard error is affected by 2 factors: the SD and the sample size ( $n$ ). The greater the SD, (high variation in the data), the greater the standard error, and the larger the sample size, the smaller the standard error.

$$\text{Standard Error} = \frac{SD}{\sqrt{n}}$$



Suppose 100 students in the 9th grade have just taken their final exam, and the mean score was 64% with SD 15. The 95% confidence interval of the mean for 9th grade students in the population would be as follows:

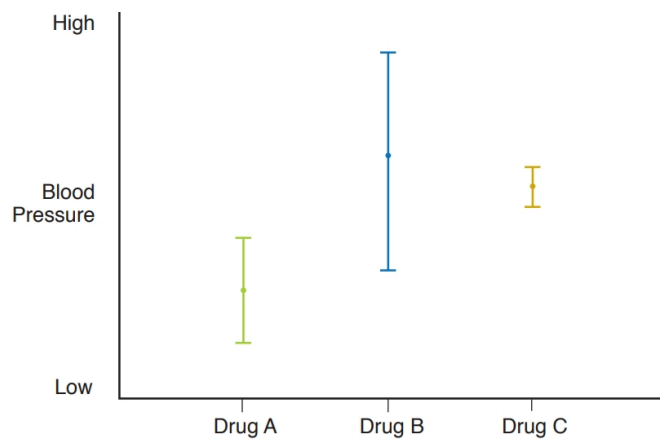
- Mean = 65
- Z score for 95% confidence = 2 (rounded up Z score)
- SD = 15
- Sample size = 100

Plug in the numbers: Mean  $\pm$  Z score  $\left(\frac{SD}{\sqrt{n}}\right)$

or  $65 \pm 2(15/10)$   $65 \pm 3$

What this means is that we are 95% sure that the mean score of 9th graders in the population will fall somewhere between 62 and 68.

Assuming the graph below presents 95% confidence intervals, which groups, if any, are statistically different from each other?



**Figure I-2-7.** Blood Pressure at End of Clinical Trial for 3 Drugs

### Recall Question

For a skewed distribution curve, what is the best representation of central tendency?

- A. Mean
- B. Mode
- C. Standard deviation
- D. Variance
- E. Median

Answer: E

When comparing 2 groups, any overlap of confidence intervals means the groups are not significantly different. If the graph represents 95% confidence intervals, drugs B and C are no different in their effects; drug B is no different from drug A and drug A has a better effect than drug C.

For the confidence interval for **relative risk and odds ratios**, consider the following: **If the given confidence interval contains 1.0, then there is no statistically significant effect of exposure.** For example:

Relative Risk	Confidence Interval	Interpretation
1.77	(1.22 – 2.45)	Statistically significant (increased risk)
1.63	(0.85 – 2.46)	NOT statistically significant (risk is the same)
0.78	(0.56 – 0.94)	Statistically significant (decreased risk)

If  $RR > 1.0$ , then subtract 1.0 and read as percent increase. So 1.77 means one group has 77% more cases than the other. If  $RR < 1.0$ , then subtract from 1.0 and read as reduction in risk. So 0.78 means one group has a 22% reduction in risk.

## Statistical Inference

The goal of science is to define reality. Think of statistics as the referee in the game of science. We have all agreed to play the game according to the judgment calls of the referee, even though we know the referee can, and will, be wrong at times. The basic steps of statistical inference are as follows:

1. Define the **research question**: What are you trying to show?
2. Define the **null hypothesis** (generally the opposite of what you hope to show). Null hypothesis says that the **findings are the result of chance or random factors**. If you want to show that a drug works, the null hypothesis will be that the drug does NOT work. The **alternative hypothesis** says what is left after defining the null hypothesis. In this example, that the drug does actually work.

There are 2 types of null hypothesis:

- **One-tailed**, i.e., directional or “one-sided,” such that one group is greater than or less than the other (Group A is not less than Group B, or Group A is not greater than Group B)
- **Two-tailed**, i.e., nondirectional or “two-sided,” such that 2 groups are not the same (Group A  $\neq$  Group B)

Once the data are collected and analyzed by the appropriate statistical test, the **hypothesis testing** is begun. How to run these tests is not tested on the exam, but you may need to be able to interpret results of statistical tests with which you are presented.

To interpret output from a statistical test, focus on the **p-value**. The term *p-value* refers to 2 things. In its first sense, the *p-value* is a standard against which we compare our results. In the second sense, the *p-value* is a result of computation. The **computed p-value is compared with the p-value criterion to test statistical significance**. If the computed value is less than the criterion, we have achieved statistical significance. In general, the smaller the *p* the better.

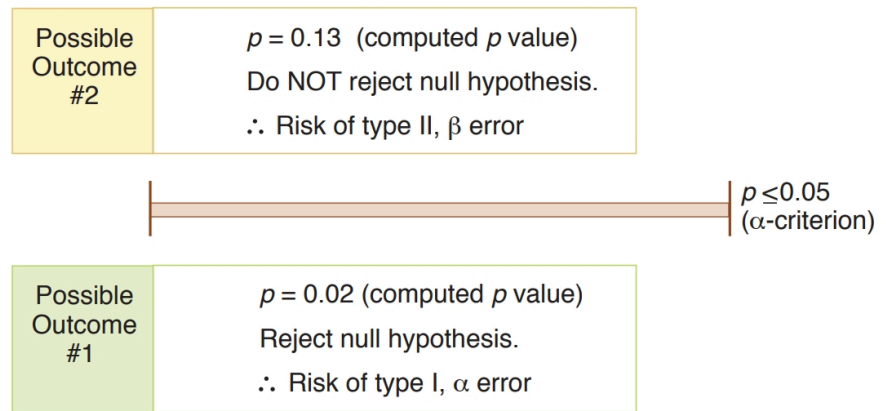
### NOTE

We never accept the null hypothesis. We either reject it or fail to reject it. Saying we do not have sufficient evidence to reject it is not the same as being able to affirm that it is true.



The  $p$ -value criterion is traditionally set at  $p \leq 0.05$ . (Assume these are the criteria if no other value is explicitly specified.) Using this standard:

- If  $p \leq 0.05$ , reject the null hypothesis (reached statistical significance).
- If  $p > 0.05$ , do not reject the null hypothesis (has not reached statistical significance).



**Figure I-2-8.** Making Decisions Using  $p$ -Values

- If  $p = 0.02$ , reject the null hypothesis, i.e., decide that the drug works.
- If  $p = 0.13$ , fail to reject the null hypothesis, i.e., decide that the drug does not work.

## NOTE

A **type I error (error of commission)** is generally considered **worse** than a type II error (error of omission).

- If the null hypothesis is rejected, there is no chance of a type II error.
- If the null hypothesis is not rejected, there is no chance of a type I error.

## Types of error

If we do reject the null hypothesis, we are still not certain we are correct, i.e., the results given by the sample may be inconsistent with the full population. If that is true, any decision made on the basis of the sample could be in error.

Two types of errors can be made:

- **Type I error ( $\alpha$  error): rejecting the null hypothesis when it is really true**
  - This type of error assumes a statistically significant effect on the basis of the sample when there is none in the population, e.g., asserting that the drug works when it doesn't.
  - The chance of type I error is given by the  $p$ -value; if  $p = 0.05$ , then the chance of a type I error is 5 in 100, or 1 in 20 if we reject the null hypothesis based on the evidence of the data.
- **Type II error ( $\beta$  error): failing to reject the null hypothesis when it is really false**
  - This type of error declares no significant effect on the basis of the sample when there really is one in the population, e.g., asserting the drug does not work when it really does.
  - The chance of a type II error cannot be directly estimated from the  $p$ -value.



The **p-value** here does a few things:

- Provides criterion for making decisions about the null hypothesis
- Quantifies the chance that a decision to reject the null hypothesis will be wrong
- Tells statistical significance, not clinical significance or likelihood of benefit

The **p-value** **does not** tell us the following:

- Chance that an individual patient will benefit
- Percentage of patients who will benefit
- Degree of benefit expected for a given patient

### Statistical power

In statistics, **power** is the capacity to detect a difference if there is one. Just as increasing the power of a microscope makes it easier to see what is going on in histology, increasing statistical power allows us to detect what is happening in the data.

Power is directly related to type II error.

$$\text{Power} = 1 - \beta$$

There are several ways to increase statistical power. The most common is to increase sample size.

Reality			
Research	Drug Works		Drug Does Not Work
	Reject	Power	Type I Error
	Not Reject	Type II Error	

**NOTE**

For the exam, focus on **nominal** and **interval** scales.

**SCALE**

To convert the world into numbers, we use 4 types of scale: nominal, ordinal, interval, and ratio. Scales of measurement refer to ways in which numbers are categorized.

**Table I-2-1. Types of Scale in Statistics**

Type of Scale	Description	Key Words	Examples
<b>Nominal (Categorical)</b>	Different groups	This or that	Gender, comparing among treatment interventions
<b>Ordinal</b>	Groups in sequence	Comparative quality, rank order	Olympic medals, class rank in medical school
<b>Interval</b>	Exact differences among groups	Quantity, mean, and standard deviation	Height, weight, blood pressure, drug dosage
<b>Ratio</b>	Interval + true zero point	Zero means zero	Temperature measured in degrees Kelvin

The scales as described below are hierarchically arranged, from **least information** provided (nominal) to **most information** provided (ratio). Any scale can be degraded to a lower scale, e.g., interval data can be treated as ordinal.

- **Nominal scale** puts people into categories without specifying the relationship between the categories
  - Example is gender, with 2 groups (male and female); other examples include drug versus control group
  - Anytime you can say, “It’s either this or that,” it is nominal scale
- **Ordinal scale** (or rank order) puts people into categories and specifies the relationship between them (quality)
  - What is not known is *how* different the categories are (quantity)
  - Example is saying Ben is taller than Fred; other examples include class rank in medical school and Olympic medals
- **Interval scale** (or numeric scale) uses a scale graded in equal increments
  - Allows us to say not only that 2 things are different, but also by *how much*
  - If a measurement has a mean and an SD, treat it as an interval scale
  - Example is the scale of length: we know that 1 inch is equal to any other inch
- **Ratio scale (best measure)** orders things and contains equal intervals, but also has a **true zero point**
  - Zero is a floor, i.e., you can’t go any lower
  - Example is measuring temperature using Kelvin scale

**Recall Question**

Assuming that the cutoff for statistical significance is 0.01 for a given set of data, what is the likelihood for a type I error to occur?

- A. 5 in 100
- B. 5 in 1,000
- C. 1 in 1,000
- D. 1 in 100
- E. Cannot be determined as the power has not been given

Answer: D

**STATISTICAL TESTS**

Selecting the correct statistical test for a research project will depend on the nature of the variables being studied.

**Table I-2-2. Types of Scale and Basic Statistical Tests**

Name of Statistical Test	Interval	Variables	
		Nominal	Comment
Pearson correlation	2	0	Is there a linear relationship?
Chi-square	0	2	Any # of groups
t-test	1	1	2 groups only
One-way ANOVA	1	1	2 or more groups
Matched pairs t-test	1	1	2 groups, linked data pairs, before and after
Repeated measures ANOVA	1	1	More than 2 groups, linked data

ANOVA = Analysis of Variance

**Correlation ( $r$ ,  $-1.0$  to  $+1.0$ )**

Correlation, by itself, does not mean causation. A correlation coefficient indicates the degree to which 2 measures are related, not *why* they are related. In other words, it does not mean that one variable necessarily causes the other.

There are 2 types of correlation:

- **Pearson correlation:** compares 2 interval level variables
- **Spearman correlation:** compares 2 ordinal level variables

A **positive value** means that 2 variables go together in the same direction, e.g., MCAT scores have a positive correlation with medical school grades.

**NOTE**

Remember, your **default choices** are:

- Correlation for interval data
- Chi-square for nominal data
- t-test for a combination of nominal and interval data



**NOTE**

On the exam you will not be asked to compute statistical tests, but do recognize how and when they should be used.

You should, however, be able to interpret **scatterplots of data**: positive slope, negative slope, and which of a set of scatterplots indicates a stronger correlation.

A **negative value** means that the **presence of one variable is associated with the absence of another variable**, e.g., there is a negative correlation between age and quickness of reflexes.

The further from zero, the stronger the relationship ( $r = 0$ ). A **zero correlation** means that **2 variables have no linear relation to one another**, e.g., height and success in medical school.

Correlation can be graphed using a scatterplot, which shows points that approximate a line.

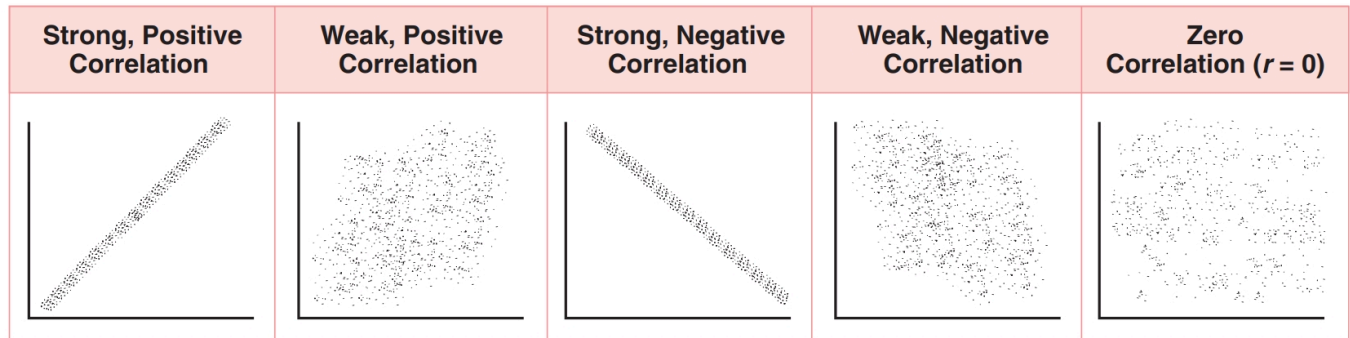


Figure I-2-9. Scatterplots and Correlations

**t-test**

A *t*-test **compares the means of 2 groups** from a single nominal variable, using means from an interval variable to see whether the groups are different. The output of a *t*-test is a “*t*” statistic. It is used for 2 groups only, i.e., compares 2 means. For example, do patients with MI who are in psychotherapy have a reduced length of convalescence compared with those who are not in therapy?

- **Pooled *t*-test** is a regular *t*-test, assuming the variances of the 2 groups are the same
- **Matched pairs *t*-test** involves matching each person in one group with a person in a second group; applies to before-and-after measures and linked data

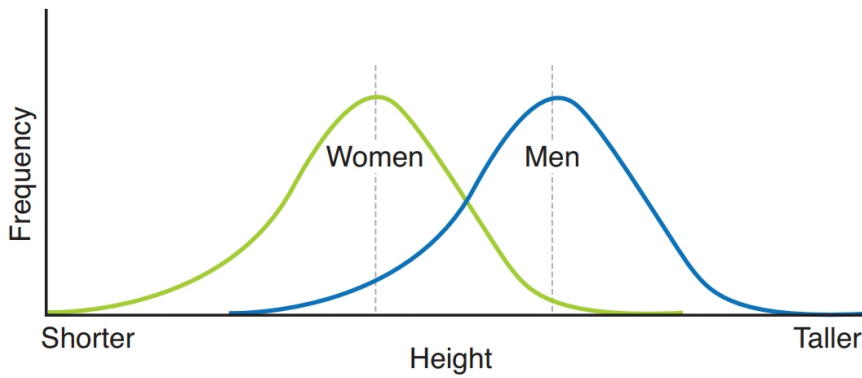


Figure I-2-10. Comparison of the Distributions of 2 Groups

## Analysis of Variance (ANOVA)

Output from an ANOVA is  $\geq 1$  F-statistics.

- **One-way ANOVA** compares means of many groups ( $\geq 2$ ) of a single nominal variable using an interval variable. A significant  $p$ -value means that at least 2 of the tested groups are different.
- **Two-way ANOVA** compares means of groups generated by 2 nominal variables using an interval variable. It can test the effects of several variables at the same time.
- **Repeated measures ANOVA** features multiple measurements of the same people over time.

## Chi-square

A *chi-square* tests to see whether 2 nominal variables are independent, i.e., in order to test the efficacy of a new drug, compare the number of recovered patients given the drug with those who were not. *Chi-square* features nominal data only, and any number of groups ( $2 \times 2$ ,  $2 \times 3$ ,  $3 \times 3$ , etc.).

Table I-2-3. *Chi-Square* Analysis for Nominal Data

	New Drug	Placebo	Totals
Recovered	45	35	80
Not Recovered	15	25	40
<b>Totals</b>	60	60	120



## Review Questions

9. A recent study finds a higher incidence of SIDS for children of mothers who smoke. If the rate for smoking mothers is 230/100,000 and the rate for nonsmoking mothers is 71/100,000, what is the relative risk for children of mothers who smoke?
- A. 159
  - B. 32
  - C. 230
  - D. 3.2
  - E. 8.4
10. A researcher wishing to demonstrate the efficacy of a new treatment for hypertension compares the effects of the new treatment versus a placebo. This study provides a test of the null hypothesis that the new treatment has no effect on hypertension. In this case, the null hypothesis should be considered as
- A. positive proof that the stated premise is correct.
  - B. the assertion of a statistically significant relationship.
  - C. the assumption that the study design is adequate.
  - D. the probability that the relationship being studied is the result of random factors.
  - E. the result the experimenter hopes to achieve.
11. A standardized test was used to assess the level of depression in a group of patients on a cardiac care unit. The results yielded a mean of 14.60 with confidence interval of 14.55 and 14.65. This presented confidence interval is
- A. less precise, but has a higher confidence than 14.20 and 15.00.
  - B. more precise, but has a lower confidence than 14.20 and 15.00.
  - C. less precise, but has a lower confidence than 14.20 and 15.00.
  - D. more precise, but has a higher confidence than 14.20 and 15.00.
  - E. indeterminate, because the degree of confidence is not specified.

12. A recently published report explored the relationship between height and subjects' self-reported cholesterol levels in a sample of 44- to 65-year-old men. The report included a correlation of  $+0.02$ , computed for the relationship between height and cholesterol level. One of the possible interpretations of this correlation is:
- The statistic proves that there is no definable relationship between the two specified variables.
  - There is a limited causal relationship between the two specified variables.
  - A real-life relationship may exist, but the measurement error is too large.
  - A scatterplot of the data will show a clear linear slope.
  - The correlation is significant at the 0.02 level.

### Questions 13–15

The Collaborative Depression study examined several factors impacting the detection and treatment of depression. One primary focus was to develop a biochemical test for diagnosing depression. For this research, a subpopulation of 300 persons was selected and subjected to the dexamethasone suppression test (DST). The results of the study are as follows:

	Actual Depression	
	NO	YES
<b>DST Results</b>		
Depressed	87	102
Nondepressed	63	48

13. Which of these ratios measures specificity?
- 102:150
  - 102:189
  - 63:150
  - 87:150
  - 63:111
14. Which of these ratios measures positive predictive value?
- 102:150
  - 102:189
  - 63:150
  - 87:150
  - 63:111



15. Which of these ratios measures sensitivity?
- A. 102:150
  - B. 102:189
  - C. 63:150
  - D. 87:150
  - E. 63:111
16. Initial research supported a conclusion that a positive relationship exists between coffee consumption and heart disease. However, subsequent, more extensive research suggests that the initial conclusion was the result of a type I error. In this context, a type I error
- A. means there is no real-life significance, but statistical significance is found.
  - B. suggests that the researcher has probably selected the wrong statistical test.
  - C. results from a nonexclusionary clause in the null hypothesis.
  - D. indicates that the study failed to detect an effect statistically, when one is present in the population.
  - E. has a probability in direct proportion to the size of the test statistic.
17. A survey of a popular seaside community (population 1,225) found the local inhabitants to have unusually elevated blood pressure. In this survey, just over 95% of the population had systolics between 110 mm Hg and 190 mm Hg. Assuming a normal distribution for these assessed blood pressures, the standard deviation for systolic blood pressure in this seaside community is most likely
- A. 10
  - B. 20
  - C. 30
  - D. 40
  - E. 50
18. A report of a clinical trial of a new drug for herpes simplex 2 versus a placebo noted that the new drug gave a higher proportion of success than the placebo. The report ended with the statement: *chi-square* = 4.72,  $p < 0.05$ . In light of this information, we may conclude that
- A. fewer than 1 in 20 will fail to benefit from the drug.
  - B. the chance that an individual patient will fail to benefit is less than 0.05.
  - C. if the drug were effective, the probability of the reported finding is less than 1 in 20.
  - D. if the drug were ineffective, the probability of the reported finding is less than 0.05.
  - E. the null hypothesis is false.



19. A recent study was conducted to assess the intelligence of students enrolled in an alternative high school program. The results showed the IQs of the students distributed according to the normal curve, with a mean of 115 and a standard deviation of 10. Based on this information it is most reasonable to conclude that
- 50% of the students will have an IQ below the standard mean of 100.
  - 5% of the students will have IQs below 105.
  - students with IQs of 125 are at the 84th percentile.
  - 2.5% of the students will have IQs greater than 125.
  - all of the students' scores fall between 85 and 135.
20. A correlation of  $+0.56$  is found between alcohol consumption and systolic blood pressure in men. This correlation is significant at the 0.001 level. From this information we may conclude that:
- There is no association between alcohol consumption and systolic pressure.
  - Men who consume less alcohol are at lower risk for increased systolic pressure.
  - Men who consume less alcohol are at higher risk for increased systolic pressure.
  - High alcohol consumption can cause increased systolic pressure in men.
  - High systolic pressure can cause increased alcohol consumption in men.

### Questions 21–23

To assess the effects of air pollution on health, a random sample of 250 residents of Denver, Colorado, were given thorough checkups every 2 years. This same procedure was followed on a matched sample of persons living in Fort Collins, Colorado, a smaller town located about 60 miles north. Some of the results, presented as percent mortality, are displayed in the table below.

**Cumulative Mortality in 2 Communities Over 10 Years**

	1975	1977	1979	1981	1983	1985
Denver	4%	6%	10%	15%	22%	28%
Fort Collins	2%	3%	7%	10%	12%	14%

21. This type of study can be best characterized as a
- cross-sectional study
  - clinical case trial design
  - cross-over study
  - cohort study
  - case-control study



22. According to the data presented in the table, the cumulative relative risk for living in Denver by the year 1981 was
- A. 0.67
  - B. 5%
  - C. 1.5
  - D. 2.0
  - E. 1.33
23. What statistical test would you run to test whether there was a difference between the cumulative mortality rate for Denver and Fort Collins in 1985?
- A. *t*-test
  - B. ANOVA
  - C. Regression
  - D. Correlation coefficient
  - E. *Chi*-square
24. A study is conducted to examine the relationship between myocardial infarction and time spent driving when commuting to and from work. Selection was made of 100 married men who had suffered infarcts and a comparison group of 100 married men who had not suffered infarcts. For both groups their average commuting time was recorded (in cases where the infarct had been fatal, the spouse provided the commuting time). When examining this data for a possible causal relationship between commuting time and the occurrence of myocardial infarct, the most likely measure of association is
- A. odds ratio.
  - B. relative risk.
  - C. incidence rate.
  - D. attributable risk.
  - E. correlation coefficient.
25. A particular association determines membership based on members' IQ scores. Only those people who have documented IQ scores at least 2 SDs above the mean on the Wechsler Adult Intelligence Scale, Revised (WAIS-R), are eligible for admission. Out of a group of 400 people randomly selected from the population at large, how many would be eligible for membership in this society?
- A. 2
  - B. 4
  - C. 6
  - D. 8
  - E. 10

26. A physician wishes to study whether moderate alcohol consumption is associated with heart disease. If, in reality, moderate alcohol consumption leads to a relative risk of heart disease of 0.60, the physician wants to have a 95% chance of detecting an effect this large in the planned study. This statement is an illustration of specifying
- A. alpha error.
  - B. beta error.
  - C. a null hypothesis.
  - D. criterion odds.
  - E. statistical power.
27. Public health officials were examining a suspicious outbreak of diarrhea in a community child-care center. Center workers identified children with diarrhea and all children at the center were studied. Officials discovered that children who drank liquids from a bottle were more likely to have diarrhea than children who drank from a glass. They concluded that drinking from unclean bottles was the cause of the outbreak. The use of bottles was subsequently banned from the center. The outbreak subsided. Which of the following is the most likely source of bias in this study?
- A. Recall bias
  - B. Lead-time bias
  - C. Measurement bias
  - D. Confounding
  - E. Random differences as to the identification of diarrhea
28. Suicides in teenagers in a small Wisconsin town had been a rare event before 11 cases were recorded in 1994. This unusual occurrence led to the initiation of an investigation to try to determine the reason for this upsurge. The researchers suspect that the suicides are linked to the increasing numbers of new families who have recently moved to the town. The best type of study to explore this possibility would likely be a
- A. cohort study.
  - B. case-control study.
  - C. cross-over study.
  - D. cross-sectional study.
  - E. community trial study.

**Questions 29–38**

Which statistical test will most likely be used to analyze the data?

29. Comparing the blood sugar levels of spouses
- A. *t*-test
  - B. *Chi*-square test
  - C. One-way ANOVA
  - D. Two-way ANOVA
  - E. Pearson correlation
  - F. Matched pairs *t*-test
30. Comparing the number of staff who do or do not call in sick for each of 3 different nursing shifts
- A. *t*-test
  - B. *Chi*-square test
  - C. One-way ANOVA
  - D. Two-way ANOVA
  - E. Pearson correlation
  - F. Matched pairs *t*-test
31. Relationship between time spent on studying and test score
- A. *t*-test
  - B. *Chi*-square test
  - C. One-way ANOVA
  - D. Two-way ANOVA
  - E. Pearson correlation
  - F. Matched pairs *t*-test
32. A researcher believes that boys with same-sex siblings are more likely to have higher testosterone levels.
- A. *t*-test
  - B. *Chi*-square test
  - C. One-way ANOVA
  - D. Two-way ANOVA
  - E. Pearson correlation
  - F. Matched pairs *t*-test

33. A physician believes that drawing blood is faster with a vacutainer for someone once that person is trained, but faster with a standard syringe for someone with no training.
- A. *t*-test
  - B. *Chi*-square test
  - C. One-way ANOVA
  - D. Two-way ANOVA
  - E. Pearson correlation
  - F. Matched pairs *t*-test
34. Twenty rats are coated with margarine and 20 with butter as part of a study to explore the carcinogenic effects of oleo.
- A. *t*-test
  - B. *Chi*-square test
  - C. One-way ANOVA
  - D. Two-way ANOVA
  - E. Pearson correlation
  - F. Matched pairs *t*-test
35. To assess the efficacy of surgical interventions for breast cancer, the quality of life, measured on a 10-point scale, of 30 women who underwent radical mastectomies was compared with 30 women who received radiation treatments and 15 women who refused any medical intervention.
- A. *t*-test
  - B. *Chi*-square test
  - C. One-way ANOVA
  - D. Two-way ANOVA
  - E. Pearson correlation
  - F. Matched pairs *t*-test
36. Comparison of passing and failure rates at each of 3 test sites.
- A. *t*-test
  - B. *Chi*-square test
  - C. One-way ANOVA
  - D. Two-way ANOVA
  - E. Pearson correlation
  - F. Matched pairs *t*-test





37. Comparison of actual measured test scores for students at each of 3 test sites.
- A. *t*-test
  - B. *Chi*-square test
  - C. One-way ANOVA
  - D. Two-way ANOVA
  - E. Pearson correlation
  - F. Matched pairs *t*-test
38. Assessing changes in blood pressure for a group of 30 hypertensives 1 week before and 3 months after beginning a course of antihypertensive medication.
- A. *t*-test
  - B. *Chi*-square test
  - C. One-way ANOVA
  - D. Two-way ANOVA
  - E. Pearson correlation
  - F. Matched pairs *t*-test
39. In a study of chemical workers, 400 workers with respiratory disease and 150 workers without respiratory disease were selected for examination. The investigators obtained a history of exposure to a particular solvent in both groups of workers. Among workers with the respiratory disease, 250 gave a history of exposure to the solvent, compared to 50 of the workers without respiratory disease. The study design can best be described as a
- A. case-control study.
  - B. cohort study.
  - C. cross-sectional study.
  - D. community trial.
  - E. comparative clinical trial.
40. The air quality is assessed in two Midwestern cities, one in which a government program has instituted reducing the amount of carbon monoxide emissions allowed, and one without the government program. The rates of respiratory problems in both cities are recorded over a 5-year period. Given the design of this study, an appropriate one-tailed null hypothesis would be
- A. air quality is related to respiratory problems in both of the cities under study.
  - B. air quality is related to respiratory problems in the city with the government program but not in the other city.
  - C. no evidence will be found for differences in air quality between the two cities.
  - D. the rate of respiratory problems in the city with the government program will not be any lower than that of the other city.
  - E. air quality will be inversely related to the rate of respiratory problems in both cities.

## Answers and Explanations

9. **Answer: D.** Relative risk means divide, compute the ratio between the 2 groups.  $[230/71 = 3.2]$
10. **Answer: D.** This is a definition question. Null hypothesis is a statement of chance, the opposite of what the researcher hopes to find.
11. **Answer: B.** A smaller interval is more precise but less confident. Precise means *narrower* interval. 95% confidence yields a smaller interval than 99% confidence.
12. **Answer: C.** One reason for a near-zero correlation is that the error of measurement is so large that it obscures an underlying relationship. It shows no linear relationship and does not mean cause. The number given is the coefficient, not the *p*-value.
13. **Answer: C.** True negatives, out of all nondiseased.  $[TN/(TN + FP)] = [63/(87 + 63)]$ .
14. **Answer: B.** True positives, out of all positives.  $[TP/(TP + FP)] = [102/(102 + 87)]$ .
15. **Answer: A.** True positives, out of all diseased.  $[TP/(TP + FN)] = [102/(102 + 48)]$ .
16. **Answer: A.** A type I error means the researcher rejected the null hypothesis but should not have. This means that although statistical significance is found, there is no real-world significance. By reversing the clauses in the answer, the correct answer becomes more apparent. Answer choice (D) is a good definition of a type II error.
17. **Answer: B.** If 95% of cases fall between 110 and 190 and the distribution is symmetrical, then the mean must be 150, and the numbers given are 2 standard deviations above and below the mean. This means that 2 standard deviations must equal 40 and that one standard deviation equals 20.
18. **Answer: D.** The key here is the “*p*-value.” Ignore the *chi*-square value. If less than 0.05, this gives the chance of a type I error. Therefore, the probability of the finding if the drug was ineffective.
19. **Answer: C.** This is 1 standard deviation above the mean:  $[115 + 10]$ . Below this point are 84% of the cases using the normal curve.
20. **Answer: B.** The given correlation is statistically significant at the 0.001 level and can therefore be interpreted. It is a positive correlation, suggesting that high goes with high and low goes with low. Avoid answers which suggest a causal relationship.
21. **Answer: D.** People in the two communities are followed forward in time, and incidence (mortality) is the outcome.
22. **Answer: C.** The key is to focus only on 1981. Relative risk means divide.  $[15\%/10\% = 1.5]$  or 1.5 times the risk.
23. **Answer: E.** Denver versus Fort Collins is one nominal variable with two groups. Dead versus alive is the second nominal variable. Two nominal variables with  $n > 25 = \text{chi-square}$ .



24. **Answer: A.** This is a case-control study (infarcts versus no infarcts). Therefore, use an odds ratio. The data is not incidence data, so relative risk does not apply.
25. **Answer: E.** The IQ is scaled to have a mean of 100 and a standard deviation of 15. What percent of the cases are more than two standard deviations above the mean? (2.5%) Therefore, what is 2.5% of 400? (10)
26. **Answer: E.** Power is the chance of detecting a difference in the study if there really is a difference in the real world. The question tells us what chance the researcher will have of finding a difference.
27. **Answer: D.** Bottle versus glass is confounded with age or maturity. The other options, while possible, are unlikely.
28. **Answer: B.** Select suicide cases and compare with nonsuicides (controls).
29. **Answer: F.** Blood sugar levels are ratio data, treated as interval data. Husbands and wives are nominal, but are linked nonindependent, matched pairs; therefore, matched pairs *t*-test.
30. **Answer: B.** Staff either call in sick or do not (nominal variable) over 3 shifts (nominal variable). Two nominal variables with a  $2 \times 3$  design, *chi*-square.
31. **Answer: E.** "Is there a relationship?" between 2 interval level variables. Pearson correlation.
32. **Answer: A.** Same sex versus no same sex (nominal variable). Testosterone level is assessed as ratio and treated as interval. Therefore, simple *t*-test.
33. **Answer: D.** Vacutainer versus standard syringe (nominal), training versus no training (nominal), and time (interval). Two nominal and one interval two-way ANOVA.
34. **Answer: B.** Margarine versus butter (nominal), cancer versus no cancer (nominal). Therefore, *chi*-square.
35. **Answer: C.** There are 3 types of treatment: surgery, radiation, and none (nominal variable, 3 groups), quality of life on the given scale (interval). Therefore, one-way ANOVA.
36. **Answer: B.** Passing versus failure (nominal), 3 sites (nominal). Therefore, *chi*-square.
37. **Answer: C.** Three sites (nominal) with actual test scores (interval). Therefore, one-way ANOVA.
38. **Answer: F.** Before and after (nominal, two-groups, matched pairs), and blood pressure (interval). Therefore, matched pairs *t*-test.
39. **Answer: A.** Respiratory (cases) versus nonrespiratory disease (controls), looking at history.
40. **Answer: D.** The correct statement needs to be a one-directional statement of no effect. "Not be any lower than" satisfies this criterion.

## **PART II**

# **BEHAVIORAL SCIENCE**





# Developmental Life Cycle

## 3

### LEARNING OBJECTIVES

- ❑ Demonstrate understanding of stages and milestones of development
- ❑ Answer questions about sexuality and gender identity
- ❑ Demonstrate understanding of aging and issues of death and bereavement

### STAGES OF DEVELOPMENT

Development occurs along multiple lines: physical, cognitive, intellectual, and social.

#### Newborns

Newborns have certain preferences:

- Large, bright objects with lots of contrast
- Moving objects
- Curves vs. lines
- Complex vs. simple designs
- Facial stimuli

**Table II-3-1. Newborn Reflexes**

Reflex	Features	Onset	Extinction	CNS Origin
Moro (startle)	Rapid extension of arms and opening of hands when child is startled	Birth	5 months	Brain stem/vestibular nuclei
Grasp	Fingers curl around object placed in hand	Birth	5 months	Brain stem/vestibular nuclei
Rooting	Baby turns face toward direction of touch and begins to make sucking motions	Birth	5 months	Brain stem/trigeminal
Babinski	<ul style="list-style-type: none"><li>• Not pathological in newborns</li><li>• Stroking bottom of foot causes the toe to move upward instead of downward; normal in adults</li></ul>	Birth	1 year	Spinal cord



## Milestones

Skills achieved by a certain age are called **milestones**, which are normative markers at median ages.

Figure Copied	Approximate Age	Figure Copied	Approximate Age
○ Circle	3	□ Square	5
✚ Cross	4	△ Triangle	6
▭ Rectangle	4½	◇ Diamond	7

**Figure II-3-1.** Figures Copied and Approximate Ages

### NOTE

**Stranger anxiety** is distress in the presence of unfamiliar people.

- Peaks at age 8 months
- Can last until age 1 year

**Separation anxiety** is distress following separation from a caretaker.

- Onset at age 8 months
- Can last until age 2 years

Some children develop more slowly while others develop more quickly, so milestones are approximate and do not have to occur concomitantly. Thus, a child may match the milestones for cognitive development but show slower growth in the social area.

**Table II-3-2. Child Development Milestones**

Age	Physical and Motor Developments
First year of life	<ul style="list-style-type: none"><li>• Puts everything in mouth</li><li>• Sits with support (4 mo)</li><li>• Stands with help (8 mo)</li><li>• Crawls, fear of falling (9 mo)</li><li>• Pincer grasp (10 mo)</li><li>• Follows objects to midline (4 wk)</li><li>• One-handed approach/grasp of toy</li><li>• Feet in mouth (5 mo)</li><li>• Bang and rattle stage</li><li>• Changes hands with toy (6 mo)</li></ul>
Age 1	<ul style="list-style-type: none"><li>• Walks alone (13 mo)</li><li>• Climbs stairs alone (18 mo)</li><li>• Emergence of hand preference (18 mo)</li><li>• Kicks ball, throws ball</li><li>• Pats pictures in book</li><li>• Stacks 3 cubes (18 mo)</li></ul>

Age	Physical and Motor Developments
Age 2	<ul style="list-style-type: none"> <li>• High activity level</li> <li>• Walks backward</li> <li>• Can turn doorknob, unscrew jar lid</li> <li>• Scribbles with crayon</li> <li>• Stacks 6 cubes (24 mo)</li> <li>• Stands on tiptoes (30 mo)</li> <li>• Able to aim thrown ball</li> </ul>
Age 3	<ul style="list-style-type: none"> <li>• Rides tricycle</li> <li>• Stacks 9 cubes (36 mo)</li> <li>• Alternates feet going up stairs</li> <li>• Bowel and bladder control (toilet training)</li> <li>• Draws recognizable figures</li> <li>• Catches ball with arms</li> <li>• Cuts paper with scissors</li> <li>• Unbuttons buttons</li> </ul>
Age 4	<ul style="list-style-type: none"> <li>• Alternates feet going down stairs</li> <li>• Hops on one foot</li> <li>• Grooms self (brushes teeth)</li> <li>• Counts fingers on hand</li> </ul>
Age 5	<ul style="list-style-type: none"> <li>• Complete sphincter control</li> <li>• Brain at 75% of adult weight</li> <li>• Draws recognizable man with head, body, and limbs</li> <li>• Dresses and undresses self</li> <li>• Catches ball with 2 hands</li> </ul>

## Cognitive Development Theories

**Table II-3-3. Cognitive Development Theories**

Age	Erikson	Freud	Piaget
Birth–2 years	Trust vs. mistrust <ul style="list-style-type: none"> <li>• Develop feeling of trust that their wants will be satisfied</li> <li>• If parent is not attentive, will learn to mistrust</li> </ul>	Oral <ul style="list-style-type: none"> <li>• Mouth is the main site of gratification; manifested by chewing, biting, and sucking</li> </ul>	Sensorimotor <ul style="list-style-type: none"> <li>• Begin to learn through sensory observation</li> <li>• Gain control of motor functions through activity, exploration, and manipulation of the environment</li> <li>• Achieve object permanence</li> </ul>



Age	Erikson	Freud	Piaget
2–4 years	<p>Autonomy vs. shame/doubt</p> <ul style="list-style-type: none"> <li>• Have sense of mastery over themselves and their drives; can be cooperative or stubborn</li> <li>• Gain a sense of separateness from others</li> <li>• Lack of appropriate autonomy can cause shame/doubt to undermine free will</li> </ul>	<p>Anal</p> <ul style="list-style-type: none"> <li>• Anus and surrounding area is main site of gratification; primarily involved in bowel functions and bladder control</li> <li>• If harsh toilet training, may become “anally fixated” (obsessive-compulsive personality disorder)</li> </ul>	<p>Preoperational</p> <ul style="list-style-type: none"> <li>• Use symbols and language more extensively</li> <li>• Are egocentric, use animistic thinking, think irreversibly, have a lack of hierarchy, and have a sense of imminent justice</li> <li>• See death as reversible</li> <li>• Lack the law of conservation</li> </ul>
4–6 years	<p>Initiative vs. guilt</p> <ul style="list-style-type: none"> <li>• Initiate both motor and intellectual activity</li> <li>• Start to become sexually curious</li> <li>• Start to develop sibling rivalry</li> <li>• Guilt is present over the drive for conquest and anxiety over failure</li> </ul>	<p>Phallic</p> <ul style="list-style-type: none"> <li>• Genital area is main site of gratification</li> <li>• Penis envy and fear of castration are evident</li> <li>• Increase in genital masturbation with fantasies involving opposite-sex parent (“Oedipal complex”)</li> </ul>	
6–12 years	<p>Industry vs. inferiority</p> <ul style="list-style-type: none"> <li>• Enter programs of learning; able to work and acquire adult skills</li> <li>• Learn they are able to master and complete a task</li> </ul>	<p>Latency</p> <ul style="list-style-type: none"> <li>• Formation of the superego; resolution of the Oedipal complex</li> <li>• Sexual interests during this period are believed to be quiescent</li> <li>• Sublimation of sexual energy into energetic learning and play activities</li> </ul>	<p>Concrete operational</p> <ul style="list-style-type: none"> <li>• Replace egocentricity with operational thought, thus can see things through others’ perspectives</li> <li>• See death as irreversible (age 10)</li> <li>• Have the law of conservation</li> </ul>
Teenage years	<p>Identity vs. role confusion</p> <ul style="list-style-type: none"> <li>• Develop group identity</li> <li>• Develop preoccupation with appearances</li> <li>• Begin to deal with morality and ethics</li> <li>• Experience “identity crisis” at end of this stage (which Piaget called normative)</li> </ul>	<p>Genital</p> <ul style="list-style-type: none"> <li>• Capacity for true intimacy</li> </ul>	<ul style="list-style-type: none"> <li>• Formal operational abstract thinking acquired</li> </ul>
Early adulthood	<p>Intimacy vs. isolation</p> <ul style="list-style-type: none"> <li>• Experience intimacy of sexual relations and friendships (all deep associations are present)</li> <li>• Develop an ability to care and share with others without fear of losing self</li> </ul>		

Age	Erikson	Freud	Piaget
Middle adulthood	Generativity vs. stagnation <ul style="list-style-type: none"> <li>• Have and raise children, as well as other interests outside the home</li> <li>• If have no children, develop sense of altruism and creativity</li> <li>• Stagnation can take the form of escapism such as mid-life crisis or substance abuse issues</li> </ul>		
Late adulthood	Integrity vs. despair <ul style="list-style-type: none"> <li>• Experience sense of satisfaction with one's life; allows for an acceptance of one's place in life cycle</li> <li>• Despair involves deep disgust of the external world and other persons to mask a fear of death</li> </ul>		

### Recall Question

According to Freudian theory, at what age do the first signs of obsessive-compulsive personality disorder first emerge?

- A. Birth to age 2
- B. Age 2–4
- C. Age 4–6
- D. Age 6–12
- E. Teenage years

Answer: B

## SEXUALITY

**Gender identity** is a child's sense of maleness or femaleness. It is established by age 3. **Sexual identity** is determined by secondary sexual characteristics.

- **Gender dysphoria** is a “disconnect” between gender identity and sexual identity. Boys > girls.
- **Gender role** is determined by behaviors exhibited by a child. It can be congruent or incongruent to the child's gender identity (usually congruent).





**Sexual orientation** is determined by gender identity and attraction to other gender identities:

- Homosexuality: same gender identity (can be ego-syntonic or ego-dystonic; when ego-dystonic, is pathological)
- Heterosexuality: opposite gender identity
- Bisexuality: either gender identity
- Asexuality: neither gender identity

Masturbation is normal at all ages and equal in both genders. When it interferes with normal functioning, it is pathological.

Exploring human sexuality is normal, especially during teenage years, even with same sex partners.

Because the onset and progression of puberty are so variable, the Tanner Stages of Development (developed by pediatrician James Tanner) help to determine whether development is normal for a given age. Boys and girls are rated on a 5-point scale; boys for genital development and pubic hair growth, and girls for breast development and pubic hair growth.

**Table II-3-4. Tanner Stages of Development**

	Female	Both	Male
Stage	Breast	Pubic hair	Genitalia
I	Preadolescent	None	Childhood size
II	Breast bud	Sparse, long, straight	Enlargement of scrotum, testes
III	Areolar diameter enlarges, breast elevates	Darker, curling, increased amount	Penis grows in length; testes continue to enlarge
IV	Secondary mound; separation of contours	Coarse, curly, adult type	Penis grows in length/breadth; scrotum darkens, testes enlarge
V	Mature female	Adult, extends to thighs	Adult shape/size

## AGING

The human body undergoes significant changes with age that have both medical and psychological implications for your patients. The leading causes of death for patients age >65 include:

- Heart disease
- Malignancy
- Cerebrovascular disease
- Chronic lower respiratory disease

As such, preventive care and primary or secondary prevention becomes crucial to patient health, improved quality of life, and survival.

Some factors can be modified by behavioral change:

- Smoking = smoking cessation
- Poor diet = low sodium diet (CHF), low cholesterol diet (ACS), low sugar diet (DM)
- Physical inactivity = exercise

Most physicians regardless of specialty will treat older patients, among others. However, the subspecialty *geriatrics* focuses more on health promotion, prevention, and treatment of disease/disabilities in older adults.

## Medical

Medical care of the geriatric population includes preventive care, vaccinations, and screening.

- **Preventive care** may include aspirin therapy and lipid management.
- **Vaccinations:** illness is usually associated with higher morbidity and mortality with older patients, so it is important they receive certain vaccinations.
  - Tetanus
  - Diphtheria
  - Pneumococcus
  - Influenza
  - Varicella/zoster
- **Screening:** the 2 main areas of screening are cancer and abdominal aortic aneurysm. For older patients, the rule of thumb is to evaluate comorbidities, functionality, and life expectancy before making recommendations for screening tests. In general, the survival screening benefit is not seen unless the patient's life expectancy is >5 years.
  - **Cancer** screening: ages for screening are usually standardized:
    - Breast cancer: women age >40
    - Colorectal cancer: men and women age >50
  - **Abdominal aortic aneurysm** screening: men age 65–75, especially if they have ever smoked

## Psychiatric

- **Depression screening**
  - Age >65 is a risk factor for suicide.
  - Screening appropriate especially when patients have a terminal or debilitating illness.
- **Adjustment disorder**
  - Many life changes can be stressors that require coping mechanisms.
  - Some life changes (e.g., retirement, even when voluntary; illness, etc.) can cause an adjustment disorder.



## Physiological

On the exam, you will be expected to recognize physiological changes that are not pathological, but rather due to aging.

- **Sexuality**
  - Sexual interest and activity does not decline significantly with aging
  - Best predictor of sexual activity in older adults is availability of a partner
  - Changes in men: slower erection, longer refractory period, more stimulation needed
  - Changes in women: vaginal dryness and thinning
- **Sleep**
  - Early morning wakefulness
  - Less deep sleep
  - REM sleep does not significantly decrease until age >85

## Financial

Several factors contribute to financial instability in older adults:

- Inadequate fixed income
  - Social Security (government-provided earned benefit): eligible adults who have worked >40 quarters; dependents of eligible adult (typically the spouse who was a homemaker)
  - Pensions (employer-provided earned benefits)
  - Investment income
- High medical costs
- Low financial literacy: older adults can be exploited by unscrupulous investment advisors and sometimes family members

## End-of-Life Care

Talking about life expectancy and end-of-life treatment and expectations is important.

- Patients should be asked about DNR status.
- Patients may have a living will or assign a health power of attorney in the event they can no longer make decisions themselves.
- You have an obligation to tell the patient everything.
- Do not give false hope to patients, but recognize that they might hope for things other than a cure: quality of life, less pain, a painless death.
- Allow patients to talk about their feelings.
- Encourage patients to avoid social isolation and stay engaged in different activities.

Patients may cycle through the Kübler-Ross stages of adjustment. The stages need not occur in order.

- Denial
- Anger
- Bargaining
- Depression
- Acceptance

**Hospice care** is care for terminally-ill patients with a life expectancy  $\leq 6$  months. It provides care and support for patients (and their families) with advanced disease; the goal is to help dying patients with peace, comfort, and dignity.

Hospice care consists of medical care, psychological support, and spiritual support. It may be delivered at specialized facilities or at home.

In the United States, payment for hospice care varies:

- Medicare hospice benefit
- Medicaid hospice benefit
- Private insurance

## DEATH AND BEREAVEMENT

### Attachment and Loss in Children

According to Bowlby's theory of attachment, children are predisposed at birth to form attachments with others. Over the first 2 years of life, they form attachments with their primary caregiver.

Separation from a child can lead to the following:

- Protest (usually seen during short-term separation, e.g., up to 2 weeks)
  - Crying, screaming, and clinging when parents leave
  - Anger toward parent upon return
- Despair
  - Protesting stops
  - Despondency and sadness
  - Child appears calmer but may be withdrawn and disinterested
- Detachment
  - If separation continues, the child will start to engage with others but will reject caregiver and remain angry
  - Indifference upon caregiver's return

### Mourning and Loss in Adults

Adults who are bereaved or are mourning the loss of a loved one also go through a period of adjustment. People move back and forth through the stages of adjustment (Kübler-Ross).

Not everyone passes through all stages or reaches adequate adjustment.

**Table II-3-5. Normal Grief vs. Depression**

Normal Grief	Depression
Normal up to 1 year	After 1 year, sooner if symptoms severe
Crying, decreased libido, weight loss, insomnia	Same but more severe
Longing, wish to see loved one, may think they hear or see loved one in a crowd (illusion)	Abnormal overidentification, personality change
Loss of other	Loss of self
Suicidal ideation is rare	Suicidal ideation is common
Self-limited, usually <6 months	Symptoms do not stop (may persist for years)
Antidepressants not helpful	Antidepressants helpful

**Recall Question**

Which of the following patients matches with the appropriate screening test at the appropriate age?

- A. Breast cancer screening in women age <40
- B. Lung cancer screening in male smokers age >35 with low-dose CT
- C. Colorectal cancer screening in men age >50
- D. Abdominal aortic aneurysm screening in female smokers age 65–75
- E. All of the above are correct

Answer: C



## SUICIDE

Suicide is the 10th leading cause of death in the United States. Men > women; however, women attempt suicide more often (pills/poison).

- Older adults are most successful and attempt less frequently.
- Adolescents attempt more frequently.
- Ethnic group with the highest suicide rate is Native Americans; within this group adolescents > older adults.
- Firearms account for >50% of all suicides.
- 50% have seen a physician in the past month.

High risk factors for suicide include:

- Previous suicide attempt
- Age
- Gender
- High socioeconomic status (SES)
- Unemployed
- Medical/psychiatric comorbidities
- Hopelessness
- Isolation
- Initiation of antidepressant pharmacotherapy (suicide window)

### NOTE

Decreased levels of 5-HIAA (serotonin metabolite) are associated with aggression and suicide.



# Theories of Learning and Behavioral Modification

# 4

## LEARNING OBJECTIVES

- ❑ Demonstrate understanding of theories of learning and how different reinforcers are applied
- ❑ Answer questions about behavioral modification, including classical and operant conditioning
- ❑ Answer questions about behavioral models of depression

## LEARNING

Learning results from a permanent change in behavior not due to fatigue, drugs, or maturation. There are two main types of learning: classical and operant.

### Classical Conditioning

In classical conditioning, a neutral stimulus is associated with an event that usually elicits an unconditioned response. The conditioned response is elicited by the conditioned stimulus after repeated pairings of the unconditioned stimulus (UCS) and conditioned stimulus (CS).

The classic example is the Pavlovian experiment, which pairs the ringing of a bell with the bringing of food. Eventually the sound of the bell elicits the salivary response that previously occurred only with the sight of the food.

Another example is when a patient receives chemotherapy (UCS), which induces nausea (UCR). Eventually, the sights and sounds of the hospital alone (CS) elicit nausea, now a conditioned response (CR).

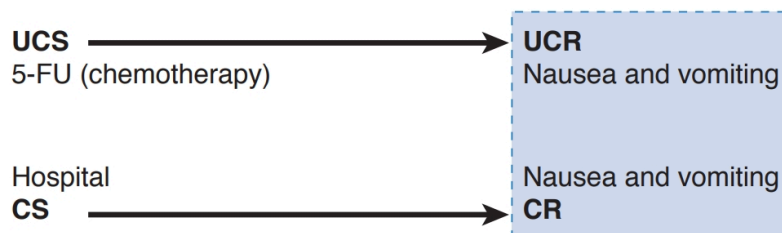


Figure II-4-1. Classic Conditioning



## Operant Conditioning

In operant conditioning (experiment by B. F. Skinner), learning occurs when a behavior is followed by an event. In the experiment:

- A rat presses a lever to get a pellet of food. (The behavior is called operant because it operates on the environment.)
- After receiving the food, the rat becomes more likely to press the lever because the food is a reinforcing event.
- The role of the reinforcer is to increase the likelihood of a response.

A **primary reinforcer** is the key motivator for behavior. It is often a physiological or psychological necessity, e.g., food, water, and sex.

A **secondary reinforcer** is a stimulus or situation that has acquired its function as a reinforcer after pairing with a stimulus that functions as a reinforcer. Examples often include tokens and money.

Behavior	→ Reinforcement	→ Response
Drug experimentation	Pleasure	Drug addiction

## Types of Reinforcers

There are 2 types of reinforcers, both of which increase the probability of a response. Typically, a positive reinforcer adds a desirable stimulus, while a negative reinforcer removes an aversive stimulus. No stimulus is universal.

- A **positive reinforcer** is a stimulus that, when applied following an operant response, strengthens the probability of that response occurring.
  - An employee gets a bonus at work after completing a big project; that will be a positive incentive to perform well again.
- A **negative reinforcer** is a stimulus that, when removed following an operant response, strengthens the probability of that response occurring.
  - A child cleans up his room (response/desired behavior) in order to stop the parent's nagging (negative reinforcer).

Behavioral response to the same stimulus can be different (increased or decreased) from person to person. Do not rely on subjective evaluations of whether the stimulus is unpleasant. An introvert might find a party aversive, while an extrovert would not.

**Punishment** is a stimulus that will decrease the probability of the response. It usually uses an aversive stimulus to the individual. In punishment, you want to decrease the response.

- A driver goes over the speed limit and gets a speeding ticket. The goal of the ticket is for the driver to drive more slowly.

**Extinction** refers to the disappearance of a response when it is no longer being reinforced. This can occur in classical or operant conditioning.

Learning theory	Extinction occurs when you	Effect
Classic conditioning	Unpair the unconditioned stimulus (food) with the conditioned stimulus (bell)	Dog does not salivate when bell is rung.
Operant conditioning	Remove reinforcer (food)	Rat stops pressing the lever looking for food.

## Types of Reinforcement

In **continuous reinforcement**, every response is followed by a reinforcement. This results in fast learning (acquisition) and fast extinction when reinforcement is stopped.

In **intermittent (or partial) reinforcement**, not every response is reinforced. Learning is slower and response is harder to extinguish.

Suppose a child often throws tantrums, and in the hope that he will stop, the parents ignore him for long periods of time. They don't want to reinforce such behavior with attention. However, if their patience eventually wears thin and they attend to him, they are putting the child on an intermittent reinforcement schedule, which will make it harder to extinguish the tantrums.

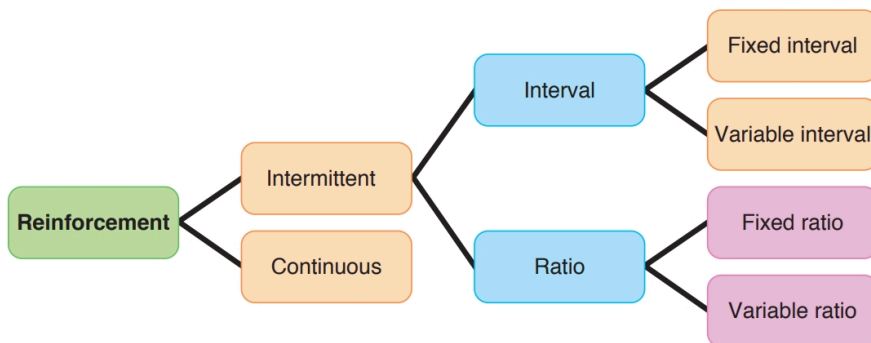


Figure II-4-2. Reinforcement

## Reinforcement Schedules

**Interval schedules** are based on the passage of time before reinforcement is given.

- A **fixed interval schedule** reinforces the response that occurs after a fixed period of time elapses. Responses are slow in the beginning of the interval and faster immediately prior to reinforcement (end-of-year bonus).
- A **variable interval schedule** delivers reinforcement after unpredictable time periods elapse (surprise bonus you can get anytime).





**Ratio schedules** are based on the number of behaviors elicited before reinforcement is given.

- A **fixed ratio schedule** delivers reinforcement after a fixed number of responses. It produces a high response rate (getting a bonus after every three projects completed).
- A **variable ratio schedule** delivers reinforcement after a changing number of responses. It produces the greatest resistance to extinction (getting a bonus after completing undisclosed number of projects).

**Table II-4-1. Reinforcement Schedules**

Interval Schedule	Examples
<b>Fixed interval</b>	<ul style="list-style-type: none"><li>• Weekly paycheck</li><li>• Bonus during holiday season</li><li>• Gift with each purchase</li><li>• Weekly quiz</li></ul>
<b>Variable interval</b>	<ul style="list-style-type: none"><li>• Surprise bonus</li><li>• Pop quiz</li><li>• Listening to radio for favorite song</li></ul>
Ratio Schedule	Examples
<b>Fixed ratio</b>	<ul style="list-style-type: none"><li>• Piecemeal work</li><li>• Free sandwich after 10 sandwiches bought</li><li>• \$5,000 to a salesman after each sale of 5 automobiles</li></ul>
<b>Variable ratio</b>	<ul style="list-style-type: none"><li>• Slot machines</li><li>• Door-to-door salesman</li><li>• Unknown sales bonus</li></ul>

## Modeling

In modeling, learning occurs through observation. Watching someone else get reinforcement is enough to change behavior.

## BEHAVIORAL MODIFICATION

### Classical Conditioning

**Systematic desensitization** usually begins with imagining oneself in a progression of fearful situations and using relaxation strategies that compete with anxiety. It is often used to treat anxiety and phobias, and is based on the concept of counterconditioning.

- Patients start by creating a list of fear-eliciting stimuli from least stressful to most stressful.
- They then pair their fear-eliciting stimulus with behaviors that elicit unconditioned responses (relaxation).
- When they are relaxed in the presence of the feared stimulus, the fear response disappears.

**Exposure** is treatment by forced exposure to the feared object; maintained until fear response is extinguished. If you are afraid of heights, you will climb to greater and greater heights until you can conquer your fear; there is a hierarchy to progress through.

**Flooding**, or massive exposure, is where patients are exposed to a maximum intensity anxiety-producing situation. If imagined, it is called implosion. If you are afraid of bugs, you will be locked in a room with millions of bugs. Contrary to exposure, there is no hierarchy.

**Aversive conditioning** occurs when a stimulus that produces undesired behavior is paired with an aversive stimulus. In treatment of alcoholism, patients are given disulfiram, which makes them sick when they drink alcohol.

## Operant Conditioning

**Shaping** (or successive approximations) achieves final target behavior by reinforcing successive approximations of the desired response. Reinforcement is gradually modified to move behaviors from the more general to the specific responses desired. A boy with autism is rewarded when he utters one word and subsequently has to utter more words to obtain the same reward.

**Stimulus control** is where a stimulus inadvertently acquires control over behavior. When this is true, removal of that stimulus can extinguish the response. Watching TV while eating will increase weight, so in order to lose weight you must stop watching TV.

**Biofeedback** (neurofeedback) uses external feedback via instruments to provide usually unperceived biological information subsequently used to modify internal physiologic states. Certain functions of the autonomic nervous system (pulse, blood pressure, muscle tone, pain perception) can be manipulated through the technique of biofeedback.

**Fading** is gradually removing the reinforcement without the individual becoming aware of the difference.

- Patients receive pain medication after surgery, but each dose is smaller until discontinuation.
- Nicotine patch begins with 21 mg and is later reduced to 14 mg and then 7 mg.
- Patients are unaware during this process that they are receiving less nicotine.

## Behavioral Models of Depression

**Learned helplessness** (or the animal model of depression) is where all normal avoidance responses are extinguished. If a rat is shocked and not allowed to escape, eventually the rat will not take an obvious avoidance route even when it is offered.



Symptoms of helplessness in animals include passivity, norepinephrine depletion, and difficulty learning responses that produce relief and weight/appetite loss.

- Characterized in people by an attitude of “when nothing works, why bother.” A woman in an abusive relationship who perceives she cannot escape the abuse will give up and become depressed.
- Increased levels of GABA in hippocampus decrease the likelihood of learned helplessness response.

**Low rate of response-contingent reinforcement** is another explanation for depression. The person receives too little predictable positive reinforcement and may lack the social skills necessary to elicit this positive reinforcement. Depression can be seen as a prolonged extinction schedule; it results in passivity.

- A man who feels he receives no positive reinforcement from his spouse can become depressed, even if he seems otherwise successful.
- A caring and giving father who feels unappreciated by his family might become depressed.

### Recall Question

A 26-year-old medical student is studying for a medical licensing exam. His mother rewards him when he scores well on his question bank. Which of the following reinforcement schedules would produce the greatest resistance to extinction?

- A. Variable ratio schedule
- B. Fixed ratio schedule
- C. Fixed interval schedule
- D. Variable interval schedule
- E. Positive reinforcement

Answer: A

# Defense Mechanisms

# 5

## LEARNING OBJECTIVES

- ❑ Define the components of psychic structures
- ❑ Describe how the different defenses are used to manage internal conflict

## PSYCHIC STRUCTURES

Psychic structures are based on Freudian theory.

The **id** controls primitive instincts and drives (what we want to do):

- Present at birth
- Influences sex and aggression

The **ego** tries to “accommodate” reality:

- Rational
- Resolves conflicts between id and superego (tries to find ways that will benefit in the long-term rather than bring grief through impulsive id decisions)

The **superego** determines our conscience or moral compass (what we ought to do):

- Begins development by age 5
- Learned from caretakers
- Insists on socially acceptable behavior, sometimes to the point of individual deprivation
- Can be punitive

## DEFENSE MECHANISMS

Defenses are the primary tools of the ego used to manage the internal conflicts between the id and superego. They are the means by which the ego wards off anxiety, and controls instinctive urges and unpleasant effects (emotions).

- All defenses are unconscious, with one exception: suppression.
- Defenses change over time; we are only aware of our defenses in retrospect.
- Defenses are adaptive as well as maladaptive.





## Narcissistic Defenses

**Projection** is when a person attributes his own wishes, desires, thoughts, or emotions to someone else. Internal states are perceived as a part of someone else or of the world in general.

- A cheating spouse accuses partner of cheating.
- A girl talks about her doll as having certain feelings, which are really what the girl feels.

This is the main defense mechanism seen in paranoid personality disorder. Paranoia results from the use of projection.

**Denial** is not allowing reality to penetrate to avoid acknowledgment of a painful aspect of reality.

- After surviving a heart attack, a patient insists on continuing his lifestyle as if nothing had happened.
- A woman prepares dinner for her husband expecting him to come home, even though he died a month earlier.
- Substance users are often “in denial,” claiming that they are not addicted and do not have a problem in the face of clearly dysfunctional or dangerous behavior.

Denial is often the first response to bad news, such as the impending death of a loved one or oneself.

**Splitting** is when people and things in the world are idealized (all good) or devalued (all bad). The world is pictured in extreme terms rather than a more realistic blend of good and bad qualities.

- “This doctor is a miracle worker, but that doctor is totally incompetent.”
- “He’s just so perfect and wonderful,” says a teenage girl in love.
- “No one from that family will ever amount to anything; they are all just plain no good.”

This is the main defense mechanism seen in borderline personality disorder. Prejudice and behavioral stereotypes are also a result of splitting.

## Immature Defenses

**Blocking** is a temporary, or transient, block in thinking or an inability to remember.

- A student is unable to recall the fact needed to answer the exam question, although he recalls it as he walks out of the exam.
- In the middle of a conversation, a woman pauses, looks confused, and asks what she was just talking about.
- In a conversation you forget someone’s name.

Blocking often happens in embarrassing moments.



**Regression** is returning to an earlier stage of development you have already completed (unconscious childish behavior in an adult).

- A husband speaks to his wife in “baby talk” when he is sick.
- A man assumes a fetal position after a traumatic event.
- A previously toilet trained child wets the bed following the birth of a new sibling.

**Somatization** is when psychological conflict is converted into bodily symptoms.

- A student gets a headache while taking an exam.
- A woman feels queasy and nauseated before asking someone out on a date.
- A man who witnesses a traumatic event becomes blind.

This is the main defense mechanism of somatic symptom disorders.

**Introjection** (identification) is when we acquire characteristics of others as our own. It is the unconscious form of imitation. Introjection is the opposite of projection.

- A resident dresses and acts like the attending physician.
- A child scolds her friend out loud in the same manner that she was scolded by her mother.
- A teenager adopts the style and mannerisms of a rock star.

This defense mechanism is used in psychotherapy.

## Anxiety Defenses

**Displacement** is when the target of an emotion or drive changes to a substitute target.

- A recently disciplined employee yells at his wife instead of his boss.
- A woman watching a movie featuring love scenes with a handsome actor goes out and seduces an unattractive man.
- In family therapy, one child in a family is often singled out and blamed for all the family’s problems, i.e., treated as a scapegoat.

This is the defense mechanism seen in phobias.

**Repression** is when an idea or feeling is withheld from consciousness. It is also called unconscious forgetting.

- A child who was abused by her mother and treated for the abuse now has no memory of any mistreatment by her mother.
- A man who survived 6 months as a hostage cannot recall anything about his life during that time period.

This is one of the most basic defense mechanisms.



**Isolation of affect** is the separation of an idea or event from the emotions (affect) that accompany it.

- A child who has been beaten discusses the beatings without any display of emotion.
- A combat pilot is calm while ejecting out of his plummeting aircraft.
- A patient who recently severed his finger in an accident describes the incident to his physician with no emotional reaction.

This is an important adaptive defense mechanism for self-preservation.

**Intellectualization** is when facts and logic are used to avoid confronting emotions.

- A patient with a bone protruding from his leg focuses on the physics that allow such an event to occur.
- A medical student speaks excessively about medical details in order to avoid the emotional content of a bad diagnosis.
- A boy who, for the first time, is about to ask a girl out talks with his friend about the importance of mating rituals for the long-term survival of the species and the mechanisms by which societies arrange for these rituals.

Physicians who are too concerned with the technical aspects of the profession and not enough with the patient may well be using intellectualization.

**Acting out** is when an emotional or behavioral outburst masks underlying feelings or ideas.

- A child throws temper tantrum when abandoned
- New-onset drug use in an adolescent boy after parents' divorce
- "Whistling in the dark" to hide underlying fear

This is a defense mechanism that can be seen in borderline and antisocial personality disorders.

**Rationalization** is when rational explanations are used to justify attitudes, beliefs, or behaviors that are unacceptable. This is not a reasoned action, but a search for reasons to allow an unacceptable action.

- A murderer saying, "Yes, I believe killing is wrong but I killed him because he really deserved it."
- An alcoholic person shares with a friend that the drinking is due to stress at work.

This defense mechanism is seen in substance use disorders.

**Reaction formation** is when an unacceptable impulse is transformed into its opposite. Excessive overreaction can be a sign of reaction formation.

- A student who always wanted to be a physician expresses relief and says, “This is the best news I’ve ever heard,” after not being accepted into medical school.
- A teenage boy intrigued by “dirty pictures” organizes an anti-pornography campaign.
- Two coworkers fight all the time because they are actually very attracted to each other.

This defense mechanism is commonly seen in obsessive-compulsive disorder and anxiety disorders.

**Undoing** is performing an act to undo a previous unacceptable act or thought.

- A man who is sexually aroused by a woman he meets immediately leaves and buys his wife flowers.
- Can include superstitions such as throwing salt over your shoulder to avoid bad luck.
- A man repeatedly checks to make sure the burners on the stove are turned off before leaving the house because he is fearful the house will burn down.

This defense mechanism is seen in obsessive-compulsive disorder.

**Passive-aggression** is when hostility is expressed covertly.

- A patient angry with her physician shows up late for appointments.
- A student agrees to share class notes with classmates but goes home without sharing them after they upset her in class.
- A communications director does not take questions from people who challenge his views.

The feelings of hostility are unconscious, and the person using the defense is generally unaware of them. If you consciously set someone up, it is not a defense, but simply being mean. This defense mechanism is seen in borderline personality disorders and young children.

**Dissociation** separates the self from one’s experience to avoid emotional distress.

- A woman who was raped reports that she felt “as if she was floating on the ceiling” watching it happen.
- The survivor of an automobile accident tells of the feeling that everything happened in slow motion.

This is the primary defense mechanism in dissociative disorders.



## Mature Defenses

**Humor** permits the overt expression of feelings and thoughts without personal discomfort.

- A student smiles when he realizes that a particularly intimidating professor looks like a penguin.
- An overweight comedian makes jokes about being fat.

Laughter covers the pain and anxiety.

**Sublimation** is when impulse gratification is achieved by channeling the unacceptable or unattainable impulse into a socially acceptable direction.

- Jack the Ripper becomes a surgeon.
- A patient with exhibitionist fantasies becomes a stripper.

Many forms of art and literature spring from sublimation, considered by some to be the most mature defense mechanism.

**Suppression** is the conscious decision to forget or ignore.

- A student with a pending exam decides to forget about it and go out for the evening.
- A woman who is afraid of heights ignores the drop of a steep cliff to appreciate the beautiful view.
- A terminally-ill cancer patient puts aside his anxiety and enjoys a family gathering.

Suppression is the **only conscious defense mechanism**.

### Recall Question

A 32-year-old man sees his psychiatrist for a follow-up visit. He states that when he talks to his wife he is often angry on the inside but never expresses it. This behavior is most representative of which defense mechanism?

- A. Displacement
- B. Introjection
- C. Intellectualization
- D. Acting out
- E. Isolation of affect

Answer: E



# Psychological Health and Testing

# 6

## LEARNING OBJECTIVES

- ❑ Answer questions about stress and how it affects the body
- ❑ Demonstrate understanding of how to calculate intelligence testing
- ❑ Demonstrate understanding of the various types of personality testing

## STRESS

Physiologic changes in response to stress include key stress response pathway: hypothalamic-pituitary-adrenal axis.

- Cortisol levels rise, then fall, within 24 hours after stressor.
- Cortisol levels spike again 48–72 hours after stressor.

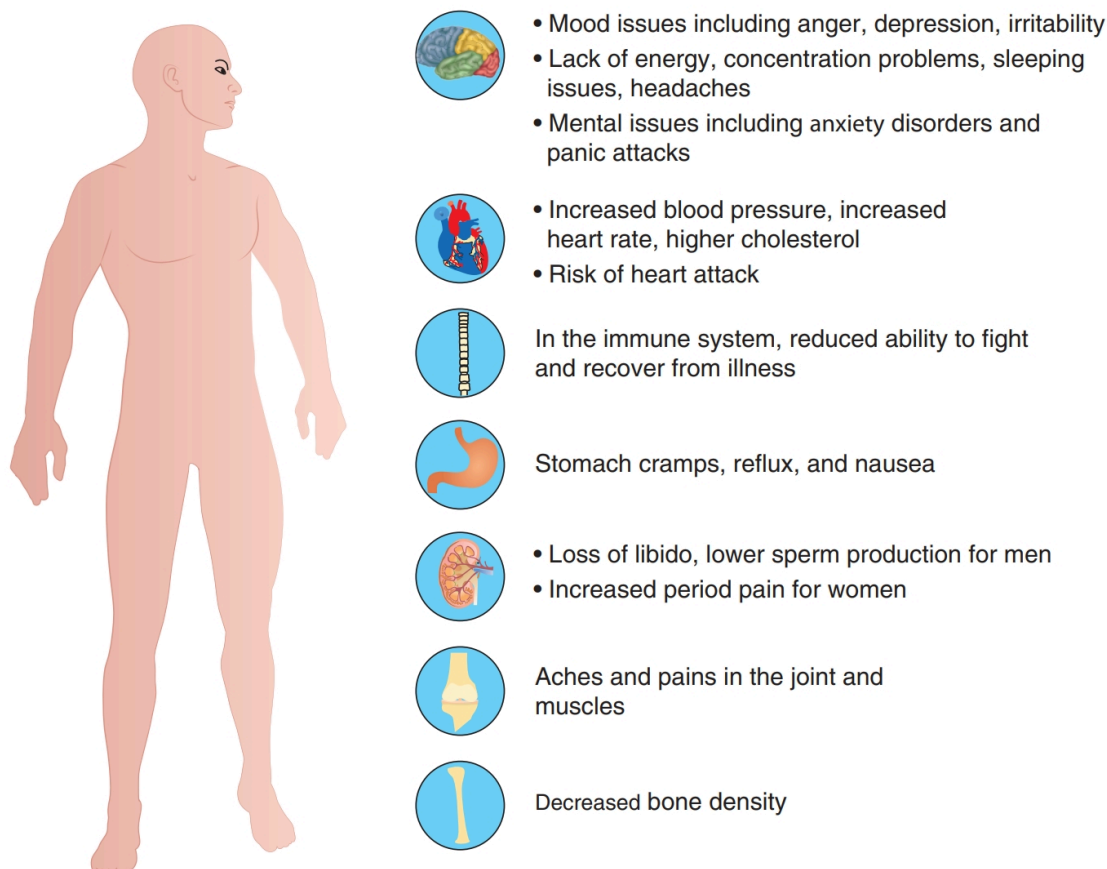


Figure II-6-1. Effects of Stress on the Body





## Type A and B Personalities

**Type A** personality is a cluster of behavioral traits that has been associated with increased prevalence and incidence of coronary heart disease.

- Tends to be impatient, competitive, preoccupied with deadlines, and highly involved with work
- Key component of type A behavior: how they handle hostility
- Has increased incidence of coronary heart disease, even after controlling for the major risk factors (systolic blood pressure, cigarette smoking, cholesterol)
- If they survive a first heart attack, less likely than type B to have a second attack

**Type B** personality lives at lower stress levels. When faced with competition, they do not mind losing.

## Stress and Illness

Mentally healthy individuals do not deteriorate in physical health as quickly as do those in poor mental health. Chronic anxiety, depression, and emotional maladjustment predict negative health events later in life.

The Holmes and Rahe scale is used to quantify stressful life events.

- Different life events contribute different weightings to the total score.
- The death of a spouse is weighed as the most stressful event.
- There is a positive correlation between stressful life events and developing illness.

**Table II-6-1. Holmes and Rahe Life Stress Inventory**

Life Event	Mean Value
Death of spouse	100
Divorce	73
Marital separation from mate	65
Detention in jail or other institution	63
Death of a close family member	63
Major personal injury or illness	53
Marriage	50
Being fired at work	47
Marital reconciliation	45
Retirement from work	45
Major change in the health or behavior of a family member	44
Pregnancy	40
Sexual difficulties	39

Gaining a new family member (birth, adoption, older adult moving in, etc.)	39
Major business adjustment	39
Major change in financial state (a lot worse or better than usual)	38
Death of a close friend	37
Changing to a different line of work	36
Major change in number of arguments with spouse (a lot more or less)	35
Taking on a mortgage (for home, business)	31
Foreclosure on a mortgage or loan	30
Major change in responsibilities at work (promotion, demotion)	29
Adult child leaving home (marriage, college, military)	29
In-law troubles	29
Outstanding personal achievement	28
Spouse beginning or ceasing work outside the home	26
Beginning or ceasing formal schooling	26
Major change in living conditions (new home, remodeling, deterioration, etc.)	25
Revision of personal habits (dress, associations, quit smoking, etc.)	24
Troubles with the boss	23
Major changes in working hours or conditions	20
Changes in residence	20
Changing to a new school	20
Major change in usual type and/or amount of recreation	19
Major change in church activity (a lot more or less)	19
Major change in social activities (clubs, movies, visiting)	18
Taking on a loan (car, TV, freezer)	17
Major change in sleeping habits (a lot more or less)	16
Major change in number of family get-togethers (a lot more or less)	15
Major change in eating habits (a lot more or less, eating hours, surroundings)	15
Vacation	13
Major holidays	12
Minor violations of the law (traffic ticket, jaywalking)	11



To find your score, add up all your points:

- **<150 points:** relatively low amount of life change and low susceptibility to stress-induced health problems
- **150–300 points:** 50% chance of a major stress-induced health problem in next 2 years
- **>300 points:** odds increase to 80% chance of a major stress-induced health problem in next 2 years

## TESTING

### Intelligence Testing

Intelligence quotient (IQ) is a general estimate of the functional capacity of a person; 70% is inherited, with recent studies suggesting it is mostly from the mother. IQ is not an absolute score, but a comparison among people. Distribution mean is 100, and standard deviation is 15.

To calculate IQ, use the following:

- **Mental age (MA) method:**  $IQ = MA/CA \text{ (chronological age)} \times 100$
- **Deviation from the norm method:** mean IQ = 100 and SD = 15
  - Intellectual disability <2 SD below the mean

There are several commonly used IQ tests:

- Wechsler Adult Intelligence Scale IV (WAIS-IV): **for adults age ≥17** (last revised 2008)
- Wechsler Intelligence Scale for Children V (WISC-V): **for children age 6–16** (last revised 2014)
- Wechsler Preschool and Primary Scale of Intelligence IV (WPPSI-IV): **for children age 2.5–7.5** (last revised 2012)
- Stanford-Binet Intelligence Scales, Fifth Edition (SB5): **for children as young as age 2** (last revised 2003)

### NOTE

Note Stanford-Binet was the first formal IQ test (1905) for children age <18. Today, it is most useful for children age <6, the impaired, and the very bright.

**Table II-6-2. Distribution of IQ Scores in the General Population**

Range	Label	Distribution
<69	Intellectual disability	About 2.5% of population
70–79	Borderline	
80–89	Low average	
90–109	Average	About 50% of population
110–119	High average	
120–129	Superior	
>130	Very superior	About 2.5% of population

## Personality Testing

**Objective tests** have the following features:

- Utilize simple stimuli (usually questions)
- Have a restricted range of possible responses (choose from provided options)
- Scored mechanistically using scoring key
- Require no clinical experience to score

In **criterion-referenced tests**, results are given meaning by comparing them with a preset standard: “Every student who scores above 75% will pass.”

In **norm-referenced tests**, results are given meaning by comparing them with a normative group: classic example is Minnesota Multiphasic Personality Inventory (MMPI-2), with >550 T/F questions, a validity scale, and a lie scale.

**Projective tests** utilize ambiguous stimuli and have a wide range of possible responses. Response meaning is interpreted by clinical correlation between collected cases of responses and personal characteristics (psychopathologies); tests are scored by experienced clinicians using consensual standards.

- **Rorschach inkblot test:** patient is asked to look at an inkblot and report what is seen
- **Thematic apperception test (TAT):** patient is asked to tell a story about what is going on in the picture
- **Sentence completion test:** patient is asked to complete a set of sentence stems with the first thing that comes to mind
- **Projective drawings:** patient is given a sheet of paper and asked to draw a house, a tree, a person, a family, etc. (very useful for children, who are unlikely to be able to realistically complete any other personality test)

### Recall Question

A 46-year-old man is being evaluated by his primary care physician for elevated blood pressure. Upon initial history the physician notices several stressful life events. Which of the following life events correlates with the highest likelihood of developing serious illness?

- Divorce
- Marriage
- Death of spouse
- Winning the lottery
- Traffic ticket

Answer: C

### NOTE

The MMPI-2 is the most widely used personality test.





# Substance Use Disorders

# 7

## LEARNING OBJECTIVES

- ❑ Demonstrate understanding of how alcoholism and tobacco use relate to mortality
- ❑ Demonstrate understanding of how genetics relates to alcoholism and tobacco use
- ❑ Answer questions about the physiology of addiction
- ❑ Answer questions about how substance use disorders can affect pregnancy
- ❑ Demonstrate understanding of how to diagnose and treat a substance use disorder

## ALCOHOL AND TOBACCO USE

Alcoholism is the most expensive health problem in the United States, costing >\$100 billion/year for alcohol-related illness and death. Tobacco, however, accounts for more loss of life. The best way to reduce long-term mortality is to eliminate smoking.

- Alcohol is most abused drug for all ages; ~10% of all adults are problem drinkers (men > women).
- Alcohol is most widely used illicit drug for teenagers (marijuana is most widely used illicit drug overall).
- Binge drinking is becoming more common; proportion of heavy drinkers age <20 has increased.
- Alcoholism rates are higher for low-SES groups, though they recover sooner.
- Alcohol use has been implicated in 15% of all car accidents, and in 50% of all MVAs not involving a pedestrian, auto accident deaths, homicides (killer or victim), and hospital admissions.



## GENETICS

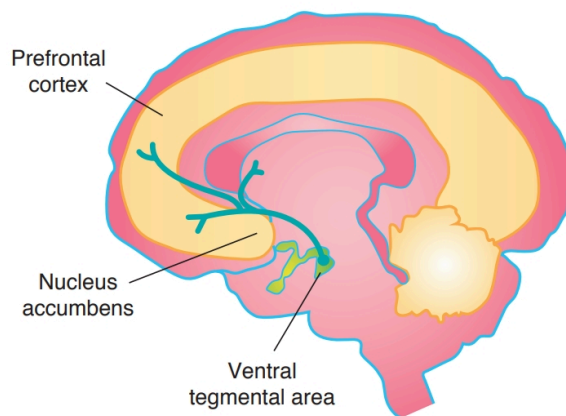
- Concordance rates are higher for monozygotic versus dizygotic twins.
- Twins born to alcoholic parents and raised by non-alcoholic parents are more likely to become alcoholics.

If biologic father was an alcoholic, the incidence of alcoholism in men adopted into nonalcoholic families is equal to the incidence of alcoholism in sons raised by biologic alcoholic fathers.

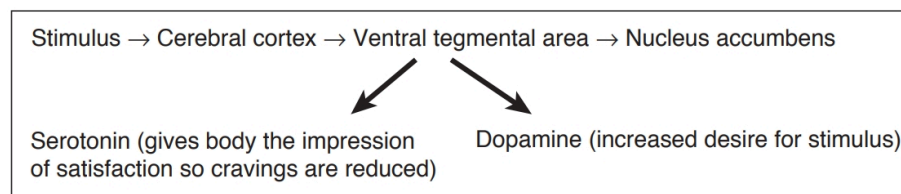
- Family history of alcoholism increases likelihood of major depression in offspring.

## PHYSIOLOGY

The addiction pathway in the brain is the mesolimbic dopamine pathway. Activation of this pathway accounts for the euphoric feelings of substance abuse which are positively reinforcing and increase the likelihood of subsequent use and potential addiction.



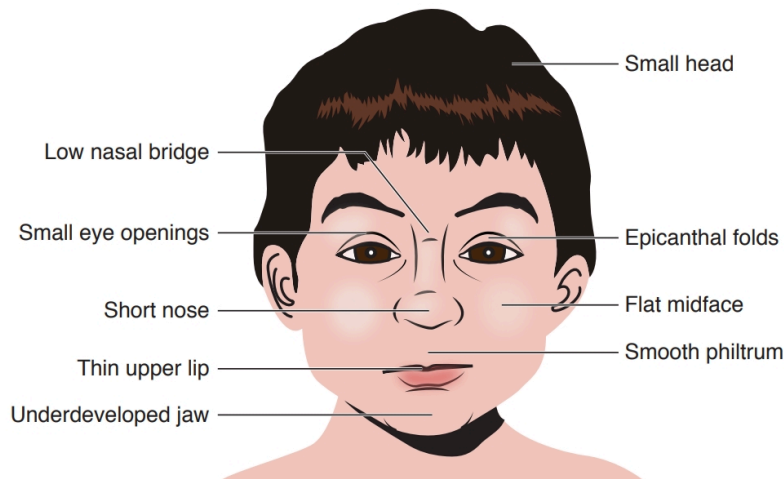
**Figure II-7-1.** Nucleus Accumbens (NAc) Pathway



Neurotransmitters involved in the addiction pathway include dopamine, which increases desire for stimulus, and serotonin, which gives the body the impression of satisfaction so cravings are reduced.

## PREGNANCY

Women are encouraged to stay away from drugs and alcohol during pregnancy because of complications related to the drug/alcohol use. Drinking between weeks 6–9 (when some women might be unaware they are pregnant) is most likely to lead to facial abnormalities associated with **fetal alcohol syndrome** (FAS). FAS can cause growth problems, mental or behavioral problems, and abnormal facial features.



**Figure II-7-2.** Effects of Fetal Alcohol Syndrome

## DIAGNOSIS AND MANAGEMENT

### Self-Awareness

Most substance users do not believe they have a problem. Denial and rationalization become their main defense.

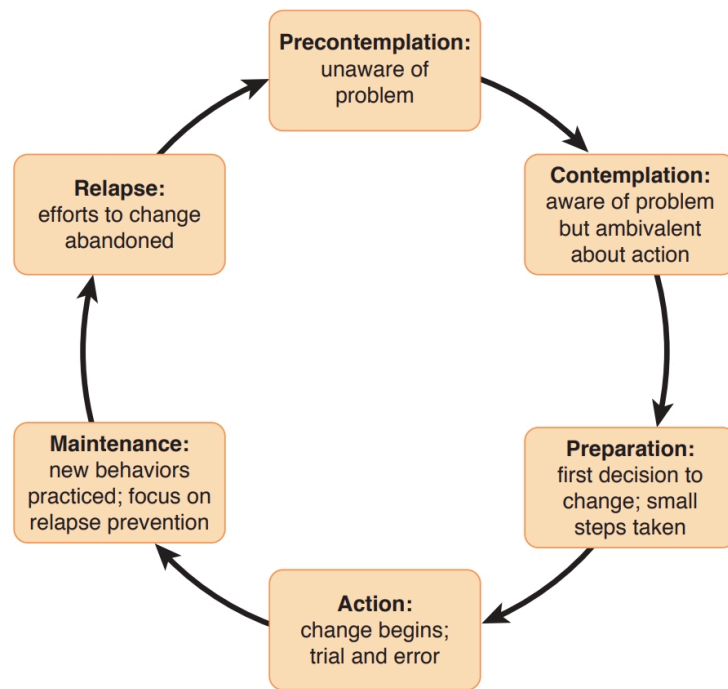
- Many substance abusers function in society, so it is hard for them to acknowledge they have a problem related to drug and alcohol.
- Typically, something significant (e.g., “hit rock bottom”) has to happen to them in order to realize there is a problem.

The CAGE questionnaire is a widely used **screening test** for problem drinking and potential alcoholism.

- Have you ever tried to Cut down on alcohol intake and not succeeded?
- Have you ever been Annoyed about criticism concerning your drinking?
- Have you ever felt Guilty about your drinking behavior?
- Have you ever had to take a drink as an Eye-opener in the morning to relieve the anxiety and shakiness?



There are common stages by which people tend to change their behavior.



**Figure II-7-3.** Stages of Behavioral Change

The cycle may repeat until sobriety is established.

Alcohol abuse can cause many medical complications: cirrhosis, alcoholic hepatitis, pancreatitis, gastric or duodenal ulcer, esophageal varices, middle-age onset of diabetes, gastrointestinal cancer, hypertension, peripheral neuropathies, myopathies, cardiomyopathy, cerebral vascular accident, erectile dysfunction, vitamin (thiamine) deficiencies, pernicious anemia, and brain disorders including Wernicke-Korsakoff syndrome. Chronic alcohol use can lead to cognitive decline.

Laboratory evidence of alcohol use will include:

- Increased transaminases (AST/ALT) (typically 2:1 ratio)
- Increased bilirubin
- Increased gamma GT (recent alcohol intake)
- Breathalyzer
- Blood alcohol level

## Diagnosis

Diagnoses will be of both *intoxication with* and *withdrawal from* drugs and alcohol. Often the diagnosis is clinical. Confirm with urine and blood toxicology screens.

- **Intoxication:** impairment due to acute drug use
- **Withdrawal:** effects of cessation or reduced drug use once patient develops tolerance for the drug (**tolerance** is the diminished efficacy of a drug after repetitive use; requires increased dosage for the same effect)
- **Substance use disorders** may have legal ramifications: driving under the influence (DUI) or driving while intoxicated (DWI)
  - **Use disorders** include the presence of cravings, tolerance, withdrawal, continued use despite adverse consequences, negative impact on home, work and social settings

## Treatment

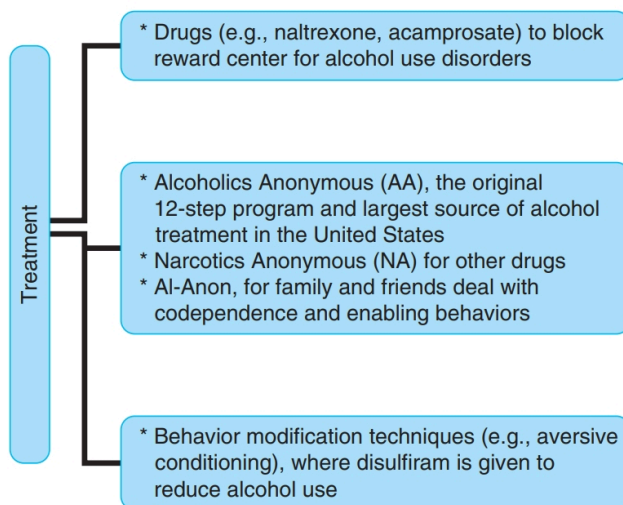


Figure II-7-4. Treatment Options for Substance Abuse

Disulfiram may work as an adjunct to psychosocial treatment to reduce alcohol use. Patients must be able committed to maintaining abstinence and to taking the medication.

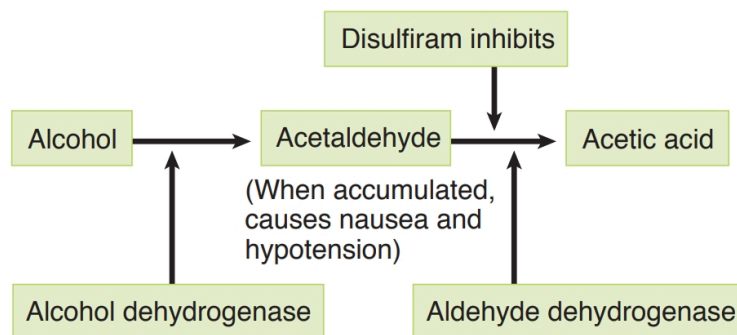


Figure II-7-5. Disulfiram Treatment

### NOTE

Alcoholics Anonymous (AA) is considered a spiritual program; it features regular meetings and sponsors who provide substitute dependency, social support, and external reminders that drinking is aversive.

### NOTE

Both naltrexone and acamprosate are effective at reducing cravings, but naltrexone may be used while the patient is still using alcohol.



**Recall Question**

A 2-year-old boy being evaluated by his pediatrician is found to have a low nasal bridge, microcephaly, flat midface, smooth philtrum, and underdeveloped jaw. His mother reports to abusing various substances throughout the course of her pregnancy. Which of the following substances is responsible for these findings?

- A. Cocaine
- B. Valproic acid
- C. Alcohol
- D. Phenytoin
- E. Alprazolam

Answer: C

**Table II-7-1. Signs and Symptoms of Intoxication/Withdrawal and Treatment**

Substance	Signs & Symptoms of Intoxication	Treatment of Intoxication	Signs & Symptoms of Withdrawal	Treatment of Withdrawal	Location/Effect of Drug Action
Alcohol	Talkative, gregarious, moody, disinhibited	If severe, consider mechanical ventilation	Tremors, hallucinations, seizures, DTs	Thiamine, MVI, folic acid, benzodiazepines	Decreases glutamate and increases GABA
Amphetamine *cocaine	Euphoria, hypervigilance, autonomic hyperactivity, weight loss, pupillary dilatation, perceptual disturbances	Antipsychotics and benzodiazepines, anti-hypertensives	Anxiety, tremors, headaches, increased appetite, depression, risk of suicide	If suicidal, consider antidepressants	Mesolimbic pathway, nucleus accumbens
Bath salts *synthetic cocaine, flakka	<ul style="list-style-type: none"> <li>Irritability, perceptual disturbances, agitation</li> <li>Symptoms can last up to 1 week</li> </ul>	Antipsychotics and/or benzodiazepines	Anxiety and depression	If suicidal: consider SSRIs	Not yet known
Cannabis	Impaired motor coordination, slowed sense of time, social withdrawal, increased appetite, conjunctival injection, psychosis	Antipsychotics if needed	Irritability, anxiety	N/A	Inhibitory G protein, GABA, increased serotonin
K2/spice *synthetic marijuana	Perceptual disturbances, agitation, seizures	Antipsychotics and/or benzodiazepines	Not yet known	N/A	Not yet known
Hallucinogens	Ideas of reference, perceptual disturbances, impaired judgment, dissociative symptoms	<ul style="list-style-type: none"> <li>Place in quiet room</li> <li>Antipsychotics, benzodiazepines</li> </ul>	N/A	N/A	Stimulate glutamate and serotonin

Substance	Signs & Symptoms of Intoxication	Treatment of Intoxication	Signs & Symptoms of Withdrawal	Treatment of Withdrawal	Location/Effect of Drug Action
Inhalants	<ul style="list-style-type: none"> <li>• Belligerence, apathy, aggression, impaired judgment, stupor or coma</li> <li>• Nasal crusting, rash, drunken appearance, dilated pupils</li> <li>• Use can be fatal</li> <li>• Parkinsonism has been associated with huffing</li> </ul>	Antipsychotics	Nausea, excessive sweating, muscle cramps, headaches, chills, agitation, shaking, and hallucinations	Benzodiazepines, antipsychotics	GABA, cerebellum
Opiates	Apathy, dysphoria, pinpoint pupils, drowsiness, slurred speech, coma, death	Naloxone	Fever, chills, runny nose, diarrhea, muscle spasms, cramps	Clonidine, methadone, buprenorphine	<ul style="list-style-type: none"> <li>• Mu, kappa, and delta receptors</li> <li>• Nucleus accumbens</li> </ul>
Krokodil (desomorphine) *synthetic opiate	Skin, blood vessel, bone, and muscle damage leading to gangrene, phlebitis, sepsis	Symptomatic	Not yet known	N/A	Not yet known
Phencyclidine (PCP)	Belligerence, psychomotor agitation, violence, nystagmus, hypertension, seizures	<ul style="list-style-type: none"> <li>• Place in quiet room</li> <li>• Antipsychotics</li> <li>• Benzodiazepines</li> </ul>	<ul style="list-style-type: none"> <li>• Elevated body temperature, seizures, muscle breakdown</li> <li>• Muscle twitching, agitation, hallucinations</li> </ul>	Benzodiazepines, antipsychotics	Antagonist of N-methyl D-aspartate glutamate receptors
Anabolic steroids	Irritability, aggression, mood instability, psychosis	Antipsychotics	Depression, headaches, anxiety	If depressed, consider SSRIs	May activate dopamine and serotonin release
Ecstasy (MDMA, Molly, E, X)	Euphoria, mild hallucinations, visual distortions, enhanced sensations, hyperthermia, bruxism, autonomic hyperactivity, seizures, dry mouth	Dantrolene, benzodiazepines Hydration	Depression, anxiety, and panic attacks	SSRIs	<ul style="list-style-type: none"> <li>• Increases serotonin and dopamine</li> <li>• Affects hypothalamus (drinking behavior/body temp); motor neurons of spinal cord (muscle spasms and jaw clenching)</li> </ul>



Substance	Signs & Symptoms of Intoxication	Treatment of Intoxication	Signs & Symptoms of Withdrawal	Treatment of Withdrawal	Location/Effect of Drug Action
Benzodiazepine	<ul style="list-style-type: none"><li>• Slurred speech, confusion, memory deficits, falls</li><li>• Respiratory depression (rare)</li></ul>	Supportive flumazenil or mechanical ventilation if needed	<ul style="list-style-type: none"><li>• Increased anxiety, tremors</li><li>• Insomnia</li><li>• Seizures</li></ul>	Benzodiazepines	GABA
Barbiturates	<ul style="list-style-type: none"><li>• Restlessness, agitation, insomnia, N/V, anxiety</li><li>• Tremors, seizures, hallucination, increased heart rate</li><li>• Respiratory depression</li></ul>	Supportive mechanical ventilation if needed	<ul style="list-style-type: none"><li>• Anxiety, depression</li><li>• Cognitive impairments</li><li>• Memory deficits, lack of attention</li><li>• Seizures, delirium</li></ul>	Phenobarbital	GABA

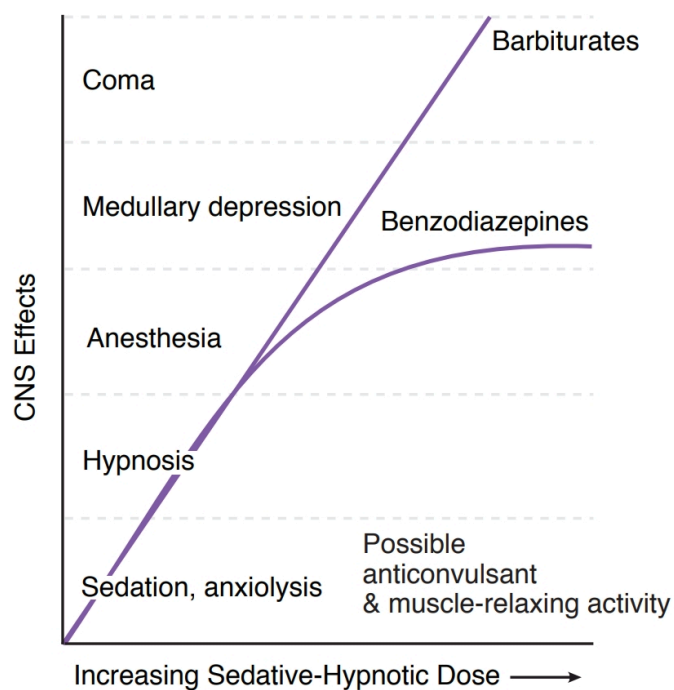


Figure II-7-6. CNS Effects

**Recall Question**

A 16-year-old boy is brought to the emergency department by his mother for altered mental status, increased appetite, and spurts of giggling episodes. On physical examination he is noted to have impaired finger-to-nose-to-finger dysmetria, conjunctival injection, and decreased rapid alternating movements. Which of the following substances is most likely responsible for these symptoms?

- A. Opiates
- B. Inhalants
- C. Cocaine
- D. Cannabis
- E. Bath salts

Answer: D





# Sleep and Sleep Disorders

# 8

## LEARNING OBJECTIVES

- ❑ Demonstrate understanding of the sleep stages and their associated waves
- ❑ Answer questions about how sleep deprivation can affect the body
- ❑ Demonstrate understand of the different sleep disorders and how to treat

## SLEEP ARCHITECTURE

Sleep consists of 2 distinct states: NREM and REM.

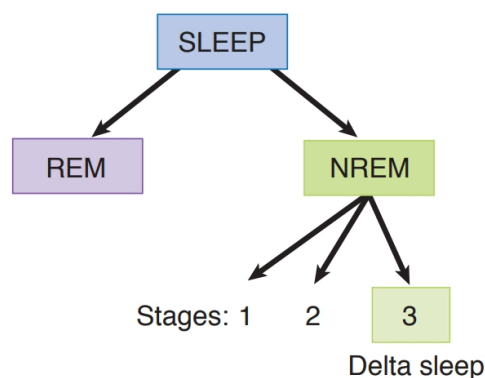
**Nonrapid Eye Movement (NREM)** alternates with REM sleep throughout the sleep period. It is divided into 3 stages on the basis of EEG criteria:

- Slowing of the EEG rhythms
- Higher muscle tone
- Absence of eye movements
- Absence of “thought-like” mental activity

NREM is an idling brain in a movable body.

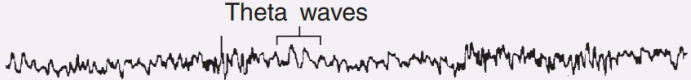
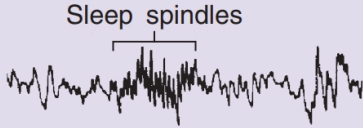
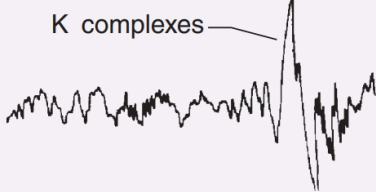
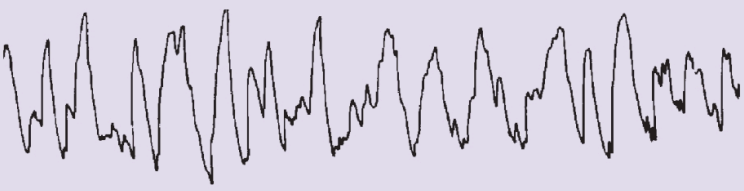
**Rapid Eye Movement (REM)** is an awake brain in a paralyzed body:

- Aroused EEG pattern
- Sexual arousal
- Saccadic eye movements
- Dreaming



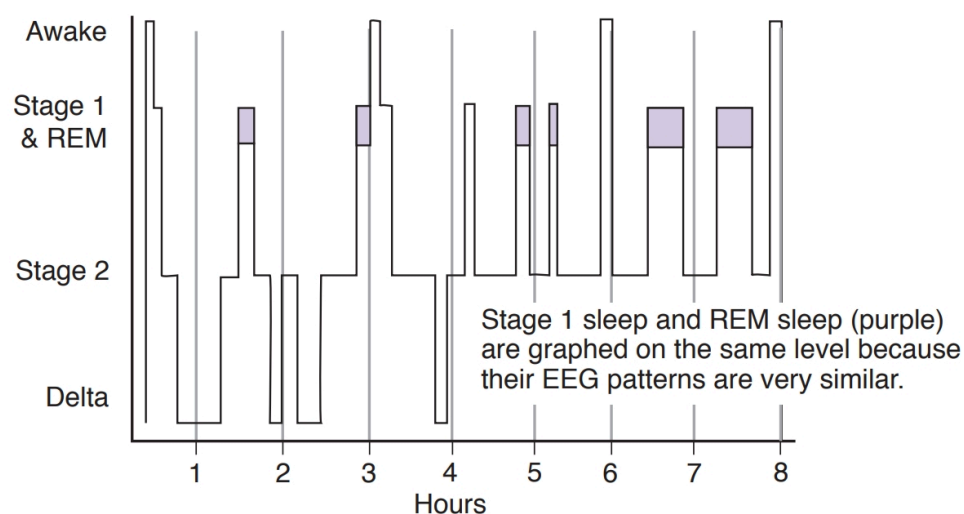
**Figure II-8-1.** Stages of Sleep

**Figure II-8-2.** Sleep Stages and Waves

Stage of Sleep	Wave Associated with Stage	EEG Pattern Associated with Waves
1	Theta	
2	Sleep spindles	
2	K complexes	
3	Delta	

**Table II-8-1. Sleep Facts**

<b>Stage 2</b>	Longest stage of sleep
<b>Stage 3</b>	<ul style="list-style-type: none"><li>• Deepest stage of sleep; delta sleep is restorative</li><li>• Tends to decrease in older adults</li></ul>
<b>Sleep latency</b>	About 5–15 min from time one goes to bed and falls asleep
<b>REM latency</b>	About 90 min from time one falls asleep to first REM period
<b>REM</b>	<ul style="list-style-type: none"><li>• First REM period of night is 5–15 min and last one is 20–40 min</li><li>• REM increases as night goes on</li><li>• Greater amounts in second half of night</li><li>• Easiest to arouse</li><li>• Memories are consolidated by hippocampus</li></ul>
<b>NREM</b>	Greater amounts in first half of night



**Figure II-8-3.** Sleep Architecture Diagram

## Sleep Deprivation

The cerebral cortex shows the greatest effects of sleep deprivation but has the capacity to cope with one night's sleep loss. In sleep-deprived individuals:

- Cortisol levels rise
- Blood pressure rises
- Glucose tolerance is reduced
- Greater amygdala activation
- Lower prefrontal cortical activity
- Increased negative mood

## Neurotransmitters

**Serotonin** helps to initiate sleep. **Acetylcholine** (ACh) is higher during REM sleep (associated with erections in men). **Norepinephrine** (NE) is lower during REM sleep.

- Ratio of ACh and NE is biochemical trigger for REM sleep.
- NE pathway begins in the pons, which regulates REM sleep.

Dopamine produces arousal and wakefulness. Dopamine levels rise upon waking.

Orexin (or hypocretin) is a neurotransmitter that regulates arousal, wakefulness, and appetite. Activation of orexin triggers wakefulness, while low levels of orexin at night serve to drive sleep. A deficiency of orexin results in sleep-state instability, leading to sleep disorders like narcolepsy.



Melatonin is converted from serotonin in the pineal gland in the brain under directions from the body's internal circadian clock.

- Melatonin production is inhibited by activation of photoreceptors cells in the retina.
- Melatonin production increases in the evening, causing drowsiness.
- Melatonin secretion regulates the sleep-wake cycle by inhibiting the circadian alerting system in the suprachiasmatic nucleus.
- Bright environmental light, capable of suppressing human melatonin, reverses the winter depressive symptoms of patients with seasonal affective disorder (SAD).

### Drugs That Alter Sleep

Dopamine increases wakefulness. Dopamine blockers (e.g., antipsychotics) increase sleep.

Benzodiazepines cause limited decrease in REM and delta sleep. If used chronically and then stopped, sleep latency will increase.

- Moderate alcohol consumption leads to early sleep onset and increased wakefulness during the second half of the night. Intoxication decreases REM; REM rebound (with nightmares) occurs during withdrawal.
- Barbiturates decrease REM; REM rebound, including nightmares, occurs in withdrawal.
- Major depression increases REM, decreases REM latency (45 rather than 90 minutes), and decreases stage 3 sleep. It also leads to early morning waking and multiple awakenings during the night.

## SLEEP DISORDERS

### Narcolepsy

Narcolepsy is a neurological disorder that decreases the ability to control the sleep-wake cycle. It is a REM disorder; patients typically enter REM within 10 minutes. It is linked to a deficiency in hypocretin (also known as orexin).

Narcolepsy patients experience 4 main symptoms (narcoleptic tetrad):

- Sleep attacks and excessive daytime sleepiness (**most common** symptoms)
- Cataplexy (pathognomonic sign): sudden loss of consciousness and symptoms ranging from slurred speech to total body collapse (can be triggered by loud noise, emotions, etc.)
- Hypnopompic and hypnogogic hallucinations (common)
- Sleep paralysis: the inability to move or speak while falling asleep or waking up from sleep

Treatment is modafinil or psychostimulants to treat the sleepiness and an antidepressant to treat the cataplexy.

## Sleep Apnea

With sleep apnea, individuals have episodes of apnea during the night causing them to have difficulties breathing. It is characterized by a loud snore and common in obese, middle-aged men.

- **Obstructive or upper airway sleep apnea:** airway collapses or becomes blocked during sleep
- **Central sleep apnea:** area of the brain that controls breathing does not send the correct signals to the breathing muscles; often associated with medical problems
- **Mixed sleep apnea:** patients experience both obstructive and central sleep apnea

Clinical presentation includes:

- High risk of sudden death during sleep
- Development of severe nocturnal hypoxemia
- Pulmonary and systemic hypertension (with elevated diastolic pressure)
- Nocturnal cardiac arrhythmias (potentially life-threatening)
- Bradycardia, then tachycardia

Symptoms commonly include dry mouth, headaches, and daytime tiredness. Restlessness and loud snoring are typically reported by sleep partners.

To diagnose, patients are referred to nocturnal polysomnography or home sleep tests to monitor pulse, oxygen level, etc. Treatment may be limited to diet or smoking cessation (mild cases); CPAP (continued positive airway pressure) in moderate to severe cases; and surgery in cases due to obstructive reasons.

## Insomnia

Insomnia is characterized by difficulty initiating and maintaining sleep (DIMS).

- **Primary insomnia**
- **Secondary insomnia** (most common) is caused by medical problems, psychiatric problems, medications, etc.

Symptoms of insomnia include sleepiness during the day, general tiredness, irritability, and problems with concentration or memory.

Treatment varies:

- Sleep hygiene
- Behavior modification: stimulus control
- Pharmacotherapy: zaleplon, zolpidem, eszopiclone (work on sleep receptors to help individual to fall and stay asleep)
- Ramelteon, a melatonin receptor-agonist, works on the sleep wake cycle and has less incidence of dependence





Table II-8-2. Parasomnias

Diagnosis	Sleep Stage	Features	Treatment	Memory for Event
Night terror	3	<ul style="list-style-type: none"><li>• Common in young boys</li><li>• Familial</li><li>• Wake up in middle of night and scream</li></ul>	Benzodiazepines	No
Nightmares	REM	Common during stressful times	Antidepressants	Yes
Somnambulism (sleep-walking)	3	<ul style="list-style-type: none"><li>• Confused and disoriented if awakened</li><li>• Common in children</li><li>• May harm themselves</li></ul>	Benzodiazepines	N/A
Bruxism (teeth grinding)	2	Usually stress-related	Teeth guards	N/A

**Recall Question**

A 25-year-old man is being evaluated for difficulty sleeping by his primary care physician. Upon questioning he states to having excessive daytime sleepiness with sleep attacks and episodes of sudden loss of consciousness. In which of the following neurotransmitters is he most likely deficient?

- A. Serotonin
- B. Acetylcholine
- C. Hypocretin
- D. Norepinephrine
- E. Dopamine

Answer: C

# Psychiatric (DSM-5) Disorders

# 9

## LEARNING OBJECTIVES

- ❑ Demonstrate understanding of the different psychiatric disorders that are identified in childhood and adolescence
- ❑ Demonstrate understanding of the different thought disorders that affect interpretation of reality
- ❑ Demonstrate understanding of the different mood and anxiety disorders
- ❑ Answer questions about the features of obsessive-compulsive disorder
- ❑ Answer questions about different eating disorders
- ❑ Answer questions about somatic symptom, dissociative, and personality disorders
- ❑ Demonstrate understanding about the types of sexual disorders

## CHILDHOOD AND ADOLESCENCE

### Intellectual Disability

The most common cause of intellectual disability is **fetal alcohol syndrome (FAS)**, while the most common genetic causes are **Down** and **fragile-X syndromes**.

**Table II-9-1. Intellectual Disability Levels**

Level	Functioning
Mild (85% of intellectually disabled; 2:1 male:female)	Self-supporting with some guidance; usually diagnosed first year in school
Moderate	Benefits from vocational training but needs supervision; sheltered workshops
Severe	Vocational training not helpful, can learn to communicate and manage basic self-care habits
Profound	Needs highly structured environment with constant nursing care and supervision



## Autism Spectrum Disorders

The hallmark of autism spectrum disorders is an **inability to connect with others**. It is usually diagnosed age <3. Boys > girls.

Clinical features include:

- Problems with communication and reciprocal social interaction
  - Abnormal or delayed language development; impairment in verbal and non-verbal communication
  - No separation anxiety; problems with relationships
  - Pronoun reversal
  - Fails to assume anticipatory posture, shrinks from touch
  - Poor eye contact
- Restrictive and repetitive behaviors (RRBs), interests, or activities
  - Stereotype or repetitive movements (echolalia, lining up toys)
  - Inflexibility
  - Oblivious to external world
  - Preference for inanimate objects

With autism, monozygotic concordance is greater than dizygotic concordance. Severity correlates to IQ deficiency. EEG may be abnormal. Seizures are present in 25% of patients.

Differential diagnosis includes:

- Rett syndrome
  - Girls > boys
  - Microcephaly
- Social communication disorder
  - Communication disorder
  - Absence of RRBs

Treatment is behavioral techniques (shaping) and antipsychotics (for aggression only), e.g., risperidone.

## Tourette Syndrome

Tourette syndrome is characterized by multiple motor and vocal tics that occur many times per day or intermittently for >1 year. Men > women 3:1.

- Mean onset is age 7 (onset must be age <18)
- Tics can be simple (rapid, repetitive contractions) or complex (appear as more ritualistic and purposeful); simple tics appear first
- Evidence of genetic transmission: ~50% concordance in monozygotic twins
- Associated with increased levels of dopamine
- Associated with ADHD and OCD

Treatment is haloperidol, pimozide, or clonidine.

## Attention Deficit Hyperactivity Disorder

Attention deficit hyperactivity disorder (ADHD) is marked by inattention, impulsivity, and/or hyperactivity that lead to problems functioning at home, school, or work. Men > women 3:1.

Impairment must occur in at least 2 settings.

- Symptoms >6 months
- Symptoms age <12
- Associated with a dopaminergic and noradrenergic imbalance

Treatment is methylphenidate, dextroamphetamine, atomoxetine, or guanfacine.

**Table II-9-2. Conduct vs. Oppositional Defiant Disorder**

	Conduct Disorder	Oppositional Defiant Disorder
<b>Age</b>	Until age 18	Preteens–teens
<b>Gender</b>	Boys > girls	Boys > girls (pre-puberty)
		Boys = girls (post-puberty)
<b>Symptoms</b>	<ul style="list-style-type: none"> <li>• 6 months of aggressive behavior</li> <li>• Violation of rules of society</li> <li>• Destruction of property</li> <li>• Deceitfulness or theft</li> </ul>	<ul style="list-style-type: none"> <li>• 6 months of negative, hostile, and defiant behaviors toward authority figures</li> </ul>
<b>Etiology</b>	Genetic	

### Recall Question

An 8-year-old boy comes for evaluation to his primary care physician. He is suspected of having Tourette syndrome. Which of the following is a characteristic feature of this syndrome?

- More common in girls than in boys
- Restrictive and repetitive behaviors
- Abnormal or delayed language development
- Failure to keep eye contact
- Increased levels of dopamine

Answer: E



## THOUGHT DISORDERS

Thought disorders are disorders that affect one's thinking, behavior, and interpretation of reality.

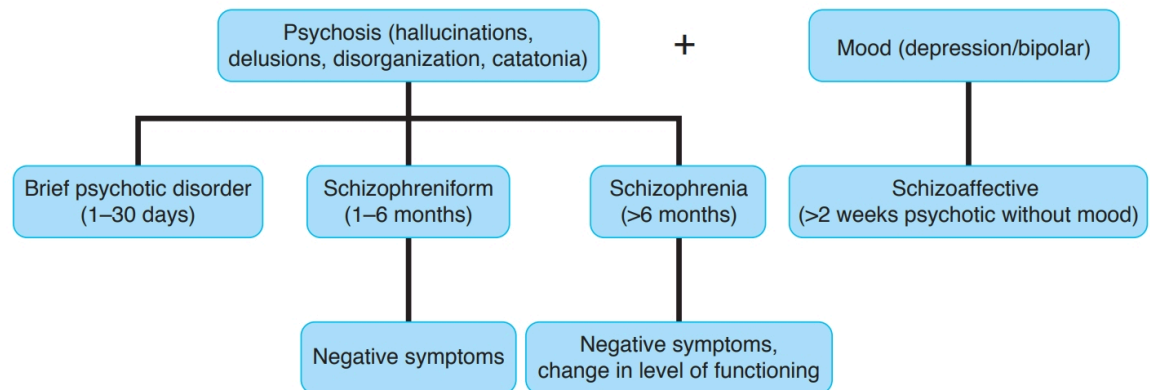


Figure II-9-1. Thought Disorders

Table II-9-3. Classification of Thought Disorders

Diagnosis	Symptoms	Duration of Symptoms	Treatment
Brief psychotic disorder	Hallucinations, delusions, disorganized behavior or thinking	>1 day but <30 days	Antipsychotics
Schizophreniform disorder	Hallucinations, delusions, disorganized behavior or speech	>1 month but <6 months	Antipsychotics
Schizophrenia	Hallucinations, delusions, disorganized behavior or speech, catatonic symptoms, negative symptoms, marked reduction in level of functioning	>6 months	Antipsychotics
Schizoaffective disorder	<ul style="list-style-type: none"><li>Schizophrenia symptoms such as hallucinations and delusions PLUS mood disorder symptoms such as depression and mania</li><li>Must have at least 2 weeks of psychotic symptoms in the absence of mood symptoms</li></ul>		Antipsychotics and mood stabilizers if bipolar type or antidepressants if depressed type

### Schizophrenia

Schizophrenia is seen in 1% of population. Men = women. Age of onset is age 15–25 (men) and age 25–35 (women). Around 90% of patients with schizophrenia are age 15–55.

- Persons with schizophrenia have higher mortality rate from accident and natural causes.
- Persons with schizophrenia are more likely to have been born in winter or early spring (increased risk of schizophrenia after exposure to influenza).
- Lifetime prevalence of substance abuse >50%.
- >90% of schizophrenics smoke (nicotine may reduce positive symptoms and improve some cognitive impairments).



There are several theories of schizophrenia:

- **Genetic:** monozygotic greater than dizygotic
- **Viral:** more born in winter and early spring
- **Social:** downward drift and social causation theories
- **Neurochemical/biochemical:** associated with increased levels of dopamine

**Table II-9-4. Biochemical Theories of Schizophrenia**

Neurotransmitter	Dopamine	Serotonin	Glutamate	Nicotine	GABA
<b>Change</b>	Increase	Increase	Increase/decrease	Decrease	Decrease
<b>Effects</b>	Positive symptoms	Positive and negative symptoms	PCP (glutamate antagonist) leads to schizophrenia-like symptoms	Cognition	Leads to hyperactivity of dopaminergic neurons

**Table II-9-5. Schizophrenia-Associated Neuropathology**

Brain Area	Ventricles	Symmetry	Limbic System	Prefrontal Cortex	Thalamus	Basal Ganglia and Cerebellum
<b>Change</b>	Increase	Decrease	Decrease	Decrease	Decrease	Increase/decrease

## MOOD DISORDERS

### Major Depressive Disorder

- Women > men
- Symptoms >2 weeks and affect level of functioning (must include depressed mood or anhedonia, plus other symptoms such as low energy, poor concentration, sleeplessness, loss of appetite or libido, suicidal ideation)
- Associated with decreased levels of NE, dopamine, and serotonin
- Suicide rate 15%

Treatment is antidepressants.

**Major depressive disorder with seasonal pattern** is associated with abnormalities in melatonin. It is common in the Northern hemisphere during the winter months. Treatment is bright light therapy (phototherapy).

### Persistent Depressive Disorder

Persistent depressive disorder is less severe than major depressive disorder.

- Symptoms >2 years; depressive symptoms experienced most days
- Hospitalization not usually needed; functioning not significantly impaired

Treatment is primarily psychotherapy.



## Bipolar Disorder

Bipolar disorder is the **most genetic of all the psychiatric disorders**. Men = women.

- Symptoms of mania >1 week, with loss of functioning. Manic symptoms include increased energy, decreased sleep, euphoria, delusions of grandeur, increased libido, distractibility, flight of ideas, increased self-esteem.
- Symptoms of major depressive disorder are very common but not necessary for diagnosis.

There are 2 types of bipolar disorder: **bipolar I** involves **mania and depression**, while **bipolar II** involves **hypomania and depression**.

**Table II-9-6. Bipolar Disorder Classification**

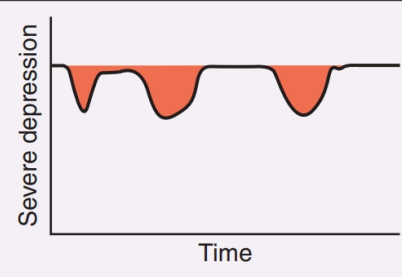
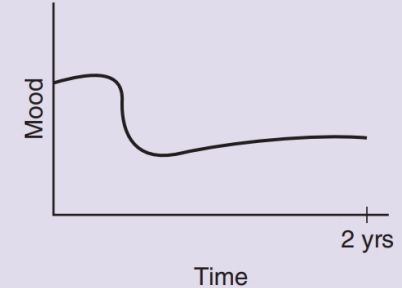
	Mania	Hypomania
Symptoms	Severe	Less severe
Level of functioning	Not functional	Functional
Hospitalization	Yes	No

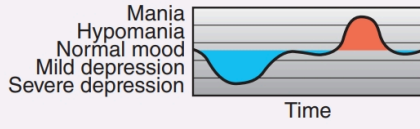
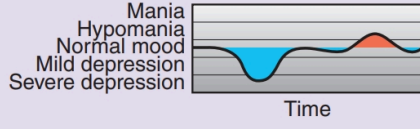
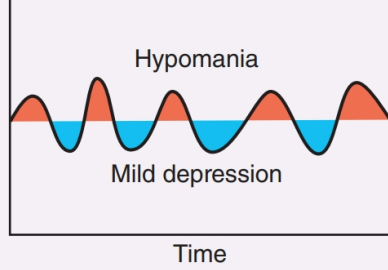
## Cyclothymic Disorder

- Symptoms >2 years characterized by:
  - Mood swings
  - Periods of hypomania alternating with periods of milder depression (neither meets criteria for mania or major depressive disorder)

Treatment is primarily psychotherapy.

**Table II-9-7. Mood Disorders**

Diagnosis	Duration	Mood Chart
Major depressive disorder	2 weeks	 <p>The mood chart for Major depressive disorder shows a baseline level of mood. The mood drops sharply into a state of 'Severe depression', indicated by the area below the baseline being shaded orange. This state of depression is shown to be recurrent over time.</p>
Persistent depressive disorder	2 years	 <p>The mood chart for Persistent depressive disorder shows a baseline level of mood. The mood drops and remains at a low, stable level for a prolonged period, indicated by a '2 yrs' marker on the time axis.</p>

Diagnosis	Duration	Mood Chart
Bipolar I disorder (mania)	1 week	 <p>Mania Hypomania Normal mood Mild depression Severe depression</p> <p>Time</p>
Bipolar II disorder	Months	 <p>Mania Hypomania Normal mood Mild depression Severe depression</p> <p>Time</p>
Cyclothymic disorder	2 years	 <p>Hypomania</p> <p>Mild depression</p> <p>Time</p>

### Recall Question

A 24-year-old man with a history of schizophrenia presents to his psychiatrist for a routine visit. His doctor suspects a substance use disorder. Which of the following is a patient with schizophrenia most likely to abuse?

- A. Nicotine
- B. Phencyclidine
- C. Cocaine
- D. Inhalants
- E. Alcohol

Answer: A



## ANXIETY DISORDERS

Anxiety disorders are linked to abnormalities in serotonin, norepinephrine, and GABA. Women > men (especially young women).

### Panic Disorder

Panic disorder is defined as the presence of panic attacks for >1 month.

- Involves worry about having more attacks and significant maladaptive behavioral changes related to the attack
- Panic attacks are short-lived and out of the blue, with increased autonomic hyperactivity:
  - Increased pulse
  - Hyperventilation
  - Palpitations
  - Tremors
  - Diaphoresis
  - Dissociative symptoms

Treatment is benzodiazepines (for panic attack) or SSRIs (for panic disorder). If hyperventilating, the patient should be instructed to breathe into a paper bag.

### Generalized Anxiety Disorder

Generalized anxiety disorder is a constant sense of worry for >6 months about things one should not have to worry about. The anxiety interferes with daily life:

- Problems with sleep
- Decreased concentration
- Irritability

Treatment is SSRIs or buspirone.

### Phobias

Phobias are irrational fears of things or situations and the need to avoid them. Specific phobias include fear of things or objects, such as animals, heights, and elevators.

Treatment is a behavioral modification technique such as systematic desensitization or flooding.

### Social Anxiety

Social anxiety is fear of being embarrassed or humiliated in a social situation, such as in a public restroom or restaurant, or public speaking (called stage fright or **performance anxiety** only if related to performance in public).

Treatment is antidepressants and beta-blockers (for stage fright, given before an event).

## OBSESSIVE-COMPULSIVE DISORDER AND RELATED DISORDERS

### Obsessive-Compulsive Disorder

- **Obsessions:** thoughts that are intrusive, senseless and time consuming
  - Ego-dystonic
  - Thoughts are distressing
  - Increases anxiety
  - Most common thoughts include contamination and doubt
  - Defense mechanism: reaction formation
- **Compulsions:** acts that are repetitive, time consuming
  - Ego-dystonic
  - Reduces the anxiety associated with the obsessive thoughts
  - Most common include washing and checking
  - Defense mechanism: undoing
- Equal incidence in men and women

Treatment is antidepressants and behavioral modification (exposure and response prevention).

### Body Dysmorphic Disorder

Body dysmorphic disorder is belief that some part of one's body is abnormal, defective, or misshapen. It is associated with serotonin. It must be differentiated from body image disturbance seen in anorexia nervosa.

Treatment is psychotherapy and SSRIs.

### Hoarding Disorder

Hoarding disorder is difficulty parting with one's possessions regardless of their value; level of functioning changes as a result of clutter in the home. There is distress when thinking of getting rid of items.

Treatment is SSRIs and psychotherapy.

### Trichotillomania

Trichotillomania is an irresistible urge to pull out one's own hair followed by a sense of relief. Many patients eat or chew the hair. The most common areas of hair pulling are the scalp, eyebrows, eyelashes, beard, and pubic area.

## TRAUMA AND STRESSOR-RELATED DISORDERS

### Post-Traumatic Stress Disorder and Acute Stress Disorder

Stress disorders result from exposure to actual or threatened death, serious injury, or sexual violation in one of the following ways:

- Direct experience
- Repeated exposure (first responders)





- Witnessing the event
- Learning of violent or accidental traumatic event involving a close family member or friend

Exposure may lead to re-experiencing of symptoms in the form of nightmares or flashbacks. Women > men. Symptoms include:

- Phobic avoidance
- Hypervigilance
- Increased startle reflex
- Mood instability
- Sleep disturbances
- Dissociative symptoms

Treatment is exposure therapy and SSRIs.

	Post-Traumatic Stress Disorder	Acute Stress Disorder
Onset	Anytime	>3 days but <1 month
Duration	≥1 month	<1 month

### Adjustment Disorder

Adjustment disorder is a maladaptive response to an identifiable stressor causing distress in functioning.

- Symptoms must occur within 3 months of stressor
- Symptoms cannot last >6 months in duration

Treatment is supportive psychotherapy.

### Recall Question

A 28-year-old woman presents to the physician for routine examination. She states that for the past 2–3 weeks she has been less able to concentrate at work, is easily distracted, has increased energy, has been sleeping only 3 hours/night, and has had multiple sexual partners. What other findings would be consistent with the most likely diagnosis?

- A. Slow, telegraphic speech
- B. Rapid, tangential speech
- C. Depressed mood
- D. Self-injurious behavior
- E. Recurrent food binges

Answer: B

## EATING DISORDERS

### Anorexia Nervosa

Anorexia is characterized by restriction of food intake that leads to **>15–20% loss of ideal body weight** or **BMI <17**. It is difficult to treat. Girls > boys.

- Body image disturbance (patients feel fat even though they are very thin)
- Fear of gaining weight
- Poor sexual adjustment
- Medical complications include:
  - Abnormal electrolytes
  - Lanugo hair
  - Abnormal hormones
  - Low blood pressure
  - Heart failure
  - Osteoporosis

Treatment is hospitalization, behavioral modification, SSRIs, and family therapy.

### Bulimia Nervosa

Bulimia nervosa is characterized by binge eating followed by purging. **Weight is normal**. Most patients recover. Girls > boys.

In bulimia, defense mechanisms are involved, e.g., purge: undoing. Characterized by:

- **Binge** (rapid ingestion of food)
- **Purge** (compensatory behavior)
  - **Vomiting** (signs of **repetitive emesis** include abrasions and callous in fingers/hands, esophageal tears, enlarged parotid glands, and dental cavities)
  - Exercising
  - Fasting
  - Use of laxatives
  - Use of diuretics

Treatment is behavioral modification and SSRIs.

### Binge Eating Disorder

Binge eating disorder is binge eating without the compensatory behavior seen in bulimia nervosa. **Weight is above normal**.

Treatment is stimulants.



## SOMATIC SYMPTOM AND RELATED DISORDERS

### Somatic Symptom Disorder

- Excessive thoughts, feelings, and behavior related to the somatic symptoms
- Duration >6 months
- Functioning impaired
- May be only one symptom; could be related to medical illness
- Main focus is how you react to the symptom

Treatment should be by one identified physician along with psychotherapy.

### Illness Anxiety Disorder

Illness anxiety disorder is characterized by the belief that one has an underlying illness, despite constant reassurance.

- Duration >6 months
- Somatic symptoms are not present; if present, mild

Treatment is psychotherapy.

### Conversion Disorder

Conversion disorder is the development of neurological symptoms following a psychological stressor that cannot be medically explained.

- All work-up tests will be negative.
- Patients will be indifferent to symptoms (*la belle indifférence*).

Treatment is psychotherapy.

### Factitious Disorder

Factitious disorder is the conscious production of signs and symptoms of a mental or physical illness. There are 2 types: **imposed on self** and **imposed on others**.

- Unconscious motivation (without knowing why)
- No obvious external gains
- Most patients become angered when confronted, will leave hospital against medical advice

Treatment is psychotherapy.

### Malingering

Malingering is **not a mental illness**. It is the conscious production of signs and symptoms of a mental or physical illness.

- Conscious motivation
- Obvious external gains: money, avoiding prison, time off from work or school
- Most patients become angered when confronted

**Table II-9-8. Somatic Symptom Disorder vs. Factitious Disorders and Malingering**

	Somatic Symptom	Factitious	Malingering
Symptom production	Unconscious	Intentional	Intentional
Motivation	Unconscious	Unconscious	Intentional

## DISSOCIATIVE DISORDERS

In dissociative disorders, the defense mechanism used is **dissociation**. It involves the splitting off of brain from consciousness, typically caused by traumatic events.

- **Amnesia:** inability to recall important personal information
  - Dissociative identity disorder (multiple personality): presence of  $\geq 2$  distinct identities; will have lapses in memory
- **Depersonalization disorder:** recurrent experiences of being detached from or outside of one's body
  - "Out of body" experiences
  - Reality testing stays intact
  - Causes significant impairment
- **Fugue** (may appear with all subtypes): involves sudden unexpected travel, an inability to recall one's past, or confusion of identity

## PERSONALITY DISORDERS

Personality disorders are maladaptive patterns of behavior. They are ego-syntonic and lifelong.

### Cluster A: Odd, Eccentric Type

**Paranoid:** long-standing suspiciousness or mistrust of others; a baseline of mistrust

- Preoccupied with issues of trust, reluctant to confide in others
- Reads hidden meaning into comments or events
- Carries grudges

**Schizoid:** lifelong pattern of social withdrawal; they like it that way

- Seen by others as eccentric, isolated, and withdrawn
- Has restricted emotional expression

**Schizotypal:** very odd, strange, weird

- Magical thinking (including ESP and telepathy)
- Ideas of reference, illusions
- Socially anxious and isolated; lacks close friends
- Incongruous affect
- Odd speech
- May have short-lived psychotic episodes



## Cluster B: Dramatic and Emotional

**Histrionic:** colorful, dramatic, and extroverted

- Unable to maintain long-lasting relationships
- Attention-seeking
- Desires spotlight
- Uses seductive behavior

**Narcissistic:** grandiose sense of self-importance

- Preoccupied with fantasies of unlimited wealth, power, love
- Demands constant attention
- Has fragile self-esteem
- Prone to depression
- Meets criticism with indifference or rage
- Genuinely surprised and angered when others don't do as they want
- Can be charismatic

**Borderline:** very unstable affect, behavior, self-image

- In constant state of crisis, chaos
- Self-detrimental impulsivity: promiscuity, gambling, overeating, substance-related disorders
- Unstable but intense interpersonal relationships
- Have great difficulty being alone
- Self-injurious behavior
- Multiple suicide attempts
- History of sexual abuse
- Defense mechanisms: splitting, passive-aggression
- Women > men 2:1

**Antisocial:** unable to conform to rules of society (**only personality disorder that requires age 18 for diagnosis**)

- Criminal acts: delinquency, theft
- Truancy
- Running away
- Unable to hold a job
- Unable to maintain enduring attachments
- Reckless
- Aggressive
- Show lack of remorse
- Men > women



## Cluster C: Anxious and Fearful

**Avoidant:** extreme sensitivity to rejection; sees self as socially inept

- Excessively shy, has high anxiety
- Socially isolated but has an intense, internal desire for affection and acceptance
- Tends to stay in same job, same life situation, and same relationships

**Obsessive-compulsive:** characterized by orderliness and perfectionism

- Inflexible, control freak
- Loves lists, rules, order; wants to keep routine
- Rigid and excessively stubborn

**Dependent:** gets others to assume responsibility

- Subordinates own needs to others
- Unable to express disagreement
- Greatly fearful of having to care for self
- May be linked to abusive spouse

## SEXUAL DISORDERS

### Sexual Desire/Arousal Disorders

In **male hypoactive sexual desire disorder**, men experience a deficiency or absence of fantasies or desires. Reasons: low testosterone, CNS depressants, depression, marital discord; common post-surgery.

In **female sexual interest/arousal disorder**, women are unable to achieve adequate vaginal lubrication. Reasons include possible hormonal connection (many women report peak sexual desire just prior to menses) and antihistamine/anticholinergic medications, which can reduce vaginal lubrication.

**Male erectile disorder** (impotence) has 10–20% lifetime prevalence; point prevalence is 3%. Half of men treated for sexual disorder complain of impotence.

- Incidence is 8% young adult and 75% men age >80
- 50% more likely in smokers

Be sure to check alcohol usage, diabetes, and marital conflict, as it must be determined whether the cause is organic or psychological. Assessment is made with the postage stamp test, snap gauge (to test physiological vs. psychological).

Treatment is sildenafil, vardenafil, and tadalafil.



## Orgasm Disorders

**Female orgasm disorder** is an inability to achieve orgasm. Overall prevalence from all causes is 30%. About 5% of married women age >35 have never achieved orgasm.

Treatment is fantasy, vibrators.

In **premature ejaculation**, the man ejaculates before or immediately after entering vagina. It is more common if early sexual experiences were in the backseat of car or with a prostitute, or there is anxiety about the sexual act.

Treatment is stop-and-go technique, squeeze technique, and SSRIs.

## Paraphilic Disorders

- Pedophilia: sexual urges toward children; most common paraphilia
- Exhibitionism: recurrent desire to expose genitals to stranger
- Voyeurism: sexual pleasure from watching others who are naked, grooming, or having sex; begins early in childhood
- Sadism: sexual pleasure derived from others' pain
- Masochism: sexual pleasure derived from being abused or dominated
- Fetishism: sexual focus on objects, e.g., shoes, stockings; transvestite fetishism involves fantasies or actual dressing by heterosexual men in female clothes for sexual arousal
- Frotteurism: male rubbing of genitals against fully clothed woman to achieve orgasm; subways and buses
- Zoophilia: animals preferred in sexual fantasies or practices
- Coprophilia: combining sex and defecation
- Urophilia: combining sex and urination
- Necrophilia: preferred sex with cadavers
- Hypoxyphilia: altered state of consciousness secondary to hypoxia while experiencing orgasm; achieved with autoerotic asphyxiation, poppers, amyl nitrate, nitric oxide

## Genito-Pelvic Pain Disorders

Genito-pelvic pain/penetration disorders involve involuntary muscle constriction of the outer third of the vagina which prevents penile insertion. Psychological in origin, they involve recurrent and persistent pain before, during, or after intercourse.

- Diagnosed only in women
- Not diagnosed if caused by a medical conditions

Treatment is relaxation and Hegar dilator.

**Recall Question**

A 17-year-old girl is brought to her primary care physician by her mother for complaints of weight loss. Her mother explains that her daughter has lost 40 pounds in the past 2 months, spending all day staring in the mirror and being concerned that she is gaining weight. The physician suspects anorexia nervosa. Which of the following is the best treatment?

- A. Antipsychotics
- B. Appetite stimulants
- C. Exposure and response prevention
- D. Selective serotonin reuptake inhibitors
- E. Individual and family therapy

Answer: E



## LEARNING OBJECTIVES

- ❑ Define the side effect profile of different receptors
- ❑ Demonstrate understanding of the types of antipsychotics and how they work
- ❑ Demonstrate understanding of the types of antidepressants and how they work
- ❑ Demonstrate understanding of the types of mood stabilizers and how they work
- ❑ Demonstrate understanding of the types of anxiety medications and how they work

## SIDE EFFECT PROFILE

Receptor	Effects
Histamine	Sedation, weight gain
Muscarine	Anticholinergic (dry mouth, blurry vision, constipation, confusion, etc.)
Alpha 1	Dizziness, hypotension

## ANTIPSYCHOTIC (NEUROLEPTIC) MEDICATIONS

Antipsychotic medications are used to treat 2 types of conditions:

- Schizophrenia and other psychotic disorders
- Tic disorders, Tourette syndrome, and bipolar disorders

The **mechanism of action** is dopamine blockage at the postsynaptic receptors.



**Table II-10-1. Medication Side Effects**

Side Effect	Peak	Treatment
Dystonic reaction	Hours to days	Anticholinergics: benztropine, trihexyphenidyl, diphenhydramine
Rigidity	3 weeks	Lower dose or anticholinergics
Tremors	6 weeks	Lower dose or anticholinergics
Akathisia	10 weeks	B-blockers, benzodiazepines; lower dose or switch to atypical
Tardive dyskinesia	>3–6 months	Switch to atypical or clozapine
Neuroleptic malignant syndrome	Any time	May be lethal; dantrolene or bromocriptine

Dopamine tracts include:

- **Mesolimbic/mesocortical:** reduces psychotic symptoms
- **Nigrostriatal:** increases movement disorder
- **Tuberoinfundibular:** increases prolactin (galactorrhea, amenorrhea, gynecomastia)

## Types of Antipsychotics

**Table II-10-2. Typical vs. Atypical Antipsychotics**

Typical	Atypical
Dopamine	Dopamine and serotonin
Treats mostly positive symptoms	Treats positive and negative symptoms
More side effects	Fewer side effects

The potency of typical antipsychotic medications is as follows:

Potency	Extrapyramidal Symptoms	Anticholinergic Effects
High (haloperidol)	High	Low
Low (chlorpromazine)	Low	High

**Typical antipsychotics** have movement and prolactin side effects.

- Haloperidol
- Fluphenazine

### NOTE

Extrapyramidal reactions include:

- Choreiform: jerky movements
- Athetoid: slow, continuous movements
- Rhythmic: stereotypical movements

- Chlorpromazine
- Mesoridazine
- Thioridazine (additional increased risk of retinitis pigmentosa and retrograde ejaculation)

**Atypical antipsychotics** are known for weight gain, increased risk of diabetes, and metabolic syndrome, but also cause movement and prolactin side effects.

- Clozapine (additional increased risk of agranulocytosis (<1%), seizures, drooling)
- Risperidone
- Olanzapine
- Quetiapine
- Ziprasidone
- Aripiprazole (partial dopamine agonist)
- Paliperidone
- Lurasidone

### Recall Question

A 26-year-old man comes to the psychiatrist for a follow-up appointment for his schizophrenia. He was recently started on a new medication. Today he complains of having difficulty with sexual intercourse and having brown-tinged vision. On which new antipsychotic medication was the patient recently started?

- Clozapine
- Haloperidol
- Thioridazine
- Quetiapine
- Ziprasidone

Answer: C

## ANTIDEPRESSANT MEDICATIONS

Antidepressant medications are used to treat depression, anxiety, and pain disorders. The **mechanism of action** is on the norepinephrine (NE), serotonin (5-HT), and dopamine receptors.

### Tricyclic Antidepressants

Tricyclic antidepressants (TCAs) block reuptake of serotonin and norepinephrine, alpha-1 adrenergic receptors, and muscarinic receptors. They cause many side effects and are lethal in overdose.

**NOTE**

Use TCAs with caution in older adults, as they cause many side effects.

- Amitriptyline
- Imipramine (monitor levels)
- Nortriptyline (monitor levels)
- Desipramine (monitor levels)
- Clomipramine

**Monoamine Oxidase Inhibitors**

Monoamine oxidase inhibitors (MAOIs) are the treatment of choice for major depressive disorder with atypical features. The **mechanism of action** is inhibition of MAO, an enzyme that metabolizes serotonin, epinephrine, and NE.

- Phenelzine
- Tranylcypromine
- Isocarboxazid

MAOI plus tyramine can cause **hypertensive crisis**. Signs include occipital headache, stiff neck, nausea/vomiting, chest pain, dilated pupils, nosebleed, and elevated blood pressure.

- Problem foods: aged cheese, dried fish, sauerkraut, sausage, chocolate, avocados, red wine
- Safe foods: cottage cheese, some wine (mostly white)

**Selective Serotonin Reuptake Inhibitors**

Selective serotonin reuptake inhibitors (SSRIs) are the **most commonly used antidepressants**. The **mechanism of action** is inhibition of the reuptake of serotonin. They are also used to treat anxiety and sexual disorders.

- Fluoxetine
- Sertraline
- Paroxetine
- Citalopram
- Escitalopram
- Fluvoxamine

Side effects include weight gain, sexual problems, headaches, and GI complaints.

Serotonin syndrome is associated with high doses, MAOI/SSRI combo, and MAOI/synthetic narcotic combination. Symptoms include general restlessness, sweating, insomnia, nausea, diarrhea, cramps, delirium, and myoclonus.

Treatment is removal of the causative agent, stopping the SSRI, and administering cyproheptadine.

**NOTE**

SSRIs do not affect histamine, alpha, or muscarinic receptors, so their side effect profile is cleaner than the other antidepressants.

## Serotonin Norepinephrine Reuptake Inhibitors

Serotonin norepinephrine reuptake inhibitors (SNRIs) are used to treat depression, anxiety, and pain disorders.

The **mechanism of action** is inhibition of the reuptake of serotonin and norepinephrine.

- Venlafaxine
- Desvenlafaxine
- Duloxetine

Side effects include increased blood pressure and blurry vision (common).

## Other Antidepressants

- Trazodone
  - 5-HT receptor antagonist, alpha-1 blocker
  - Almost no anticholinergic adverse effects
  - May lead to priapism so sometimes used to treat erectile dysfunction
  - Sedation is common side effect
- Mirtazapine
  - Stimulates NE and 5-HT release; blocks 5-HT<sub>2</sub> and 5-HT<sub>3</sub> receptors
  - Sedation and weight gain are common side effects
- Bupropion (approved for depression and smoking cessation)
  - Relatively weak inhibitor of the neuronal reuptake of norepinephrine and dopamine; does not inhibit the reuptake of serotonin
  - Not associated with weight gain or sexual side effects
  - Side effect is increased risk of seizures, so it is not used in patients with seizure disorders, eating disorders, or alcohol withdrawal seizures

## MOOD STABILIZER MEDICATIONS

### Lithium

Lithium is the drug of choice for bipolar disorders. It is quickly absorbed from the GI tract—not protein-bound or metabolized. Therapeutic index is low, meaning it requires reaching plasma levels very close to toxic levels for full effect (reached in 10–14 days).

Good kidney function and adequate salt- and fluid-intake are essential with lithium, as 95% is excreted in urine.



The **mechanism of action** (hypothesized) is blocking of inositol-1-phosphate (second messenger).

- Monitor blood levels; if  $>2.5$  mEq/L, consider dialysis as the treatment of choice.
- Potassium-sparing diuretics have no effect; loop diuretics will produce increased serum levels.
- Side effects include:
  - Tremor, thirst, anorexia, GI distress
  - Polyuria, polydipsia, edema
  - Acne
  - Hypothyroidism
  - Nephrotoxicity
  - Teratogenicity (Ebstein's anomaly affecting the tricuspid valve)
  - Diabetes insipidus
  - If toxic, ataxia, seizures and confusion may be seen.

### Valproic Acid

Valproic acid is used to treat bipolar disorders and rapid cycling bipolar disorders. The **mechanism of action** involves augmentation of GABA in CNS.

- Side effects include sedation, weight gain, tremors, alopecia, GI distress, and teratogenicity (neural tube defects).
- If toxic, may cause confusion, coma, or cardiac arrest.
- Monitor blood levels, as it can cause hepatotoxicity (liver function impairment).

### Carbamazepine

The **mechanism of action** involves blocking sodium channels in neurons with action potential; it alters central GABA receptors.

- Side effects include GI distress, rash, mild leukopenia, agranulocytosis, and aplastic anemia.
- If toxic, may cause hypotension, tachycardia, respiratory depression, or coma.
- Monitor blood levels and signs of rash.

### Lamotrigine

Lamotrigine is associated with Stevens-Johnson syndrome.



## ANTIANXIETY MEDICATIONS

### Benzodiazepines

Benzodiazepines are used to treat anxiety disorders, sleep disorders, alcohol withdrawal, and seizures.

The **mechanism of action** is depression of the CNS at the limbic system, RAS, and cortex. Benzodiazepines bind to GABA-chloride receptors, facilitating the action of GABA.

- All benzodiazepines undergo hepatic microsomal oxidation (except for lorazepam, oxazepam, and temazepam, which undergo glucuronide conjugation).
- Side effects include sedation, insomnia, addiction, falls (older adults), confusion, and disinhibition.

### Buspirone

Buspirone is used for generalized anxiety disorder and other anxiety disorders when possible abuse of benzodiazepines is a concern. It has no withdrawal effect and is not potentiated by alcohol.

The **mechanism of action** works on serotonin, not on GABA.

- Full effect is seen >7 days
- Some sedation is seen
- Has low-abuse potential

#### Recall Question

A 25-year-old G1P1 woman presents to the clinic for a follow-up. She has a well-documented history of bipolar disease for which she takes lithium. Which of the following potential cardiac-relevant teratogenic effects does lithium have on the fetus?

- Ventral septal defect
- Tetralogy of Fallot
- Transposition of the great arteries
- Atrial septal defect
- Displacement of the tricuspid valve

Answer: E



# Brain Function and Neurocognitive Disorders

# 11

## LEARNING OBJECTIVES

- ❑ Demonstrate understanding of left and right brain dominance
- ❑ Be able to correlate specific function with corresponding part of the brain
- ❑ Demonstrate understanding of how healthy parts of the brain differ from injured parts
- ❑ Answer questions about how dominant parietal lobe dysfunction differs from non-dominant dysfunction
- ❑ Demonstrate understanding of the different neurotransmitters and how they affect the brain
- ❑ Demonstrate understanding about how the neurocognitive disorders differ

## LEFT AND RIGHT BRAIN DOMINANCE

The **left hemisphere** is dominant in **language** and **calculation-type problem solving**. It is dominant in 97% of the population (60–70% in left-handed persons).

- Stroke damage to the left hemisphere is more likely to lead to **depression**.

The **right hemisphere** is dominant in **perception**, **artistic**, and **visual-spatial tasks**. It is activated for intuition-type problem solving.

- Stroke damage to the right hemisphere is more likely to lead to **apathy and indifference**.



## AREAS OF THE BRAIN

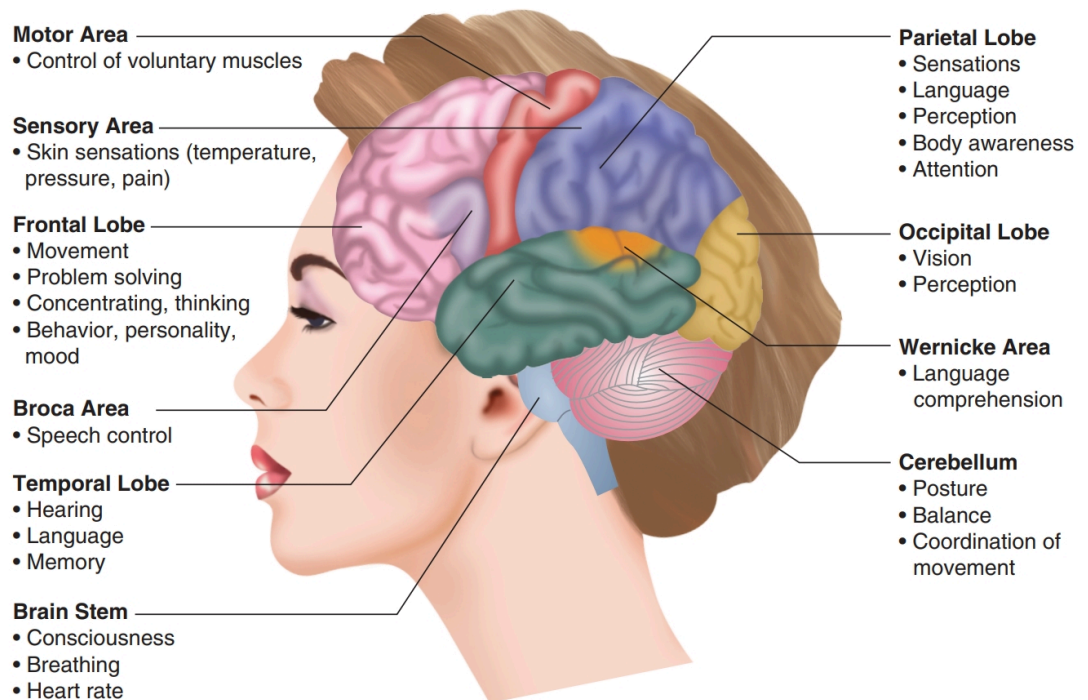


Figure II-11-1. Functional Areas of the Brain

	Healthy Brain	Injured Brain
<b>Frontal lobe</b>	<ul style="list-style-type: none"><li>• Personality/emotions</li><li>• Intelligence</li><li>• Attention/concentration</li><li>• Judgment</li><li>• Body movement</li><li>• Problem-solving</li><li>• Speech (speaking and writing)</li></ul>	<ul style="list-style-type: none"><li>• Loss of movement (paralysis)</li><li>• Repetition of a single thought</li><li>• Unable to focus on a task</li><li>• Mood swings, irritability, impulsiveness</li><li>• Changes in social behavior and personality</li><li>• Difficulty problem solving</li><li>• Difficulty with language; cannot get the words out (aphasia)</li></ul>
<b>Parietal lobe</b>	<ul style="list-style-type: none"><li>• Sense of touch, pain, and temperature</li><li>• Distinguishing size, shape, and color</li><li>• Spatial perception</li><li>• Visual perception</li></ul>	<ul style="list-style-type: none"><li>• Difficulty distinguishing left from right</li><li>• Lack of awareness or neglect of certain body parts</li><li>• Difficulty with eye-hand coordination</li><li>• Problems reading, writing, naming</li><li>• Difficulty with mathematics</li></ul>
<b>Occipital lobe</b>	Vision	<ul style="list-style-type: none"><li>• Defects in vision or blind spots</li><li>• Blurred vision</li><li>• Visual illusions/hallucinations</li><li>• Problems reading and writing</li></ul>

	Healthy Brain	Injured Brain
<b>Temporal lobe</b>	<ul style="list-style-type: none"> <li>• Speech (understanding language)</li> <li>• Memory</li> <li>• Hearing</li> <li>• Sequencing</li> <li>• Organization</li> </ul>	<ul style="list-style-type: none"> <li>• Difficulty understanding language and speaking (aphasia)</li> <li>• Difficulty recognizing faces</li> <li>• Difficulty identifying/naming objects</li> <li>• Problems with short- and long-term memory</li> <li>• Changes in sexual behavior</li> <li>• Increased aggressive behavior</li> </ul>
<b>Cerebellum</b>	<ul style="list-style-type: none"> <li>• Balance</li> <li>• Coordination</li> </ul>	<ul style="list-style-type: none"> <li>• Difficulty coordinating fine movements</li> <li>• Difficulty walking</li> <li>• Tremors</li> <li>• Dizziness (vertigo)</li> <li>• Slurred speech</li> </ul>
<b>Brainstem</b>	<ul style="list-style-type: none"> <li>• Breathing</li> <li>• Heart rate</li> <li>• Alertness/consciousness</li> </ul>	<ul style="list-style-type: none"> <li>• Changes in breathing</li> <li>• Difficulty swallowing food and water</li> <li>• Problems with balance and movement</li> </ul>

## APHASIA

Aphasia is an impairment of language affecting one's ability to speak/understand speech, read, or write.

- **Dominant (left)** parietal lobe dysfunction (in most right-handed and some left-handed patients):
  - Language disorders (aphasia, alexia)
  - Gerstmann syndrome (dyscalculia, dysgraphia, finger agnosia, right-left confusion)
  - Apraxia
- **Non-dominant (right)** parietal lobe dysfunction:
  - Hemispatial neglect
  - Sensory and visual inattention
  - Constructional and dressing apraxia (more severe for right-sided lesions)



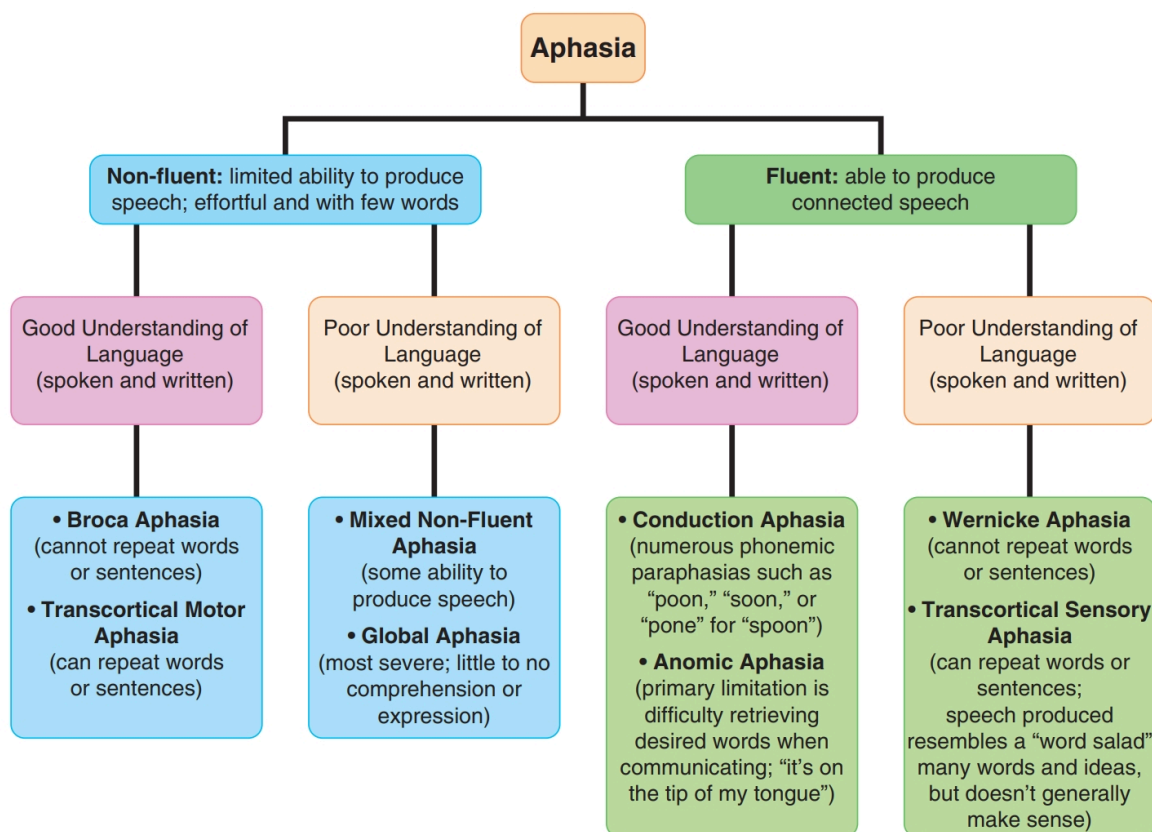


Figure II-11-2. Aphasia

### Recall Question

A 76-year-old man is brought to the emergency department with signs and symptoms of a stroke. On physical examination he is noted to have difficulty with hand-eye coordination and has finger-to-nose-finger dysmetria, difficulty walking and vertigo. Which area of the brain is most likely injured?

- A. Brainstem
- B. Cerebellum
- C. Temporal lobe
- D. Parietal lobe
- E. Frontal lobe

Answer: B

## NEUROTRANSMITTERS

### Acetylcholine (ACh)

ACh is a neurotransmitter at nerve-muscle connections for all voluntary muscles of the body and also many of the involuntary (autonomic) nervous system synapses. The exact role of ACh in the brain is unclear. It plays a significant role in Alzheimer disease.

- Cholinergic neurons concentrated in the RAS and basal forebrain
- Neurocognitive disorder in general associated with decreased ACh concentrations in amygdala, hippocampus, and temporal neocortex
- Associated with erections in men
- Muscarinic and nicotinic receptors
- In the corpus striatum, ACh circuits are in equilibrium with dopamine neurons

## Norepinephrine

Norepinephrine (NE) is one of the catecholamine neurotransmitters. It is a transmitter of the sympathetic nerves of the autonomic nervous system, which mediate emergency response.

- Acceleration of the heart
- Dilatation of the bronchi
- Elevation of blood pressure

NE is implicated in altering attention, perception, and mood. The key pathway is locus coeruleus in upper pons. It is implicated in monoamine hypothesis of affective disorders.

- Depletion of NE leads to depression
- Excess of NE (and serotonin) leads to mania
- Based on 2 observations: reserpine depletes NE and causes depression; antidepressant drugs block NE reuptake, thus increasing the amount of NE available postsynaptically

Receptors:

- Alpha-1: sympathetic (vasoconstriction)
- Alpha-2: on cell bodies of presynaptic neurons, inhibit NE release
- Beta-1: excitatory for heart, lungs, brain
- Beta-2: excitatory for vasodilatation and bronchodilation

## Dopamine

Dopamine is the other catecholamine neurotransmitter, synthesized from the amino acid tyrosine.

- D2 receptors most important
- D1 and D5 stimulate G-protein and increase cAMP and excitation
- D2, D3, and D4 inhibit G-protein and decrease cAMP and excitation

Three pathways of known psychiatric importance:

- **Nigrostriatal pathway:** blockade leads to tremors, muscle rigidity, bradykinesia
- **Mesolimbic-cortico pathway:** blockade leads to reduction of psychotic symptoms
- **Tuberoinfundibular system:** blockade leads to increases in prolactin (DA = PIF)



### Serotonin (5-Hydroxytryptamine, 5-HT)

Serotonin is the transmitter of a discrete group of neurons that all have cell bodies located in the raphe nuclei of the brain stem. Changes in the activity of serotonin neurons are related to the actions of psychedelic drugs. It is involved in the therapeutic mechanism of action of antidepressant treatments (most are 5-HT reuptake inhibitors; a few new ones are 5-HT agonists).

- Has inhibitory influence; linked to impulse control
- Low 5-HT = low impulse control
- Has role in regulation of mood, sleep, sexual activity, aggression, anxiety, motor activity, cognitive function, appetite, circadian rhythms, neuroendocrine function, and body temperature

### Glutamic Acid

Glutamic acid is one of the major amino acids in general metabolism and protein synthesis; it is also a neurotransmitter.

- Stimulates neurons to fire
- Is the principal excitatory neurotransmitter in the brain and the neurotransmitter of neuronal pathways connecting the cerebral cortex and corpus striatum
- Is the transmitter of the granule cells, the most numerous neurons in the cerebellum

There is evidence that glutamic acid is the principal neurotransmitter of the visual pathway. It may have a role in producing schizophrenic symptoms; is the reason for PCP symptoms (antagonist of NMDA glutamate receptors). Glutamate agonists produce seizures in animal studies.

### Enkephalins

Enkephalins are composed of 2 peptides, each containing 5 amino acids. They are normally occurring substances that act on opiate receptors, mimicking the effects of opiates. Neurons are localized to areas of the brain that regulate functions influenced by opiate drugs.

### Substance P

Substance P is a peptide containing 11 amino acids and is a major transmitter of sensory neurons that convey pain sensation from the periphery, especially the skin, into the spinal cord; also found in numerous brain regions. Opiates relieve pain in part by blocking the release of substance P.

### Gamma Aminobutyric Acid

Gamma aminobutyric acid (GABA) is one of the amino acid transmitters in the brain. It occurs almost exclusively in the brain, reduces the firing of neurons, and is the brain's principle inhibitory neurotransmitter (present at 25–40% of all synapses in the brain). GABA is associated with anxiety, cannabis, and benzodiazepines.

#### NOTE

There is a new class of antidepressant medications being tested to work on substance P.



## NEUROCOGNITIVE DISORDERS

**Delirium** is an acute onset of impaired cognitive functioning that is fluctuating, brief, and reversible. **Neurocognitive disorder** is a loss of cognitive abilities, impairment of social functioning, loss of memory, and/or change in personality that may be progressive or static. It is reversible only 15% of the time.

**Mild** neurocognitive disorder is moderate cognitive decline that has minimal interaction with functioning. **Major** neurocognitive disorder is significant cognitive decline that interferes with functioning and independence.

### Neurocognitive Disorder Due to Alzheimer Disease

- Neurocognitive disorder due to Alzheimer disease is seen in >50% of nursing-home patients and 50–60% of those with neurocognitive disorder.
- Risk factors: female, family history, head trauma, Down syndrome
- Neuroanatomic findings: cortical atrophy, flattened sulci, enlarged ventricles
- Histopathology: senile plaques (amyloid deposits), neurofibrillary tangles, neuronal loss, synaptic loss, granulovacuolar degeneration of neurons
- Associated with chromosome 21 (gene for the amyloid precursor protein)
- Decreased ACh and NE
- Deterioration is gradual; average duration from onset to death ~8 years
- Focal neurologic symptoms rare

Treatment is long-acting cholinesterase inhibitors such as donepezil, rivastigmine, galantamine, and memantine. Antipsychotic medications may be helpful when psychotic symptoms are present but contraindicated to control behavior.

### Vascular Neurocognitive Disorder (Multi-Infarct Neurocognitive Disorder)

Vascular neurocognitive disorder is seen in 15–30% of those with neurocognitive disorder.

- Risk factors: male, advanced age, hypertension or other cardiovascular disorders
- Affects small and medium-sized vessels
- Examination may reveal carotid bruits, fundoscopic abnormalities, and enlarged cardiac chambers
- MRI may reveal hyperintensities and focal atrophy suggestive of old infarctions
- Deterioration may be stepwise or gradual, depending on underlying pathology
- Focal neurologic symptoms (pseudobulbar palsy, dysarthria, and dysphagia are most common)
- Abnormal reflexes and gait disturbance often present

Treatment is directed toward the underlying condition and lessening cell damage. Control of risk factors such as hypertension, smoking, diabetes, hypercholesterolemia, and hyperlipidemia is useful.

**Table II-11-1. Alzheimer Disease vs. Vascular Disorder**

Alzheimer	Vascular
Women	Men
Older age	Younger age
Chromosome 21	Hypertension
Linear or progressive deterioration	Stepwise or patchy deterioration
No focal deficits	Focal deficits
Treatment is supportive	Treat underlying condition

**Recall Question**

An 18-year-old drug addict presents to the methadone clinic. The physician prescribes him a novel medication which has properties of a neurotransmitter that mimics the effects of opiates. Which neurotransmitter has properties that mimic the effects of opiates?

- A. Enkephalins
- B. Substance P
- C. Gamma aminobutyric acid
- D. Glutamic acid
- E. 5-hydroxytryptamine

Answer: A

**Frontotemporal Neurocognitive Disorder (Pick Disease)**

- Neuroanatomic findings: atrophy in frontal and temporal lobes
- Histopathology: Pick bodies (intraneuronal argentophilic inclusions) and Pick cells (swollen neurons) in affected areas of brain
- Etiology unknown
- Most common in men with family history of Pick disease
- Difficult to distinguish from Alzheimer disease
- May see features of Klüver-Bucy syndrome (hypersexuality, hyperphagia, passivity)

**Neurocognitive Disorder Due to Prion Disease**

- Rare spongiform encephalopathy caused by a slow virus (prion)
- Presents with neurocognitive disorder, myoclonus, and EEG abnormalities (e.g., sharp, triphasic, synchronous discharges and, later, periodic discharges)
- Symptoms progress over months from vague malaise and personality changes to neurocognitive disorder and death



- Findings include visual and gait disturbances, choreoathetosis or other abnormal movements, and myoclonus
- Other prions causing neurocognitive disorder (e.g., Kuru) may exist

### Neurocognitive Disorder Due to Huntington Disease

- Rare, progressive neurodegenerative disease that involves loss of GABAergic neurons of the basal ganglia; manifested by choreoathetosis, neurocognitive disorder, and psychosis
- Caused by a defect in an autosomal dominant gene located on chromosome 4
- Atrophy of the caudate nucleus, with resultant ventricular enlargement, is common
- Clinical onset ~age 40
- Suicidal behavior fairly common

### Neurocognitive Disorder Due to Parkinson Disease

- Common, progressive, neurodegenerative disease that involves loss of dopaminergic neurons in the substantia nigra
- Clinical onset ~age 50–65
- Motor symptoms include resting tremor, rigidity, bradykinesia, and gait disturbances
- Neurocognitive disorder occurs in 40% of cases; depressive symptoms common
- Destruction of dopaminergic neurons in the substantia nigra is a key pathogenic component; may be caused by multiple factors including environmental toxins, infection, genetic predisposition, and aging

Treatment of Parkinson disease involves use of dopamine precursors (e.g., levodopa, carbidopa), dopamine agonists (e.g., bromocriptine), anticholinergic medications (e.g., benztropine, trihexyphenidyl), amantadine, and selegiline. Antiparkinsonian medications can produce personality changes, cognitive changes, and psychotic symptoms.

### Neurocognitive Disorder with Lewy Bodies

- Hallucinations, parkinsonian features, and extrapyramidal signs
- Antipsychotic medications may worsen behavior
- Patients typically have fluctuating cognition, as well as REM sleep behavior disorder

### Neurocognitive Disorder Due to HIV Infection

- HIV directly and progressively destroys brain parenchyma.
- Becomes clinically apparent in at least 30% of those with AIDS, starting with subtle personality changes.
- Diffuse and rapid multifocal destruction of brain structures occurs; delirium is often present.



- Motor findings include gait disturbance, hypertonia and hyperreflexia, pathologic reflexes (e.g., frontal release signs), and oculomotor deficits.
- Mood disturbances in those with HIV infection are apathy, emotional lability, or behavioral disinhibition.

### Wilson Disease

- Ceruloplasmin deficiency
- Hepatolenticular degeneration
- Kayser-Fleischer rings in the eye
- Asterixis

### Normal Pressure Hydrocephalus

- Enlarged ventricles
- Normal pressure
- Neurocognitive disorder, urinary incontinence, and gait apraxia

Treatment is shunt placement.

### Pseudodementia

- Typically seen in older patients with a depressive disorder who appear to have symptoms of neurocognitive disorder
- Improvement should be seen after treatment with antidepressants
- Onset of symptoms can usually be dated

**Table II-11-2. Delirium vs. Neurocognitive Disorder**

Delirium	Neurocognitive Disorder
Acute onset	Insidious onset
Fluctuating course	Chronic course
Lasts days to weeks	Lasts months to years
Recent memory problems	Recent then remote memory problems
Disrupted sleep-wake cycle	Less disorientation at first
Disorientation	Normal sleep-wake cycle
Hallucinations common	Hallucinations, sundowning
Treat underlying condition	Supportive treatment

## LEARNING OBJECTIVES

- ❑ Demonstrate understanding of how important court cases have shaped medical care
- ❑ Demonstrate understanding of important elements of physician behavior and how they can affect patient care
- ❑ Answer questions about unconscious interactions and how they can affect patient care

## LEGAL ISSUES

### Selected Important Court Cases

#### Karen Ann Quinlan: Substituted Judgment Standard

In the Quinlan case, Karen Ann was in a persistent vegetative state, being kept alive only by life support. Her father asked to have her life support terminated according to his understanding of what Karen Ann would want. The court found that “if Karen herself were miraculously lucid for an interval . . . and perceptive of her irreversible condition, she could effectively decide upon discontinuance of the life support apparatus, even if it meant the prospect of natural death.”

- The court therefore allowed termination of life support—not because the father asked but because it held that the father’s request was most likely the expression of Karen Ann’s own wishes.
- Substituted judgment begins with the premise that decisions belong to the competent patient by virtue of the rights of autonomy and privacy.
- In this case, however, the patient is unable to decide and a decision-maker who is the best representative of her wishes must be substituted.
- In legal terms, the patient has the right to decide but is incompetent to do so. Therefore, the decision is made for the patient on the basis of the best estimate of his or her subjective wishes.

The key here is **not who is the closest next of kin**, but **who is most likely to represent the patient’s own wishes**.





### Brother Fox (*Eichner v. Dillon*): Best Interest Standard

In its decision of *Eichner v. Dillon*, the New York Court of Appeals held that trying to determine what a never-competent patient would have decided is practically impossible. Obviously, it is difficult to ascertain the actual (subjective) wishes of incompetents. Therefore, if the patient has always been incompetent, or no one knows the patient well enough to render substituted judgment, the use of substituted judgment standard is questionable, at best.

Under these circumstances, decisions are made for the patient using the **best interest standard**, the object of which is to decide what a hypothetical “reasonable person” would decide after weighing the benefits and burdens of each course of action.

The issue of who makes the decision is less important here. All persons applying the best interest standard should come to the same conclusions.

### Infant Doe: Foregoing Lifesaving Surgery, Parents Withholding Treatment

As a general rule, parents cannot withhold life- or limb-saving treatment from their children. Yet, in this exceptional case they did.

Baby Boy Doe was born with Down syndrome (trisomy 21) and with a tracheoesophageal fistula. The infant’s parents were informed that surgery to correct his fistula would have “an even chance of success.” Left untreated, the fistula would soon lead to the infant’s death from starvation or pneumonia. The parents, who also had 2 healthy children, chose to withhold food and treatment and “let nature take its course.”

Court action to remove the infant from his parents’ custody (and permit the surgery) was sought by the county prosecutor. The court denied such action, and the Indiana Supreme Court declined to review the lower court’s ruling. Infant Doe died at 6 days of age, as Indiana authorities were seeking intervention from the U.S. Supreme Court.

Note that this case is simply an application of the best interest standard. The court agreed with the parents that the burdens of treatment far outweighed any expected benefits.

### Roe v. Wade (1973): The Patient Decides

Known to most people as the “abortion legalizing decision,” the importance of this case is not limited to its impact on abortion. Faced with a conflict between the rights of the mother and the rights of the putative unborn child, the court held that in the first trimester the mother’s rights are paramount and that states may, if they wish, have the mother’s rights remain paramount for the full term of the pregnancy.

- Because the mother gets to decide even in the face of threats to the fetus, by extension all patients get to decide about their own bodies and the health care they receive.
- In the United States, the locus for decision-making about health care resides with the patient, not the physician.

Note that courts have held that a pregnant woman has the right to refuse care (e.g., blood transfusions) even if it places her unborn child at risk.

### NOTE

In 2022, the U.S. Supreme Court returned the authority to regulate abortion back to the individual states.

### Tarasoff Decision: Duty to Warn and Duty to Protect

A student visiting a counselor at a counseling center in California states that he is going to kill someone. When he leaves, the counselor is concerned enough to call the police but takes no further action. The student subsequently kills the person he threatened. The court found the counselor and the center liable because they did not go far enough to warn and protect the potential victim.

- The counselor should have called the police and then tried in every way possible to notify the potential victim of the potential danger.
- In similar situations, first try to detain the person making the threat. Next, call the police. Finally, notify and warn the potential victim. All three actions should be taken, or at least attempted.

## Autonomy

Autonomy is the central principle for ethics in health care. The origins of the word *autonomy* are from the Greek words: “autos” and “nomos,” meaning self-rule or self-determination. In ethics, this translates to the principle that every competent individual has the right to make his or her own health care decisions without coercion or coaxing.

In medical practice, competent patients are required to provide informed consent for any treatment or procedure.

## Informed Consent

Informed consent is a complete discussion of proper information related to a treatment or procedure between a physician and patient, where the patient voluntarily agrees to the care plan and is free of coercion.

- Full, informed consent requires that the patient has received and understood 5 components of information:
  - Nature of the procedure: What is the procedure or treatment?
  - Purpose or rationale: Why the procedure is being performed? or Why the drug is being administered?
  - Risks of the treatment regimen
  - Benefits of the treatment regimen
  - Alternatives to the recommended treatment regimen
- A signed paper granting informed consent that the patient does not read or does not understand does NOT constitute informed consent:
  - It is not simply enough for a physician to “give” the patient information.
  - The patient needs to understand what he is being treated with, why the physician recommends this treatment, and the risks, benefits, and alternatives to treatment.
  - The patient must understand all 5 components of information.





- The physician cannot discuss treatment options that are not approved. For example, the physician should not discuss with the patient a homeopathic treatment option for cancer.
- Informed consent may be **written or oral**.
- Informed consent can be withdrawn at any time. It does not matter if the patient has signed all the necessary paperwork and is on the way to the operating room; he can decide to not have the procedure done for any reason.

There are 4 situations in which a physician **does not need to obtain informed consent** from a patient in order to perform a procedure or another treatment, i.e., there are special situations in which **informed consent is not required**.

- **Emergency situation**

- In an emergency situation, the physician should do what is in the best interest of the patient.
- If the patient is unconscious and needs a life-saving or limb-saving procedure, the procedure should be performed (consent is implied).

- **Waiver is provided by patient**

- The patient “waives” his right to receive information related to the treatment. In other words, the patient trusts that you will do what is in his best interest.

- **Patient is incompetent**

- Some patients do not have the capacity to provide informed consent:
  - Are unconscious
  - Have attempted suicide
  - Are in a grossly psychotic or dysfunctional state
  - Are intoxicated with drugs and/or alcohol
  - Are in physical or mental state which prevents simple communication
- Incompetence is determined by a judge based on a physician’s assessment of capacity.

- **Therapeutic privilege**

- The physician will deprive the patient of autonomy in the interest of health. In other words, if the physician truly believes the patient is not able to make good decisions for himself AND other physicians agree, the physician can treat without informed consent.
- The physician can invoke therapeutic privilege and move beneficence, nonmaleficence, and justice above patient autonomy.

## Committed Patients

A committed mentally ill adult has the following legal rights:

- **Must have treatment available**

- Patient should be informed on a regular basis what treatment options are available.

- **Can refuse treatment**
  - Patient with a severe form of schizophrenia still has the right to refuse to take antipsychotic medication (except when patients are a danger to themselves or others).
- **Can request a legal hearing to determine *sanity***
  - Competence is a legal matter; only a court can determine competence.
  - Patient has the right to demand a trial to determine sanity.
- **Loses only the civil liberty to “come and go”**
  - Patient does not have the right to leave.
  - Patient can “choose” to take his medication; however, he cannot “choose” to leave.

**Table II-12-1. Decision-Making Standards**

	What It Means	Who Makes the Determination
Capacity	An assessment of your decision-making ability	Physician
Competence	A legal assessment of your ability to make medical decisions for yourself	Judge
Sanity	A verdict on your ability to make decisions and be held accountable for the consequences of those decisions	Jury

Assume the patient is competent unless you have clear behavioral evidence that indicates otherwise.

- Competence is a legal issue.
- We do not determine competence on a medical basis.
- From an ethical and legal standpoint, all adult patients are considered competent unless specifically proven otherwise.
- Only a court of law can make that assessment.

Any physician—not just a psychiatrist—can determine whether a patient has the capacity to understand the medical issues (and related treatment) pertaining to his condition. The physician is able to determine whether there is an organic delirium affecting the patient’s capacity to understand, i.e., caused by a medical condition such as alcohol/drug intoxication, meningitis, or a psychiatric disorder. The conclusions made by the physician will be based primarily on a neurological exam, as well as an assessment of the patient’s comprehension, memory, judgment, and reasoning skills.

It should be noted that a diagnosis such as schizophrenia by itself tells you little about a patient’s competence. If the patient is diagnosed with schizophrenia and controlled on medication, the patient may very well be competent. So a diagnosis alone cannot render a patient incompetent.

**NOTE**

A physician is permitted to “detain” a patient for up to 48 hours.

Clear behavioral evidence of incompetence includes:

- An attempted suicide
- Gross impairment in reality (psychosis) and dysfunctionality **and/or** physical or mental state preventing patient from having simple conversation

Patients who attempt suicide, for example, may be admitted to the hospital against their will for psychiatric evaluation.

If, as the physician, you are unsure, you must assume the patient is competent. The patient does *not* have to prove to you that he is competent. There must be clear evidence to assume that he is not.

When patients are unable to make medical decisions for themselves, someone called a **surrogate** needs to make those decisions for them.

In order for a surrogate to make a decision, three conditions must be present:

- The patient must be **incapacitated**.
- The patient must **not have made an advance directive**.
- The surrogate must know **what the patient would truly want if he were competent**.

Suppose a woman is unconscious as a result of a severe car accident. The surrogate will be asked, “What do you think the patient would want if she were conscious?” Based on the response, the patient will be appropriately treated or treatment measures will be withdrawn.

When a surrogate makes a decision for a patient, use the following criteria and **in this order**:

1. Subjective standard
2. Substituted judgment
3. Best interests standard

There is a set priority, i.e., an order, of who can serve as a surrogate. First is a person’s spouse. Second is a person’s adult children:

1. Spouse
2. Adult children
3. Parents
4. Adult siblings
5. Other relatives

Suppose the patient mentioned earlier is determined to be “brain dead” as a result of the car accident, and it is determined that she had no advance directive. Her spouse would be the first person asked about potentially terminating life support and allowing nature to take its course.

A **subjective standard** is based on the premise that a decision is being made based on the actual wishes of the patient. You should consider the following questions:

- Is there an actual intent or advance directive?
- What did the patient say in the past? Can that be verified?



Always follow the advance directives outlined in a living will or by a Health Care Power of Attorney (HCPOA).

A **substituted judgment** begins with the premise that decisions belong to the competent patient by virtue of the rights of autonomy and privacy. You should consider the following questions:

- Who best represents the patient?
- What would the patient say if she were competent?

In both ethical and legal terms, the patient has the right to make medical decisions but is now unable to do so by virtue of incompetence. The key here is not to identify the closest next of kin, but to identify the person most likely to represent the patient's own wishes, i.e., the person who knows the patient best.

For a **best interest standard**, the primary objective is to decide what action a hypothetical "reasonable person" would take after weighing the benefits and burdens of a particular medical decision or course of action. The issue of who actually makes the decision is less important, as all those applying the principles of best interest standard should come to the same conclusion. You should consider the following question:

- Are these in the best interest of the patient and not in the best interest of the decision-maker?

### Recall Question

A 91-year-old woman presents to the emergency department with nausea, vomiting, and abdominal pain. Laboratory tests and imaging studies confirm a diagnosis of acute pancreatitis. Given the new diagnosis, she changes her code status from *full code* to *do not resuscitate*. Which of the following describes patient autonomy?

- Assessment of a patient's decision-making ability
- Legal assessment of a patient to make medical decisions
- Verdict on a patient's ability to make decisions and be held accountable for the consequences of those decisions
- A patient's financial ability to pay for healthcare
- Right of a competent patient to make personal health care decisions

Answer: E

## Advance Directives

An advance directive is a set of instructions given by a patient in anticipation of the need for a medical decision in the event the patient becomes incompetent. There are three primary forms of advance directive:

- An **oral advance directive** includes statements made by a patient prior to incapacitation.

### NOTE

An advance directive can be given in writing or given orally.



- Problems can arise from variance and interpretation; e.g., was the patient properly informed before she became incapacitated? How specific was the directive?
- Good rule to follow: the more people who heard the oral directive, the more valid the directive.
- A **living will** is a written advance directive detailing the treatment measures the patient would want to receive (or not receive) should decision-making capacity be lost.
  - A family member cannot override patient's wishes; i.e., if the patient's living will indicates she does not want to be intubated in the event she becomes incapacitated but the patient's family requests intubation, the physician cannot intubate.
- A **medical power of attorney** or HCPOA is a designated agent assigned by the patient to make medical decisions in the event she loses decision-making capacity.
  - Assumption is that the agent fully understands the wishes of the patient and essentially "speaks with the patient's voice."
  - The physician must follow the directives of this individual, irrespective of other family members' wishes.

**Do not resuscitate (DNR)** orders are made by the patient or the surrogate. DNR refers **only to cardiopulmonary resuscitation**.

- In many instances, the physician may not be aware of DNR decisions.
- If DNR order is in place, cardiopulmonary resuscitation measures must be stopped as soon as the physician becomes aware of the order.
- All other treatment measures should be continued.

## Patient Confidentiality

Patient confidentiality is absolute. Physicians require patients to divulge private information, and in doing so are required to keep all discussions confidential. Breach of trust can cause irreparable harm to the physician-patient relationship.

- **Physicians must strive to ensure that others cannot access patient information.**
  - Patient care must not be discussed with another health care provider in a public venue, where others can overhear the conversation (lunch room, elevator).
  - Patient's physical and electronic medical records must be protected.
  - Health care provider owns the medical records, but patient must be given access or copy upon request.
- If you receive a court subpoena, show up in court but do not divulge information about your patient. When asked personal health information questions about a patient, you should maintain patient confidentiality.

There are a few **exceptions to patient confidentiality**.

- **Duty to warn and to protect** (Tarasoff case)



- If patient is a threat to self or others, the physician *must* break confidentiality.
- There is a duty (on the part of the physician) to warn and protect innocent people from harm that could be imposed by “your patient.”
- Specific threat to a specific person
- Suicide, homicide, and child/elder abuse
- Infectious diseases may need to be reported to public officials or an innocent third party
- Impaired drivers

**Table II-12-2. Rules of Privacy in Health Care**

Situation	Appropriate Response
Questions from insurance company	Obtain a release from patient
Questions from patient's family	Requires explicit permission from patient
When to withhold information from patient	Never, i.e., under no circumstances (if concerned about negative reaction by patient, figure out a way to explain and mitigate negative outcome)

## Treatment of Minors

Children age <18 years are minors and thus legally incompetent. Children cannot make health-related decisions for themselves, thus they cannot give “informed consent” to authorize a medical procedure/treatment. A parent or guardian must provide informed consent instead.

**Emancipated minors**, however, present some exceptions:

- If child is age >13 and taking care of self (i.e., living alone, responsible for all aspects of own life), he is essentially treated as an adult.
- Person age <18 who is married
  - Child who marries age <18 is deemed competent to make own decisions.
  - Pregnancy or birth does not always emancipate; differences from state to state make this unlikely to be tested on the exam.
- Person age <18 serving in the military

**Partial emancipation** is granted to minors in some cases:

- Substance and drug-abuse treatment
- Prenatal care
- Sexually transmitted diseases
- Birth control

For example, a 15-year-old girl could go to a physician's office for evaluation of an STD or to request birth control, and the physician must treat her. Furthermore, the physician must respect her **confidentiality** pertaining to these issues.

## NOTE

The Health Insurance Portability and Accountability Act (HIPAA) protects the privacy of individually identifiable health information. HIPAA violations can result in imprisonment and substantial fines.

## NOTE

A child who comes home from school and takes care of siblings while waiting for parents/guardians to return from work would not be considered an emancipated minor.

## NOTE

In general, the exam will not test controversial topics where there may be different state laws.



### Withholding Treatment from Minors

Parents cannot withhold life- or limb-saving treatment from their children. If parents refuse permission to treat their child, then do the following:

- **Immediate emergency:** go ahead and treat
- **Not emergency but still critical** (e.g., juvenile diabetes): the child will be declared a ward of the court and the court grants permission
- **Not life- or limb-threatening** (e.g., minor stitches needed): listen to parents

Look at the following scenarios. For each, see who would provide consent.

Situation	Who Provides Consent
The parents of a 17-year-old boy are overseas, so a babysitter is staying with him	If a threat to health, the physician can treat under doctrine of <i>in locum parentis</i>
A 17-year-old girl who has been living on her own and taking care of herself	The girl herself
A 17-year-old girl who is married	The girl herself
A 16-year-old boy refuses medication but his mother consents	The mother; write the prescription
The 16-year-old daughter consents to medication, but the mother refuses	The mother; do not write the prescription
The mother of a minor consents to medication but the father refuses	Consent from only 1 parent is required; write the prescription

#### Recall Question

A 28-year-old schizophrenic man presents to the emergency department with altered mental status after ingesting a large amount of bath salts. When questioned about it, he states “they told me to do it.” Which of the following is correct when determining patient competency?

- A. It is the verdict about a patient's ability to make decisions and be held accountable for the consequences of those decisions
- B. It is determined by the physician
- C. It is determined by a judge
- D. The patient in the question stem is not competent
- E. The patient in the question stem is legally insane

Answer: C

## Physician-Assisted Suicide

Assisted suicide is suicide committed by a person with the assistance of another person.

- You cannot assist patients to commit suicide. You can permit “competent” patients to die by withdrawing medical treatment (feeding tube, hydration) at their request. However, you cannot provide patients with the means to commit suicide themselves.
- Well-informed and competent patients have an almost absolute right to refuse any part (including the whole) of a medical treatment. Even though you may not understand the reasoning behind the decision, you must respect patients’ wishes.

## Good Samaritan Laws

Good Samaritan laws limit liability when physicians help in nonmedical settings. Suppose a physician is driving down a road when she comes upon a three-car accident. No one else has stopped to help. She now has a choice to make: should she stop or not? As a physician she is not required to stop; i.e., if she does not, no civil or criminal charges would be brought against her.

The motorist who has crashed in this scenario is a “person,” and not a “patient.” Physicians are not required to stop and help at the scene of an emergency. If they do stop, they are acting as Good Samaritans. As such, the Good Samaritan laws limit a physician’s liability, so long as certain conditions are met.

- **Actions are within the physician’s competence.**
  - For example, every physician has been trained to administer CPR. If you have a medical bag with you, you could potentially administer some stitches. However, if the motorist was impaled with a large piece of wood, it is not likely you would be able to attend to the injury with your bag of medical supplies. Your focus would be to assess vital signs and keep the person calm while waiting for emergency services.
- **Only accepted procedures are performed.**
  - You would perform only standard of care procedures, not procedures that were considered alternative care or experimental.
- **The physician remains at the scene after starting therapy, until relieved by competent personnel.**
  - If you stop to assist a person, you need to stay there and provide assistance until the paramedics arrive.
  - In most instances, after receiving a call from 911 the paramedics are at the site of the action within a few minutes. Once they arrive and acknowledge that they now have the situation “under control” you can leave. However, you cannot treat the “person” and leave; you need to wait.
  - Preferably, join the ambulance and hand over the patient to another physician yourself.





- **No compensation changes hands.**
  - The person may offer you money or a gift as a “thank you” for stopping. You cannot accept any form of compensation.
  - If you accept compensation (or even a token gift), you become liable for the care provided because your services as a physician have been employed and the “person” now becomes your “patient.”

## Negligence

Negligence is an act or omission (failure to act) by a physician or medical professional that deviates from the accepted medical standard of care. Negligence is often used regarding a civic duty. It can be intentional or unintentional:

- **Intentional:** malpractice
- **Unintentional:** medical negligence

## Impaired Physician

Remove from patient contact health care professionals who pose risk to patients.

Types of risks include:

- Infectious disease (TB)
- Substance related disorders
- Depression (or other psychological issues)
- Incompetence

Insist that they take time off; contact their supervisors if necessary. The patient, not professional solidarity, comes first.

## Abuse

Abuse is defined by tissue damage, neglect, sexual exploitation, and mental cruelty.

**Child abuse** is a mandatory reportable offense up to age 18. Failure to report is a criminal offense.

If a case is reported in error, you (the physician) are protected from legal liability. Your duty to protect the child comes first. First separate child from the parents (protect); then report.

- Most cases of physical abuse involve injury to soft tissues (bruises, burns, and lacerations); in some cases there are no signs at all.
- Clinical signs suggesting abuse of a child include broken bones in year one of life, STD, and bruises, burns, and lacerations with incongruent explanations.
- Pay attention to injury location: soft tissue injury of inaccessible parts of the extremities/trunk.
- Non-accidental burns have a particularly poor prognosis.
- Shaken baby syndrome: look for broken blood vessels in eyes.

### NOTE

Be careful not to mistake benign cultural practices, such as coining or moxibustion, for child abuse, but treat female circumcision as abuse.

Table II-12-3. Types of Abuse

	Child Abuse	Elder Abuse	Domestic Abuse
Annual cases	>2 million	5–10% in population	>4 million
Most common type	Physical battery/neglect	Neglect (most common with 50% of all reported cases); physical, psychological, or financial	Physical battery
Likely gender of victim	Age <5: female Age >5: male	63% female	Female
Likely gender of perpetrator	Female	<ul style="list-style-type: none"> <li>• Male or female</li> <li>• Caretaker is most likely source of abuse; spouses are often caretakers</li> </ul>	Male
Mandatory reportable?	Yes	Yes, mandatory reportable offense	No, not mandatory reportable offense
Physician's response	Protect and report	Protect and report	<ul style="list-style-type: none"> <li>• Counseling and information</li> <li>• Provide the victim information about local shelters and counseling; abused spouses tend to identify with the aggressor and blame themselves for the abuse</li> </ul>
Comments	<p><b>Child sexual abuse</b> is defined as sex experienced age &lt;18 with someone 5 years older:</p> <ul style="list-style-type: none"> <li>• &gt;25% of adult women report being sexually abused as a child</li> <li>• 50% of perpetrators are family members</li> <li>• 50% of victims tell no one</li> </ul>		





### Recall Question

A 75-year-old man is brought to the physician by his wife for a follow-up appointment for essential hypertension. The patient's wife is requesting medical records in regard to her husband's care. She states that it is for legal reasons so she can assume future power of attorney. Which of the following is correct regarding patient confidentiality?

- A. Patient care must not be discussed with another health care provider in a public venue
- B. Patient care must not be discussed with another health care provider except in emergent situations
- C. Patient's physical and electronic medical records are subject to revision by third party members in emergent situations
- D. Health care providers own the medical records, and patients are not allowed access without a subpoena from court
- E. Police and other authorities of the law can get access to patients' medical records without a subpoena

Answer: A

## PHYSICIAN BEHAVIOR

The primary reason for **rejection of medical advice, changing physicians, and missed appointments** is a lack of rapport between the patient and physician. Failure of a patient to cooperate or even to keep appointments should be seen as the result of physician insensitivity or seeming indifference.

The key is not the amount of time spent with a patient, but what is done during that time. A good rapport fosters adherence to treatment regimens and is positively associated with a reduction of malpractice suits.

### Patient-Centered Interview

Nothing should be between you and your patient.

- Get rid of tablets and computers.
- Ask family members to leave the room, unless patient requests unprompted that they stay.
- Ask questions focused on the patient's feelings and needs.
- Address patient's concerns.

Anything that increases communication is good.

- Take the time to talk with patient, even if others are waiting.
- Ask follow-up questions for clarification and try to understand patient's thinking; ask "why"; ask about personal issues beyond the disease: job, family, children.

- Be available (take calls and answer emails).
- Respond to the emotional as well as the factual content of questions from your patient.

Tell the patient everything, even if you have not been asked.

- Answer any question that is asked of you; if you only have partial information, let the patient know and provide the information you do have.
- Do not force a patient to hear bad news if he resists, but inquire why so you can address the underlying fears as soon as possible.

Keep everything confidential.

- Information should flow through the patient to the family, not the reverse.

Consider the patient interview and history-taking an opportunity to develop a better relationship.

- Make eye contact; sit so you are at same eye level if possible.
- Work on a long-term relationship, not just short-term problems.
- Tell patient what you are doing before every physical maneuver (defined touch).

Listen more; talk less.

- Hearing from patient is most important; allow patient to choose words to describe (do not ask leading questions).
- Allow silences while patients search for words.
- Listen for clues and pay attention to body language; you know what matters but patient won't.
- Ask what patient knows before explaining.
- Provide opportunity for patient to ask questions of you.

Negotiate rather than order.

- Medical decisions are made by patient; the physician provides and explains the options.
- Treatment choices are the result of agreement.
- An agreement fosters adherence while instructions and commands do not.

Agree on the problem before moving to a solution.

- Informed consent requires the patient to fully understand what is wrong. Offering a correct treatment before the patient understands his condition is not the right approach.
- A patient may not articulate his problem clearly and might exhibit emotions without articulating an underlying problem at all.
  - Ask questions to get details first before you offer solutions.
  - Begin with open-ended questions, then move to closed-ended questions.



- Your patient's problem is your problem.
  - Talk and think of solutions, not "an answer."
  - Change your plan to deal with new information when it is presented.

Practice effective interview techniques.

- Open-ended questions allow broad range for answer; closed-ended questions limits answer to yes or no.
- Leading questions suggest a preferred answer.
- Direct questions seek information directly; avoid judgmental terms.
- **Confrontation** brings to the patient's attention some aspect of appearance or demeanor.
- **Facilitation** gets the patient to continue a thought, talk more, "tell me about that . . ."
- **Redirection** puts question back to the patient.

### Physician-Patient Relationship

The physician-patient relationship is a partnership based on trust. In the setting of a productive alliance there are tremendous opportunities for clinical interventions that can significantly improve the patient's health and quality of life. The key is what the ideal physician should do to build rapport, establish trust, and maintain trust.

**Keep the physician-patient relationship within bounds.** Intimate social contact with anyone who is or has been a patient is prohibited. AMA guidelines recommend no interpersonal relationship with a former patient "for at least two years."

- Do not date parents of pediatric patients or children of geriatric patients.
- Do not treat friends or family.
- Do not prescribe treatment for colleagues unless a physician/patient relationship exists.
- If patients are inappropriate, gently but clearly let them know what acceptable behavior would be.
- Decline any gift from a patient beyond a small token.
- Tell patients everything: as a physician you must always be honest and transparent; there should be no lies or omissions.
- Admit to mistakes.

**Remember your duty to the patient.** Always place the interests of the patient first. Choose the patient's comfort and safety over yours or anyone else's. The goal is to serve the patient, not to worry about your legal protection.

- Ask about and know the patient's wishes.
  - Make conversations positive.



- Patient cannot select inappropriate treatments but you must discuss options that are available. Don't just say no to a patient's request.
- If a patient asks for an inappropriate medication that she heard advertised, explain why it is not indicated.
- Never "pass off" your patient to someone else. Refer to a specialist when something is beyond your expertise. You provide instruction in aspects of care, e.g., nutrition, use of medications.
- Be an advocate for the patient and try to get the patient what they need.
- Never refuse to treat a patient because she can no longer pay.
- Do not be involved in counseling about organ donation for a patient in your care. This undermines your physician-patient relationship.

**Foster patient adherence.** It is not enough for you to provide counsel/treatment and leave adherence to the patient. You must present information in ways that will optimize patient adherence. For best adherence:

- Attend to the amount of information; explain its complexity.
- Note the patient's affective state.
- Explain why a particular treatment is being recommended.
- Stress the threat of non-adherence to health.
- Stress the effectiveness of the prescribed regimen; give instructions both orally and in writing.
- Arrange for periodic follow-up.
- Ask the patient to do less; a long list of instructions is detrimental to adherence.

In cases of non-adherence:

- Do not blame the patient.
- Check for patient dissatisfaction with the physician, misunderstood instructions, family interference, or inability to pay for medication.

**Never abandon a patient.** Suppose a patient frequently comes to your office to complain about the office staff and your services. He even calls you on your cell phone to express discontent. You may be tempted to just dismiss the patient and let another physician deal with him. From an ethical standpoint, that would be patient abandonment.

- Make every effort to determine why the patient feels a certain way and then work to remedy the situation. Perhaps he has a psychiatric disorder that needs to be addressed.
- Never stop treatment on a patient due to lack of financial resources or treatment results. If a patient comes in with a medical complaint and he is past due on his medical bills, provide him with the same level of care and respect you would provide for any other patient.
- Do not ever threaten abandonment. If a patient is annoying or disruptive, you cannot say, "If you do not change your behavior, I will be forced to dismiss you from my practice and you will need to seek medical attention elsewhere."

**NOTE**

Treat all patients with the same level of care and respect, even if they do not reciprocate the same to you and your staff.

**Have empathy.** Empathy is the capacity to place oneself in another's position. Empathy both acknowledges and validates a patient's feelings. Do not confuse it with sympathy, which is simply feeling bad for another person's suffering.

- Empathy: "I feel your pain. What can I do to help?"
- Sympathy: "I'm sorry for your pain."

**Accommodate different cultures.** Offer language assistance services (translator) to patients with limited English proficiency (a legal right). It will help to facilitate proper communication.

- Interpreters: spoken communication
- Translators: written communication

Respect patients' religious beliefs, even when you do not share them. The goal is to make the patient comfortable.

- Ask about patient's beliefs.
- Accommodate religious practices: participate when requested and if possible (although you are not required to do anything against your own religious/moral beliefs or anything that risks the patient's health).
  - Suppose a patient requests you take an unsterile totem made of animal bone and bring it into surgery with you for good luck. You might accommodate the request by placing the item into a sealed plastic pouch and take it with you while keeping it far from the surgical field.
  - Accept benign "folk medicine" practices. Expect them.
    - Moxibustion: dried plants called moxa are burned on or near the body.
    - Coining: a form of dermabrasion therapy in which a heated coin is dragged along the skin.
    - Cupping: inverted cups are placed on the skin and suction is applied either by heat or vacuum; leaves circular marks.
    - Acupuncture: Thin needles are inserted into the body; due to the potential for medical complications and ramifications (such as contaminated or infected needles), this is not a benign practice.
  - Explain medical diagnosis in a manner that can be understood by a patient, even if it is not technically precise.
  - Offer to facilitate discussions or explain things to family members.

**Deal with difficult patients.** Treat difficult or suspicious patients in a friendly, open manner. An annoying or difficult patient is still your patient. You cannot ever threaten abandonment.

**Treatment Issues**

- Suppose a patient's course of action is against your medical recommendation (a common scenario). Remember, any medical treatment can be withdrawn at the patient's request.
  - A feeding tube is a medical treatment and can be withdrawn at the patient's request.
  - A competent person can refuse even lifesaving hydration and nutrition.



- You are not obligated to provide medical treatment that is inappropriate; in fact it is your duty to refuse to provide such care even when the patient demands it.
- In other words; a patient can refuse care, but cannot demand inappropriate care.
- You cannot ethically act to facilitate a patient's death, but you may administer care to provide relief to a terminal patient, even if such care may hasten demise (providing pain medication for example).
  - Passive: allowing patient to die
  - Active: killing patient
  - Active euthanasia: administering lethal medication with the purpose of ending life (illegal in the United States)
  - Assisted suicide: providing a patient the means with which to take his own life (legal in some states in the United States)
- You decide when the patient is dead.
  - You are obligated to continue treatment at the behest of patients and their surrogate, even if they surmise from a patient's lack of improvement that such treatment is futile.
  - If you determine that the patient is dead, then treatment must stop.
  - Any physician can decide/declare a time of death for a patient and the courts (or a judge) will officially declare a patient to be dead. For example, if a patient is brought to the emergency department following a severe car accident and "dies" in the emergency room, the physician will "decide" the actual time of death. The physician will fill out the necessary paperwork and a judge will "declare" that the patient is dead.

### Angry Patients

An irate patient requires care just as much a pleasant patient. The rule of thumb to **defuse the situation**.

- Validate your patient's feelings and find ways to hand him back control of the situation: "If I had to walk up four flights of stairs with my leg in a cast, I'd be upset. Now that you are here, what would you like to do?"

### Reluctant Patients

When a patient seems hesitant to share information, an assurance of confidentiality might be helpful.

- Silence is effective. A few moments of silence might be uncomfortable, but it allows the patient an opportunity to collect her thoughts and reinforces that you are there to listen to her problem.

### Sick role

The sick role is a "limited and conditional" set of expectations that are attached to individual persons socially when they are defined as being "sick." These expectations are held dependent on both the nature and severity of the condition.



### Rights

- Person is exempt from normal responsibilities: can stay home from work and not do chores around the house.
- Person is not to blame for illness: anyone can get the flu and there is no “fault.”

### Obligations

- Person is obligated to get well: should rest, drink fluids, try to eat.
- Person is obligated to seek competent help: for the flu a patient may not be required to go to the doctor; however, some employers require a “doctor’s note” upon return to work.

### Recall Question

A 24-year-old woman presents to her primary care physician for an unexpected follow-up. She is covered in bruises, has a black eye, and has multiple cuts and dry scabs on her right arm. The physician suspects domestic abuse. Which of the following is the appropriate next step?

- A. Report this to the authorities
- B. Disregard any notion of abuse; the patient has immune thrombocytopenia purpura and needs medical attention
- C. Counsel the patient on domestic abuse and provide information about local shelters
- D. Call the patient’s significant other and request that you hold an intervention together
- E. Ask the patient if she is depressed and if these are self-inflicted wounds

Answer: C

## UNCONSCIOUS INTERACTIONS

Patients and physicians may unconsciously react to each other. These are not defense mechanisms, although they may seem to function similarly. These reactions can be classified as transference and countertransference.

**Transference:** patient may unconsciously transfer thoughts onto physician:

- Unconscious
- Thoughts or attitudes are typically of a parent or significant other
- Patient identifies within the physician similar traits that lead the association and transference
- Transference may be positive (cause you to unaccountably like someone) or negative (cause you to unaccountably dislike someone)
- Likelihood of transference is not related to the duration of treatment.

**Countertransference:** physician may unconsciously transfer thoughts onto patient:

- Affects attitude of the physician toward patient
- May be positive (physician wants to help an older patient because she reminds him of his parent)
- May be negative (physician unaccountably dislikes a patient)

## Review Questions

For the scenarios below, identify whether you would treat or not treat.

1. A patient refuses lifesaving treatment on religious grounds
2. A wife refuses to consent to emergency lifesaving treatment for her unconscious husband, citing religious grounds
3. A wife produces a card stating her unconscious husband's wish to not be treated on religious grounds
4. A mother refuses to consent to emergency lifesaving treatment for her daughter on religious grounds
5. A child's life is at risk, but the risk is not immediate

## Answers

1. Do not treat.
2. Treat the woman's husband; this is no time to assess substituted judgment.
3. Do not treat the woman's husband.
4. Treat the woman's daughter.
5. Court will take guardianship.

### Recall Question

When considering the physician-patient relationship, which of the following is correct?

- A. Accepting gifts from patients is acceptable, as long as it is not monetary
- B. Addressing patient safety is the first step in dealing with an impaired physician
- C. If a patient is acting inappropriately, it is your job to immediately involve the authorities
- D. It is acceptable to date parents of pediatric patients or children of geriatric patients
- E. Providing treatment for personal friends is acceptable as long as no invasive procedures are involved

Answer: B



# Health Care Delivery Systems

# 13

## LEARNING OBJECTIVES

- ❑ Answer questions about the different types of payer systems
- ❑ Demonstrate understanding of the basic definitions of health care

## PAYER SYSTEMS

	Definition	Characteristics
<b>Private Insurance</b>	Medical plan that patients purchase to hedge against medical costs	<ul style="list-style-type: none"><li>• Patient pays monthly premium</li><li>• When/if patient is ill, insurance company will pay for bulk of the medical bills</li></ul>
<b>Medicare</b>	Federal government program that makes health care payments to those on Social Security	<ul style="list-style-type: none"><li>• Program pays health care costs for older (age &gt;65), disabled, and dependents of disabled</li><li>• Part A pays for hospital care</li><li>• Part B pays for physician services</li><li>• Annual deductibles and copayments are applicable</li></ul>
<b>Medicaid</b>	Joint state/federal program that covers all care for those on welfare	<ul style="list-style-type: none"><li>• Covers hospital stays, physician services, medication, and nursing homes</li><li>• There are no deductibles or copayments</li></ul>
<b>Health Maintenance Organization (HMO)</b>	Prepaid group practice that hires physicians or contracts with physicians to provide services	<ul style="list-style-type: none"><li>• Payment is made by capitation: fixed payment for the number of patients in their care</li><li>• Physicians receive only minor additional compensation for care when it is provided</li><li>• Preventive care is incentivized</li></ul>
<b>Preferred provider organization (PPO)</b>	Fee-for-service at a discount	<ul style="list-style-type: none"><li>• Provider makes money on volume, i.e., less money per patient but more patients</li><li>• Efficiency is rewarded</li></ul>

## DEFINITIONS

### Deductible

Before insurance assistance begins, patients must pay a certain amount called a deductible. After the deductible is “met,” the remainder of the bill is divided between the patient and insurance company (**co-insurance**).





- In an annual deductible, patient pays certain amount each year
- In a per-occurrence deductible, patient pays certain amount each time services are rendered
- **Copayment** is a flat fee due at time of service that is based on type and location of service (e.g., primary care \$25, specialist \$45)
- **Coinsurance** is the portion, or percentage, of final bill that patient and insurance are each responsible for paying (e.g., 80/20 = insurance covers 80% of remaining bill and patient is responsible for 20%) (full coverage means insurance covers 100% of bill)

## Capitation

Capitation is a fixed, pre-arranged monthly payment made for each patient.

- Physicians are paid for number of patients they are responsible for, not for how “much” they do for each patient.
- Same payment is made whether services are used or not.
- No additional (or only minimal) payment is made when services are used.
- Physicians make money when patients stay well and require no services.
- Under-treatment is incentivized, but also more likely to foster preventive medicine.

## Catastrophic Coverage

Catastrophic coverage is insurance for big medical events.

- It is more appealing for younger patients who do not expect to have medical expenses.
- Insurance premiums are lower, but out-of-pocket costs are larger if one becomes sick.

## Medically Indigent Adults

Medically indigent adults (MIAs) do not have private health insurance. They are not eligible for other health care coverage, such as Medicaid or Medicare.

### Recall Question

A 70-year-old woman presents to her primary care physician for a follow-up. She has no form of private insurance. Which form of payer system is she most likely to use?

- A. Blue Cross-Blue Shield
- B. Medicaid
- C. HMO
- D. Medicare
- E. PPO

Answer: D

**PART III**

# **SOCIAL SCIENCES**



## LEARNING OBJECTIVES

- ❑ Answer questions about scope of patient safety problems
- ❑ Describe the categories of medical error
- ❑ Answer questions about the systems approach to medical error and failure analysis
- ❑ Analyze cases concerning error disclosure and reporting
- ❑ Demonstrate understanding of principles of quality improvement
- ❑ Explain the leadership role of physician to lead change in patient safety

## INTRODUCTION

### Case 1: Care done well

A 3-year-old girl falls into an icy fishpond in a small Austrian town in the Alps. She is lost beneath the surface for 30 minutes before her parents find her on the pond bottom and pull her up. CPR is started immediately by the parents on instruction from an emergency physician on the phone, and EMS arrives within 8 minutes. The girl has a body temperature of 19 C (66.2 F) and no pulse. Her pupils are dilated and do not react to light. A helicopter takes the patient to a nearby hospital where she is wheeled directly to an operating room. A surgical team puts her on a heart-lung bypass machine, her body temperature increases nearly 10 degrees, and her heart begins to beat. She requires placement on extracorporeal membrane oxygenation. Over the next few days her body temperature continues to rise to normal, and the organs start to recover. She suffered extensive neurologic deficits; however, by age 5, after extensive outpatient therapy, she recovers completely.

### Case 2: Failure of the medical system

A newborn baby boy is first noted to be jaundiced through visual assessment hours after delivery, but a bilirubin test is not done. At the time of discharge from the hospital, the child is described as having “head to toe jaundice,” but a bilirubin test had still not been done, nor had his blood type or Coombs test been performed. The parents are instructed that the jaundice is normal and they should not worry, and to simply place the infant in the window for sunlight. A few days later the baby’s mother calls the newborn nursery stating that her son is still yellow, lethargic, and feeding poorly. She is asked if she is a



“first-time mom” and then assured that there was no concern. The mother continues to notice that the child is not well. At age 5 days, the mother’s concerns are acknowledged and a pediatrician admits the baby boy to the pediatric unit. On day 6 in the afternoon, the child has a high pitched cry, respiratory distress, and increased tone. He also starts to arch his neck in a way that is characteristic of opisthotonos. The child is ultimately diagnosed with classic textbook kernicterus, resulting in permanent brain damage.

The 2 real cases above represent the reality of our current health care system and the issues of patient safety. In one case a series of complex processes result in an excellent outcome, while in another a patient suffers preventable injury.

What are the factors that cause a good versus poor outcome? The field of patient safety seeks to answer this question and take steps to prevent future patients from being harmed by medical errors.

Patients are at risk for sustaining harm from the health care system and do so at an alarmingly high rate. Injury can range from minor to severe incidents, including death. The cause of these adverse events is not usually intentional injury (i.e., someone intending to harm patients), but rather is due to the complexity of the health care system combined with the inherent capability of human error.

The prevalence of medical errors in the United States is a significant and ongoing problem. Media reports of catastrophic injury resulting in disability or death due to medical care often reach news headlines, and are a significant concern to patients, families, and members of the health care team. The causes of these errors are varied, and can include failures in the administration of medication, performing surgery, reporting laboratory results, and diagnosing patients, to name a few.

Ensuring patient safety is the responsibility of every member of the health care team. To do so requires an understanding of safety science and quality improvement principles. Patients, providers, payers, and employers are all stakeholders in improving patient safety. Applying these principles to the study of medical errors can help health care professionals learn from past errors and develop systems that prevent future errors from harming subsequent patients. Systems in health care delivery can be redesigned to create safeguards and safety nets which make it difficult for members of the health care team to make errors that harm patients. The goal of health care should be to learn the strategies and systems that are currently being put into place to improve patient safety.

## SCOPE OF THE PROBLEM

In 1999 the Institute of Medicine (IOM) published its landmark publication, “To Err is Human: Building a Safer Health System,” reporting that at least 44,000 people—and perhaps as many as 98,000—die in hospitals each year as a result of medical errors that could have been prevented. This exceeds deaths attributed to breast cancer, motor vehicle collisions, and HIV. Approximately 1 in 10 patients entering the hospital will suffer harm from an adverse event.

Patient harm from preventable medical errors is a serious concern in health care. The impact of these errors can have dramatically negative effects on patients, their families, and the health care personnel involved. In addition to the toll on human suffering, medical errors also present a significant source of inefficiency and increased cost in the health care system.



Medical errors are the eighth leading cause of wrongful death in the United States. The problem is not limited to this country, however; medical errors are a global problem.

Some of the more common contributors to medical errors and adverse patient events are as follows:

**Medication errors** represent one of the most common causes of preventable patient harm. An estimated 1.5 million deaths occur each year in the United States due to medication error. The IOM estimates that 1 medication error occurs per hospitalized patient each day.

Common causes of medication error:

- Poor handwriting technique on a prescription pad or order form, resulting in a pharmacist or nurse administering the wrong drug or wrong dose
- Dosing or route of administration errors
- Failure to identify that given patient is allergic to a prescribed medication
- Look-alike or sound-alike drugs (e.g., rifampin/rifaximin)



**Figure III-14-1.** “Look-Alike” Medications

Strategies that help to reduce or prevent medication errors are as follows.

- The 5 Rs help to confirm several key points before the administration of any medication.
  - Right drug
  - Right patient
  - Right dose
  - Right route
  - Right time
- Computerized physician order entry (CPOE) involves entering medication orders directly into a computer system rather than on paper or verbally. The computer software (i.e., electronic health record) can automatically check for prescribing errors or allergies.



**Hospital-acquired infections (HAI)** affect 5–15% of all hospitalized patients and 40% of patients in ICU. The World Health Organization (WHO) estimates that the mortality from health-care-associated infections ranges from 12–80%.

HAI can occur in many forms, the most common of which in hospitalized patients is **urinary catheter-related infection (UTI)**. UTI accounts for 40% of all HAI; >80% of these infections are attributable to use of an indwelling urethral catheter. Adhering to strict indications for using indwelling catheters, maintaining sterile technique during catheter insertion and exercising prompt removal of the catheter when it is no longer required can help reduce the risk of a urinary catheter-related infection.

**Central line associated bloodstream infection (CLABSI)** is another common HAI, and among one of the most common infections observed in patients admitted to critical care units. It is estimated that 70% of hospital-acquired bloodstream infections occur in patients with central venous catheters. Symptoms include fever, chills, erythema at the skin surrounding the central line site and, in severe cases, hypotension secondary to sepsis. These infections can be associated with significant morbidity and mortality, increased length of hospital stay, and increased hospital cost. Checklists have been developed which provide best practices for the placement of central lines that lower the risk of infection (e.g., hand washing, gloving and gowning, sterile barriers, and early removal of central lines when possible).

**Hospital-acquired pneumonia (HAP)** is commonly seen in ventilated patients, typically  $\geq 48$  hours after admission to a hospital. (This subtype of HAP, called ventilator-associated pneumonia [VAP], tends to be more serious because patients are often sicker and less able to mount effective immune responses.) HAP is the second most common nosocomial infection. Common symptoms include coughing, fever/chills, fatigue/malaise, headache, loss of appetite, nausea/vomiting, shortness of breath, and sharp/stabbing chest pain that gets worse with deep breathing or coughing. Prevention of HAP is done with infection control (e.g., hand hygiene and proper use of gloves/gown/mask), elevation of head of the bed in ventilated patients, and other measures which reduce the risk of aspiration.

**Surgical site infections (SSI)** occur following a surgical procedure in the part of the body where the surgery took place. Some SSIs are superficial and limited to the skin, while others are more serious and involve deep tissue under the skin, body cavities, internal organs, or implanted material (e.g., knee or hip replacements). Symptoms include fever, drainage of cloudy fluid from the surgical incision or erythema, and tenderness at the surgical site. Most superficial SSIs (e.g., cellulitis) can be treated with appropriate antibiotics, whereas deeper infections (i.e., abscess) require drainage. Pre-operative antibiotics have been effective in reducing the rate of SSIs.

**Patient falls** are a common cause of injury in hospitals and other health care settings such as nursing homes. Over 1/3 of older people age >65 fall each year. Researchers estimate that >500,000 falls happen each year in U.S. hospitals, resulting in 150,000 injuries. Approximately 30% of inpatient falls result in injury, with 4–6% resulting in serious injury. Injuries can include bone fractures, head injury, bleeding, and even death. Injuries from falls also increase hospital costs.

Assessing a patient's fall risk helps to identify high-risk patients who can benefit from preventative resources. Some risk factors include advanced age (age >60), muscle weakness, taking >4 prescription medications (especially sedatives, hypnotics, antidepressants, or benzodiazepines), impaired memory, and difficulty walking (e.g., use of a cane or walker). Interventions such as increased observation, nonslip footwear, and making the environment safe all play a role in preventing injury from falls.

**Unplanned readmissions** occur when patients unexpectedly return to the hospital <30 days after being discharged. According to a *New England Journal of Medicine* study analyzing close to 12 million Medicare beneficiaries, nearly 20% of those discharged were readmitted within 30 days. Several factors can lead to a hospital readmission, such as poor quality of care or breakdowns in communication during a transition of care (e.g., hospital to rehabilitation center). Readmissions may also occur if patients are discharged from hospitals prematurely, are discharged to inappropriate settings, or if they do not receive adequate information or resources to aid in recovery.

For example, a 79-year-old patient treated for congestive heart failure (CHF) returns to the hospital 10 days after discharge with exacerbation of CHF. It was discovered that upon release the patient had failed to fill the prescription for the diuretic started during the initial hospitalization. Improved communication, patient education, and increased support to patients at risk for readmission are all strategies to reduce unplanned readmissions.

### Recall Question

Which of the following is the most common cause of preventable patient harm?

- A. Wrongful diagnosis
- B. Delayed treatment
- C. Medication error
- D. Hospital-acquired infection
- E. Patient fall

Answer: C

## CAUSES OF MEDICAL ERROR

The miraculous recovery of the little girl after the drowning event in case 1 highlights the incredible complexity of our modern health delivery system. There were numerous steps that were required to get right in the care of the patient. Unfortunately, these steps are not always followed as well as they were in that case. Machines break down, a team can't get moving fast enough, or a simple step is forgotten or the wrong step applied. The greater the number of steps required, the greater the risk of something going wrong. Couple that with the fact that human beings are prone to error, especially when working under less-than-ideal circumstances, and it is no wonder that medical errors pose such a threat to health care.



**NOTE**

Errors are bound to occur due to a combination of a complex health care system and the reality of human fallibility.

The complexity of the health care system, together with the potential for mistakes due to human nature, is the primary reason that patients experience medical errors. Understanding medical error and the science of patient safety can help us design a health care system capable of getting it right every time.

The potential for human error is amplified by poor working conditions. This includes poor workplace conditions (e.g., overworked staff, time pressures, lack of safety protocols, or lack of appropriate supervision), as well as poor individual conditions (e.g., fatigue, stress, or illness).

The following is a mnemonic to help assess the fitness of a health care professional to attend to patient care.

**IM SAFE**

- I:** Illness (Are you suffering from an illness that is degrading your performance?)
- M:** Medications (Are you taking medications that may impair your judgment?)
- S:** Stress (Are you adequately managing the stressors in your life?)
- A:** Alcohol (Are you using alcohol in excess with negative consequences?)
- F:** Fatigue (Are you getting enough rest?)
- E:** Eating (Are you maintaining a healthy diet?)

For example, one study on physician performance found that being awake 24 hours was equivalent to having a blood alcohol level of .10 (legally intoxicated by most standards) (Dawson & Reid, 1997).

Communication and teamwork failures are another leading cause of adverse patient events. Lack of appropriate communication creates situations where medical errors are likely to occur. These errors have the potential to cause severe injury and unexpected patient death. Errors at the time of transitions or handoffs are among the most common communication errors in healthcare. Handoffs occur frequently between nurses and between residents in teaching hospitals, but also among attending faculty (e.g., on-call physicians, hospitalists, ED staff). Using techniques of structured communication (e.g., SBAR, call-backs) can help safeguard against errors. Poor teamwork and lack of coordination between members of the patient care team also result in medical errors. A growing recognition of the need for improved teamwork in health care has led to the application of teamwork training principles, originally developed in aviation, to a variety of clinical settings. Recognized barriers to effective teamwork include:

- Inconsistency in team membership
- Lack of time
- Lack of information sharing
- Hierarchy
- Defensiveness
- Conventional thinking
- Complacency
- Varying communication styles

- Conflict
- Lack of coordination
- Distractions
- Fatigue
- Workload
- Misinterpretation of cues
- Lack of role clarity

Teamwork training attempts to reduce the potential for patient harm by developing effective communication skills, a supportive working environment, and an atmosphere in which all team members feel comfortable speaking up when they suspect a problem. Team members are trained to cross-monitor; check each other's actions, offer assistance when needed, and address errors in a nonjudgmental fashion (i.e., watch each other's backs). Huddles, briefs and debriefs are essential components of teamwork training as is providing feedback, especially after critical incidents. Remember, a chain is only as strong as its weakest link.

## TYPES OF MEDICAL ERROR

### Types of Errors

#### Diagnostic

- Error or delay in diagnosis
- Failure to employ indicated tests
- Use of outmoded tests or therapy
- Failure to act on results of monitoring or testing

#### Treatment

- Error in the performance of an operation, procedure, or test
- Error in administering the treatment
- Error in the dose or method of using a drug
- Avoidable delay in treatment or in responding to an abnormal test
- Inappropriate (not indicated) care

#### Preventive

- Failure to provide prophylactic treatment
- Inadequate monitoring or follow-up of treatment
- Other
  - Failure of communication
  - Equipment failure
  - Other system failure

Source: Leape, Lucian; Lawthers, Ann G.; Brennan, Troyen A., et al. Preventing Medical Injury. Qual Rev Bull. 19(5): 144–149, 1993



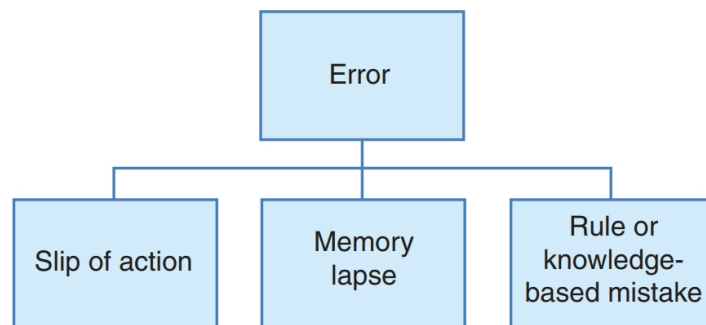


Errors can be categorized as slips, lapses, or mistakes.

- **Slips** can be thought of as actions not carried out as intended or planned, e.g., injecting a medication intravenously when you meant to give it subcutaneously. Slips are observable.
- **Lapses** are missed actions and omissions (e.g., forgetting to monitor and replace serum potassium in a patient treated with furosemide for acute congestive heart failure). Lapses are generally not observable (i.e., one cannot directly “see” a lapse of memory).

Both slips and lapses are actions that do not “go as intended.”

- **Mistakes** are a specific type of error brought about by a faulty plan or incorrect intentions; the intended action is wrong (e.g., extubating a patient prematurely based on misapplication of guidelines, or treating a patient for a suspected pneumonia when the patient was misdiagnosed and actually has a pulmonary embolism).



**Figure III-14-2.** Types of Error

It is important to differentiate errors (slip, lapse, or mistake) from violations.

- **Violations** are deliberate actions, whereby someone does something and knows it to be against the rules (e.g., deliberately failing to follow proper procedures). A health care professional may consider that a violation is well-intentioned; however, it would still technically constitute a “violation” rather than an error. For example, a physician may decide to forgo entering a patient’s allergies into the electronic record due to time constraints in starting treatment. If this act led to an adverse medication reaction due to a missed allergic reaction, it would technically be considered a violation and not an error.

Errors may result in adverse events or near-misses.

- **Adverse events** are harms or injuries that result directly from medical care, not from negative outcomes due to the patient’s disease or medical condition.
- **Near-misses** are errors that occur but do not result in injury or harm to patients because they are caught in time or simply because of luck.

Diagnostic errors account for at least 17% of preventable errors in hospitalized patients. Diagnostic errors can be categorized as no-fault, system-related, and cognitive.

- **No-fault errors** may happen when there are masked or unusual symptoms of a disease, or when a patient has not fully cooperated in care.
- **System-related errors** include technical failure, equipment problems, and organizational flaws.
- **Cognitive errors** frequently result from a diagnosis that was wrong, missed, or unintentionally delayed due to clinician error.

The following are examples of common cognitive errors.

A wrong diagnosis may occur when the clinician holds on to a particular diagnosis (usually the initial one, in a phenomenon called **anchoring bias**) and becomes dismissive to signs and symptoms pointing to another diagnosis. For example, a 65-year-old man presents with epigastric pain and emesis, and he sits leaning forward. He has a history of alcoholism. The patient is likely to be diagnosed with pancreatitis. However, holding on to this diagnosis to the exclusion of any other diagnosis—despite the patient’s denial of alcohol use for several years, normal blood levels of pancreatic enzymes, and abnormal EKG which is ignored—would be an anchoring error.

**Confirmation bias**, looking for evidence to support a pre-conceived opinion, rather than looking for evidence that refutes it or provides greater support to an alternative diagnosis, may accompany an anchoring error. Clinicians should regard conflicting data as evidence for the need to continue to seek the true diagnosis (e.g., in the case above; acute MI) rather than as anomalies to be disregarded.

**Availability bias** is the tendency to assume a diagnosis based on recent patient encounters or memorable cases (i.e., the most cognitively “available” diagnosis).

It is estimated that thousands of hospitalized patients die every year due to diagnostic errors. Missed or delayed diagnoses (particularly of cancer) are a prominent reason for malpractice claims. Poor teamwork/communication between clinicians and a lack of reliable systems for common outpatient clinical situations (e.g., triaging acutely ill patients by telephone and following up on test results) have been identified as predisposing factors for diagnostic error.

### Recall Question

Which of the following is an example of poor workplace conditions?

- Overworked staff
- Lack of safety protocols
- Lack of supervision
- Physician fatigue
- All of the above

Answer: E



## SYSTEMS APPROACH TO MEDICAL ERROR

Health professionals dedicate their lives to the care of patients. Most are highly trained and competent; however, the nature of health care is extremely complex, and people, despite good intentions, are still capable of making errors.

Although hospitals, clinics, and doctor's offices take many steps to keep their patients safe, medical errors can, and do, occur. Rather than penalize individuals who make honest mistakes, the goal of patient safety is to redesign systems to be more fool-proof and able to compensate for human error.

**Bad Apples/Blame Culture:** When a medical error occurs, the bad apple approach seeks to identify who is responsible for the error and take punitive action against that individual. However, this approach does not improve safety. It creates a culture of fear and doesn't address the root cause of the error.

Only 5% of patient harm is due directly to incompetence or poor intentions. People need to be accountable, but systems changes are needed to truly transform care. Unfortunately, health care has a long tradition of a blame culture. Blaming people who make errors does not get to underlying causes or help to prevent the error from happening to someone else in the future.

The most effective approach to reducing harm from medical error is to find out *how* the error happened, rather than who did it, and then fix the system to prevent errors from causing injury to patients. Improvements in patient safety will be hindered as long as there is a focus on blaming individuals.

## SYSTEMS APPROACH TO FAILURE

An understanding of medical error requires an understanding of the systems failures underlying the majority of adverse patient events. Health care is a complex system. Errors that harm patients tend to have multiple causes that are ingrained in this complex system. James Reason, a pioneer and leader in the research area of human error and organizational processes, describes the **Swiss cheese model** of accident causation; it is a model used in risk analysis and risk management in complex systems including health care.

The Swiss cheese model encompasses the understanding that patient harm often results from multiple, upstream or proximal errors.

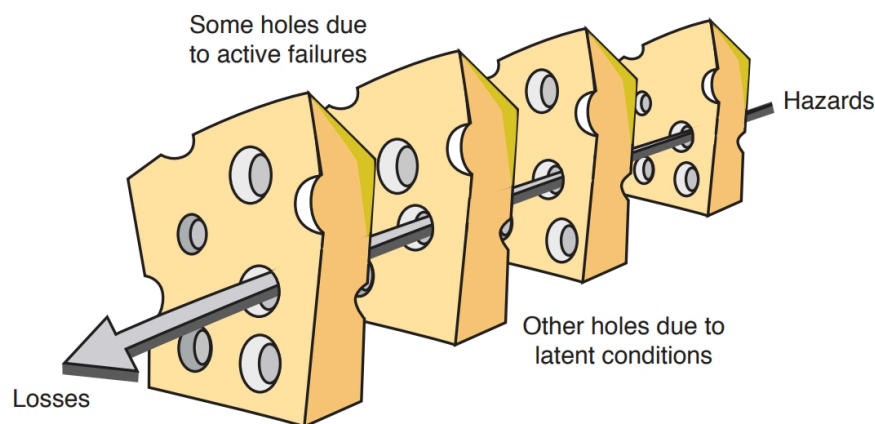
- Each 'slice' represents a barrier, and each hole is a failure in the system due to either active or latent failures.
- Under normal circumstances, one of the barriers works to prevent patient harm (e.g., the nurse catches that the medication ordered is the wrong dose before giving it to the patient)
- Occasionally, however, the "perfect storm scenario" arises where the holes line up and allow an error to reach the patient, resulting in harm.

For example, if the hazard were wrong-site orthopedic surgery, slices of cheese might include policies for identifying sidedness on radiology imaging, a protocol for signing the correct site when the surgeon and patient meet in the preoperative area, and a second protocol for reviewing the medical record and checking the previously marked site in the operating room. Many more layers exist but the point is that no single barrier is foolproof. They each have "holes," hence, the Swiss cheese.



In some serious events such as wrong site surgery, even though the holes will only align infrequently, the result is still unacceptable patient injury. For instance, in an emergency situation, all 3 of the surgical identification safety checks mentioned above may fail or be bypassed, resulting in the surgeon meeting the patient for the first time in the operating room already under anesthesia. A hurried x-ray technologist might mislabel a film (or simply hang it backward and a hurried surgeon may not notice), confirming the surgical site with the patient may not take place at all (e.g., if the patient is unconscious) or, if it takes place, be rushed and offer no real protection.

Under the blame culture traditionally present in health care, a person may be reprimanded for an error but the holes in the system are not addressed; making it quite probable that the same error will be committed by someone else in the future leading to more patient harm. The goal is to examine the system and develop methods to redesign care so that the holes are removed.



Source: James Reason

**Figure III-14-3.** Successive Layers of Defenses, Barriers, and Safeguards

Other industries with complex systems, such as aviation and nuclear power plants, have successfully employed systems engineering to drastically improve safety and reliability. These industries have also made changes to improve communication, teamwork, and the culture of safety.

Another example of lessons learned from systems engineering is the automobile safety industry. Most motor vehicle collision (MVC) deaths are due to driver error or deliberate misbehavior (e.g., speeding, running a red light, failure to wear a seatbelt, etc.). The death toll from MVC in the past several decades has declined significantly. Drivers today are not necessarily safer drivers than before; however, design changes in cars (e.g., collapsible steering columns, airbags) and safe highway design (e.g., improved lighting, deformable lampposts) have resulted in drastic reductions in mortality from MVCs.

Likewise, the goal in patient safety is to prevent errors from resulting in harm to patients. Health care must create safety nets that absorb mistakes before they reach patients. Some examples of system-based redesigns for patient safety include protocols to ensure proper patient identification, such as the following:

## NOTE

Approximately 80% of medical errors or adverse patient events are system-derived.



- Using at least 2 methods such as patient name and date of birth to confirm patient identify prior to the administration of medications
- Using a standardized pre-operative checklist to help operating room staff review critical information prior to surgery (e.g., pre-operative antibiotics)
- Removing look-alike drugs from the nursing unit in order to prevent medication errors

### Recall Question

Which of the following is characteristic of a “near-miss” error?

- A. Error that occurs when there are masked/unusual symptoms of a disease or when a patient has not fully cooperated in care
- B. Error that occurs but results in no injury/harm to a patient because it is caught in time or simply because of luck
- C. Error that results in injury/harm directly from medical care, not from negative outcomes due to the patient’s disease or medical condition
- D. Error that includes technical failure, equipment problems, and organizational flaws
- E. Error that results from a diagnosis that was wrong, missed, or unintentionally delayed due to clinician error

Answer: B

## ERROR DISCLOSURE AND REPORTING

Many victims of medical errors never learn that the mistake occurred, because the error is simply not disclosed. Healthcare professionals have traditionally shied away from discussing errors with patients, due to fear of precipitating a malpractice lawsuit, issues of professional embarrassment, or discomfort with the disclosure process. It is both an ethical and professional responsibility to ensure that errors resulting in patient harm are disclosed and reported.

The first priority after an event which causes patient harm is to care for the patient’s medical needs. **Disclosure** of the error is another important early action. Following an adverse event, patients and families want to hear an apology and to know what is being done to prevent the error from harming someone else in the future. They may also require emotional and social support. Honesty and transparency are essential. There is no role for covering up an error (e.g., altering documentation to conceal the error) or withholding information from the patient or family. Such practices are unethical and betray the professional responsibility we have to patients. Studies have demonstrated that a timely and sincere apology may actually reduce the likelihood of a lawsuit.



Often the most senior physician responsible for the patient and most familiar with the case will make the official disclosure. An error disclosure should include the following 3 elements:

- Accurate description of the events and their impact on the patient
- Sincere apology showing care and compassion
- Assurance that appropriate steps are being taken to prevent the adverse event from happening to another patient in the future

**Reporting** allows for errors to be studied so that system-based improvements can be made to help prevent such errors from harming patients in the future. Reporting errors is essential for error prevention and provides opportunities to improve processes of care by learning from failures of the health care system. In order to be effective, reporting must be safe. Individuals who report incidents must not be punished or suffer other ill effects from reporting. The fear of punitive retaliation or other negative consequences will serve as an impediment to incident reporting. The identities of reporters should not normally be disclosed to third parties.

Other barriers to error reporting include having the belief that no corrective action will be taken and having an overly burdensome reporting system. To overcome these barriers, reported events should be reviewed and acted upon in a timely fashion, and the system for reporting errors should be made as straightforward as possible.

One other recognized barrier to error reporting is failure to recognize that an error has occurred. For example, an interventional cardiologist accidentally orders the wrong dose of medication during a cardiac catheterization; however, the nurse who has worked with this cardiologist for years knows the correct dose intended and makes the appropriate adjustment. No harm has occurred but it would be wrong not to realize that an error did happen.

Health care professionals need to be educated about medical error identification, including the identification and importance of near-misses. Although near-misses (errors that occur but fortunately do not result in patient harm) do not generally need to be disclosed to patients, they should still be reported to the system so that they, too, can be studied. One person's near-miss may be the next person's fatal error. Estimates of the scope of medical errors likely do not reflect the numerous near-misses that do not result in patient harm.

It is important to have a culture that promotes error reporting and error analysis in order to enhance health systems. Every error represents an opportunity to improve a process; however, in order to improve, these errors must be recognized and made known so that system-wide learning and performance can take place.

#### NOTE

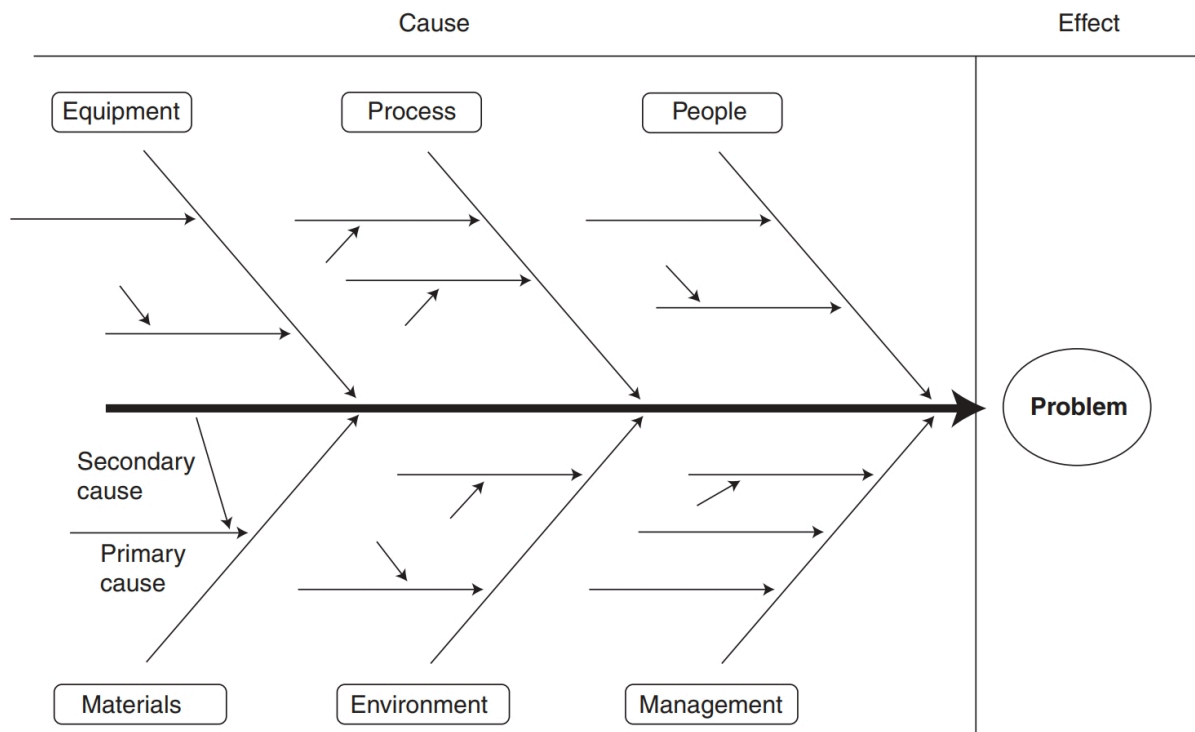
Estimates are that voluntarily reported medical errors only reflect 10–20% of actual errors.

## ANALYSIS OF MEDICAL ERRORS

A systematic approach for understanding the cause of adverse events and identifying flaws in the system which can be corrected to prevent harm in the future is called **root cause analysis** (RCA). RCA is *retrospective* in nature; the focus is on systems and process rather than individual blame. The question asked is, “**how did this happen?**” not “whose fault is this?” The goal is to determine why an event happened and what can be done to prevent it from happening again. RCA is not applicable to negligence or willful harm.



A classic tool used in RCA is the **fishbone** or **Ishikawa diagram** (also known as a **cause and effect diagram**), which analyzes a complex system and identifies possible causes for an effect or problem. This type of diagram is used to explore and display all the possible causes of a particular error.



**Figure III-14-4.** Sample Fishbone (Ishikawa) Diagram

The RCA allows the team to identify problems in the system or process of care. The end product of the RCA process is a list of recommended actions to prevent the recurrence of the adverse event in the future. Recommendations commonly consist of one or more of the following actions: standardizing equipment, using double checks or backup systems, employing forcing functions that physically prevent users from making common mistakes, making changes to the physical set-up, updating or improving technology, using cognitive aids (e.g., checklists or mnemonic devices), simplifying a process, educating staff, or implementing new safety policies.

In contrast to the retrospective nature of RCA, the prospective **failure mode effects analysis** (FMEA) is an engineering approach which seeks to anticipate and prevent adverse events through safety design. The goal of FMEA is to prevent patient problems before they occur. FMEA is a systematic and proactive approach that seeks to identify possible failures in the system and potential weaknesses in order to develop strategies to prevent the failures from occurring.

**Recall Question**

When disclosing an error to a patient, which of the following actions should be taken?

- A. Alter the documentation to conceal the error
- B. Withhold information from the patient or family to avoid a lawsuit
- C. Offer to provide financial compensation for the error
- D. Make an excuse for what happened
- E. Disclose an accurate description of the events and the impact on the patient

Answer: E

## PRINCIPLES OF QUALITY IMPROVEMENT

“Every system is perfectly designed to get the results it gets.”

— Source: Don Berwick, M.D.

A key principle of quality improvement is to design systems capable of identifying, preventing, absorbing, and mitigating errors. Some everyday examples of safety design outside of health care are seatbelt alarms in cars, heat-sensitive fire sprinkler systems, and tip-over switches which automatically turn off space heaters that have accidentally fallen over.

In 2001, the IOM published a report, “Crossing the Quality Chasm,” which aimed at promoting fundamental changes in health care in order to close the quality gap. The report recommended a redesign of the American health care system and provided principles for guiding quality improvement. Specifically, the report defined 6 aims of health care (STEEEP):

1. **Safe:** avoid injuries to patients from the care that is intended to help them
2. **Timely:** reduce waits and harmful delays in care
3. **Effective:** provide care based on scientific knowledge likely to benefit patients
4. **Efficient:** avoid waste in equipment, supplies, ideas, and energy
5. **Equitable:** provide care that does not vary in quality because of personal characteristics such as gender, ethnicity, geographic location, and socioeconomic status
6. **Patient-centered:** provide care that is respectful of and responsive to individual patient preferences, needs, and values

Another significant initiative in quality improvement is the Institute for Health Care Improvements (IHI) Triple Aim that describes an approach to optimizing health system performance using new designs to pursue 3 dimensions (i.e., “Triple Aim”).





- Improve the patient experience of care (including quality and satisfaction)
- Improve the health of populations
- Reduce per capita cost of health care

## Measures of Quality

There are 3 traditional categories of measure used in quality improvement: structure, process, and outcomes.

- **Structure** relates to the physical equipment, resources, or facilities (e.g., number of ICU beds in a hospital).
- **Process** relates to how the system works (e.g., how often nurses use bar coding to identify patients prior to administering medication).
- **Outcomes** represent the final product or end result in patient care (e.g., infection rate in pediatric hematology patients admitted to the hospital). Outcomes are often difficult to assess in quality improvement, and many people often use process measures as a surrogate for outcomes. For example, it may be difficult to accurately track all HAI (outcomes measure), so rates of compliance with hand washing are monitored instead (process measure).

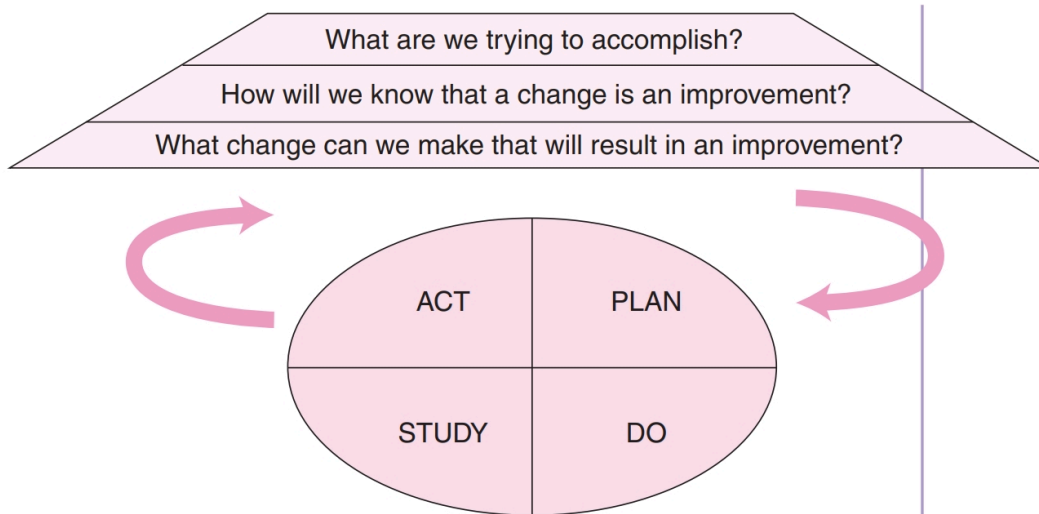
A fourth type of measure introduced to quality improvement is the concept of a balancing measure. **Balancing measures** ask whether changes made to improve one part of the system cause an unanticipated decrease in performance in another part of the system (e.g., did an initiative aimed at increasing the efficiency of discharging patients from the hospital lead to more patients being sent home without appropriate follow-up instructions?).

## Models of Quality Improvement

One example of a common quality improvement model is a combination of building and applying knowledge to make an improvement by asking 3 questions and using the **PDSA** (plan, do, study, act) cycle developed by W. Edwards Deming, a pioneer and influential leader in quality control.

1. What are we trying to accomplish?
2. How will we know whether a change is an improvement?
3. What changes can we make that will result in an improvement?

This model takes the simple concept of “trial and error” and transforms it into the PDSA model that can be used to make improvements in health care.



Source: Langley, Nolan, Nolan & Provost 1999

**Figure III-14-5.** The Model for Improvement

- **Plan:** plan a change or a pilot test of a new intervention or innovation
- **Do:** carry out the plan
- **Study:** evaluate the results
- **Act:** decide what actions should be taken to improve (i.e., implement the new intervention or start over with a new plan based on the prior results)

**Six Sigma** is another model for quality improvement with origins from the manufacturing industry. The term comes from the use in statistics of the Greek Letter (sigma) to denote Standard Deviation from the mean. Six sigma is equivalent to 3.4 defects (or errors) per million. This system uses specific steps to reduce variation and improve performance.

- **DMAIC** (define – measure – analyze – improve – control): an improvement system for **existing processes** falling below specification
  - **Define:** Define the problem in detail.
  - **Measure:** Measure defects (in terms of “defects per million,” or Sigma level).
  - **Analyze:** Do in-depth analysis using process measures, flow charts and defect analysis to determine the conditions under which defects occur.
  - **Improve:** Define and test changes aimed at reducing defects.
  - **Control:** What steps will you take to maintain performance?

**Lean** (also called Lean Enterprise or Toyota Production System) is an improvement process that seeks to improve value from the patient’s perspective, by reducing waste in time and resources that do not enhance patient outcomes. This includes certain lab tests, imaging studies or care services that may be commonly performed, but in reality do not actually help the patient. For example, a pre-operative EKG obtained on a healthy 21 year-old with no cardiac symptoms undergoing a small outpatient procedure can be considered a wasteful test that does not help the patient.





**Flowcharts** allow health care teams to understand the steps involved in the delivery of patient care service. A flowchart is a visual illustration of all the steps or parts of a process in patient care. There are 2 types of flowcharts: **high-level flowcharts** (more conceptually focused, 'big picture') and **detailed flowcharts** (more focused on specific, fine points).

Flowcharts are more accurate and effective when all representative members of a health care team actively participate in their design. They help health-care providers achieve a shared understanding of a clinical process and use that knowledge as the basis for designing new ways to improve services. Specifically, they can help to identify steps that do not add value to the process (e.g., unnecessary duplication of services), to determine areas of delay in care, and to discover failure points in the system.

### Recall Question

When attempting to understand the cause of an adverse event and identify the flaws in the system, i.e., root cause analysis, which of the following tools is most helpful?

- A. Fishbone diagram
- B. Failure mode effects analysis (FMEA)
- C. Error reporting
- D. Error disclosure
- E. Swiss-Cheese model showing successive layers of defenses, barriers, and safeguards

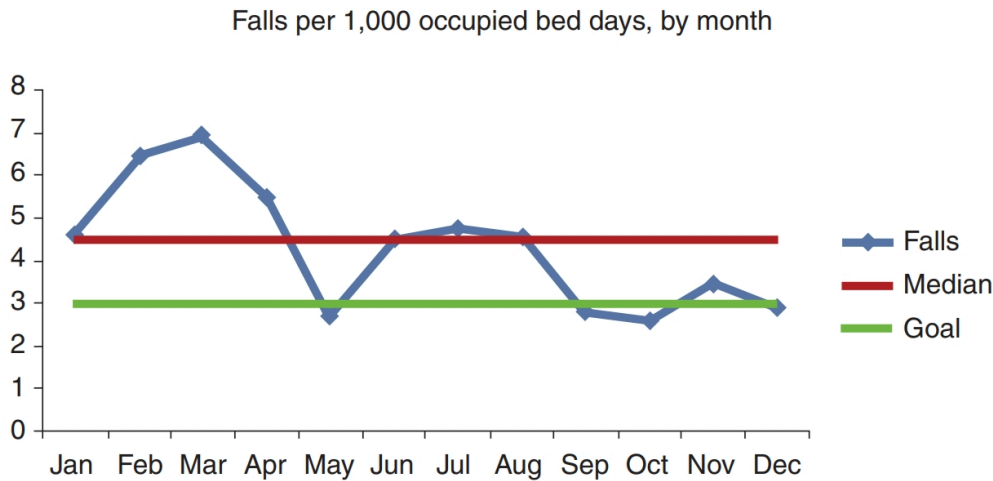
Answer: A

**Pareto charts** are used to describe a large proportion of quality problems being caused by a small number of causes. It is based on the classic 80/20 rule from economics, where 80% of the world's wealth is described to be in the hands of an elite 20% of the population.

The Pareto principle applied to health care states that the **majority of patient safety errors stem from only a few recurring contributing factors**, which should serve as the focus of the problem-solving efforts. In essence, it is a method of prioritizing problems, highlighting the fact that most problems are affected by a few factors and indicating which problems to solve and in what order. A Pareto chart includes the multiple factors that contribute to an effect arranged in descending order (according to the magnitude of their effect). The ordering is an important step because it helps the team concentrate efforts on those factors that have the greatest impact.

**Run charts** (or time plots) are graphs of data collected over time which can help determine whether an intervention or enhancement in the patient care process has resulted in true improvement over time or rather if it simply represents a random fluctuation (that might be incorrectly interpreted as a significant improvement). Run charts are created by plotting time along the x-axis (e.g., minutes, hours, days, months) and the quality measure on the y-axis (e.g., number of infections, wait times, falls). The median (or 50th percentile) is measured using baseline historical data and then compared to outcomes measured following the quality improvement intervention.

Run charts help identify whether there is a true trend vs. a random pattern. A shift in the process signaling a significant change in quality can be identified, for example, by observing  $\geq 6$  consecutive points above or below the median, or by  $\geq 5$  consecutive points all increasing or decreasing.



**Figure III-14-6.** Sample Run Chart Plotting Patient Falls (ahrq.gov)

A Shewhart (or control chart) applies formal statistical calculations (statistical process control) to determine whether the observed rise and fall of a quality measure over time is within a predictable range of variation or is an indication of a significant change in the system. Control charts use upper and lower control limits (sometimes called “natural process limits”) which indicate the threshold at which the process output is considered statistically ‘unlikely,’ and are drawn typically at 3 standard errors from the center line.

A **convenience sample** is the study group or population used in the test of a quality improvement initiative. Using convenience sampling is an efficient and simple method to test an intervention. This is not the same process often used in randomized controlled trials, and thus may not be an accurate reflection of the larger group. Ideally, however, the sample will have approximately similar characteristics to the larger population.



## LEADING CHANGE IN PATIENT SAFETY

Patient safety is the professional responsibility of everyone on the patient care team. In order to effect change in the quality of health care, health care professionals must utilize leadership principles. Changing behavior is difficult, and there are always multiple barriers to change efforts. To be effective in leading transformation, change efforts need to create a sense of urgency, be data-driven, team-based, specific, and measurable.

Successful leadership can be achieved even without a formal position of authority. Strategies for effectively influencing change include the following:

- Gathering compelling data
- Adopting a 'systems' view of the problem
- Getting buy-in from administrative leadership or a powerful clinical ally
- Developing ideas to solve the problem
- Formulating an action plan

Goals should be SMART (specific, measurable, achievable, realistic, and time-sensitive). Good leaders are able to organize a team, articulate clear goals, manage conflict resolution, and make decisions based on the input of team members. Good leaders also lead by example and model good patient safety behavior.

### Recall Question

What does the PDSA model of quality improvement entail?

- A. Defines the problem in detail
- B. Performs in-depth analysis using process measures, flowcharts, and defect analysis to determine the conditions under which defects occur
- C. Defines and tests changes aimed at reducing defects
- D. Utilizes run charts or time plots which help determine whether an intervention in patient care process has resulted in true improvement in the patient health care process
- E. Plans a change, carries out the plan, evaluates the results, and decides what actions should be taken to improve

Answer: E



## KEY DEFINITIONS

- **Adverse event:** any injury caused by medical care
  - An adverse event results in unintended harm to a patient by an act of commission or omission, rather than by the underlying disease or condition of the patient. Identifying something as an adverse event does not imply error, negligence, or poor quality care. It simply indicates that an undesirable clinical outcome resulted from some aspect of diagnosis or therapy, not an underlying disease process.
- **Adverse reaction:** occurs when unexpected harm results from a justified action
  - An adverse drug reaction occurs when the correct process was followed for the context in which the medication was used.
- **Authority gradient:** command hierarchy of power or balance of power, measured in terms of steepness
  - First used in aviation to describe the phenomenon where pilots and copilots failed to communicate effectively in stressful situations due to the significant difference in their perceived expertise or authority. Hierarchies which exist in medicine are also subject to causing errors. Most health care teams require some degree of authority gradient; otherwise roles are blurred and decisions cannot be made in a timely fashion. However, within a hierarchy, tools of effective clinical communication and teamwork can overcome risks to patient safety.
- **Brief:** short planning session prior to the start of a clinical activity, in order to achieve team orientation, establish expectations, anticipate problems, and plan for contingencies
- **Checklist:** algorithmic listing of actions to be performed in a given clinical setting, with the goal to ensure that no critical step will be forgotten
  - Though a seemingly simple intervention, checklists have played a leading role in the most significant successes of the patient safety movement, including the near-elimination of central line–associated bloodstream infections in many intensive care units. Checklists have also been used in the operating room to ensure that OR teams are well-oriented and that evidence-based standards known to reduce complications are followed (e.g., use of pre-operative antibiotics).
- **Closed-loop communication:** a type of communication whereby, when a request is made of team members, someone specifically affirms out loud that he will complete the task and states out loud when the task has been completed
  - For example, during a cardiac resuscitation a physician orders a medication to be given intravenously and the nurse verbally confirms receipt of the order and verbally confirms when the medication has been administered as requested.
- **Debrief:** information exchange process designed to improve team performance and effectiveness, held after a clinical event in order to review and learn





- **Error:** failure of a planned action to be completed as intended or the use of a wrong plan to achieve an aim (i.e., an act of commission or doing something wrong); also includes failure of an unplanned action that should have been completed (i.e., an act of omission, or failing to do the right thing)
  - For example, ordering a medication for a patient with a documented allergy to that medication is an error of commission. Failing to prescribe a proven medication with major benefits for an eligible patient (e.g., low-dose unfractionated heparin for venous thromboembolism prophylaxis for a patient after hip replacement surgery) is an **error of omission**. Errors of omission are more difficult to recognize than errors of commission but are thought to represent a larger scope of the problem in patient safety. Errors can also be defined in terms of active or latent as coined by Professor James Reason, one of the founders in the field of safety science. According to Professor Reason, **active errors** occur at the point of contact between a human and some aspect of a larger system (e.g., a human-machine interface). They are generally readily apparent (e.g., pushing an incorrect button, ignoring a warning light) and almost always involve someone at the frontline. Active errors or active failures are sometimes referred to as errors at the ‘sharp end,’ figuratively referring to a scalpel. In other words, errors at the sharp end are noticed first because they are committed by the person closest to the patient. This person may literally be holding a scalpel (e.g., an orthopedist operating on the wrong leg) or figuratively be administering any kind of therapy (e.g., a nurse programming an intravenous pump with the wrong medication dose) or performing any aspect of care. **Latent errors** (or latent conditions), in contrast, refer to less apparent failures of organization or design that contribute to the occurrence of errors or allow them to cause harm to patients. To complete the metaphor, latent errors are those at the other end of the scalpel—the ‘blunt end’—referring to the many layers of the health care system that affect the person “holding” the scalpel. For example, policies that allow a patient to enter an operating room and start an operation before confirming the patient’s identify, intended procedure, and site of surgery are considered latent errors that can result in wrong patient or wrong site surgery.
- **Forcing function:** aspect of a design which prevents a specific action from being performed or allows its performance only if another specific action is performed first
  - For example, automobiles are now designed so that the driver cannot shift into reverse without first putting a foot on the brake pedal. One of the first forcing functions identified in health care was the removal of concentrated potassium from general hospital wards. This action is intended to prevent the inadvertent preparation of intravenous solutions with concentrated potassium, an error that had produced small but consistent numbers of deaths for many years.
- **Handoffs:** the process whereby one health care professional updates another on the status of  $\geq 1$  patients for the purpose of taking over their care

- An example includes a resident physician who has been on call overnight telling an incoming resident about the patients admitted who require ongoing management. Nurses commonly conduct a handover at the end of their shift, updating the oncoming nurse about their status of the patients and tasks that need to be performed. Handoffs are a potential source of patient safety failure from the lack of important information being conveyed or misinformation being conveyed.
- **Harm/hazard:** harm is the impairment or any negative effect on the structure of function of the body (e.g., disease, injury, suffering, disability, death); hazard is a circumstance, agent or action with the potential to cause harm
- **Huddle:** an often impromptu problem-solving meeting conducted in order to assess a critical situation, reestablish situation awareness, reinforce plans already in place, and determine the need to adjust the plan
- **Iatrogenic:** an adverse effect of medical care, rather than of the underlying disease (literally “brought forth by healer,” from Greek *iatros*, for healer, and *gennan*, to bring forth)
- **Incident reporting:** collecting and analyzing information about an event which could have harmed (near-miss) or did harm (adverse event) a patient in a health care setting
- **Medication error:** any preventable event which may cause or lead to unintended and incorrect medication use or patient harm, while the medication is in the control of the health care professional or patient
  - Medication error occurs when a patient receives (a) the wrong medication, or (b) the right medication but in the wrong dosage or manner (e.g., given orally instead of IV, correct medication given at the wrong time).
- **Medication reconciliation:** process of avoiding unintended inconsistencies in medication regimens which can occur with any transition in care (e.g., hospital admission, transfer to ICU, discharge to rehab center) by reviewing the patient’s current medication regimen and comparing it with the regimen being considered for the new setting of care
  - Medical reconciliation helps to ensure that the intended medications are continued, and that medications that are supposed to be discontinued are not inadvertently continued. For example, medical reconciliation performed prior to discharging a patient from the hospital can detect if medication changes were made during the hospital stay that need to be continued once the patient is home (e.g., intravenous antibiotics started in the hospital during the treatment of pneumonia which are intended to be continued orally at home).
- **Near-miss (or close call):** error or other incident which does not produce patient injury, but only because of intervening factors or pure chance
  - This good fortune might reflect robustness of the patient (e.g., a patient with penicillin allergy receives penicillin, but has no reaction) or a fortuitous, timely intervention (e.g., a nurse happens to realize that a physician wrote an order in the wrong chart).





- **Patient safety:** The WHO defines patient safety as ‘the reduction of risk of unnecessary harm associated with health care to an acceptable minimum (2009)
  - The Agency for Healthcare Research and Quality uses the definition that ‘patient safety is a discipline in the health care sector that applies safety science methods toward the goal of achieving a trustworthy system of health care delivery.’ Patient safety is also an attribute of health care systems; it minimizes the incidence and impact of, and maximizes recovery from, adverse events.
- **Quality assurance (QA):** an older term, not likely to be used today; QA was reactive, retrospective, policing, and in many ways punitive; often involved determining who was at fault after something went wrong
- **Quality improvement (QI):** involves both prospective and retrospective reviews; is aimed at improvement—measuring where you are and figuring out ways to make things better; specifically attempts to avoid attributing blame and to create systems to prevent errors from happening
- **Read backs (or call-backs):** when a listener repeats key information so that the transmitter can confirm its correctness
  - To address the possibility of miscommunication when information is conveyed verbally, many high-risk industries use protocols for mandatory read-backs. For example, a laboratory technician calling a physician with a critical lab value may request that the physician read back the critical lab value to ensure it was received correctly.
- **Root cause analysis (RCA):** structured process for identifying the causal or contributing factors underlying adverse events or other critical incidents
  - Initially developed to analyze industrial accidents, RCA is now widely employed in error analysis within health care. A central tenet of RCA is to identify underlying problems that increase the likelihood of errors, while avoiding the trap of focusing on mistakes by individuals. RCA seeks to explore all the possible factors associated with an incident by asking what happened, why it happened, and what can be done to prevent it from happening again.
- **SBAR:** a form of structured communication first developed for use in naval military procedures; it stands for situation (what is going on with the patient?), background (what is the clinical background or context?), assessment (what do I think the problem is?), recommendation/request (what would I do to correct it?)
  - It has been adapted for health care as a helpful technique for communicating critical information that requires immediate attention and action concerning a patient’s condition. It promotes patient safety by helping individuals communicate with shared expectations in a concise and structured format which improves efficiency and accuracy.
- **Sentinel event:** adverse event in which death or serious harm to a patient has occurred; used to refer primarily to events that were not at all expected or acceptable (e.g., an operation on the wrong patient or body part)

- **Violation:** intentional or deliberate deviation from safe operating procedures, standards, or policies
  - A violation is different from an error, which is an unintentional action. Unlike errors which are honest mistakes due to human nature, intentional violations are behaviors for which individuals need to be held accountable.
- **Wrong-site procedure:** operation or procedure done on the wrong part of the body or on the wrong person; it can also mean the wrong surgery or procedure was performed
  - Wrong-site procedures are rare and preventable, though they do still occur. A standard system to confirm the patient, site, and intended procedure with the medical team and patient before starting the procedure is a widely employed method of reducing or eliminating wrong-site procedures.

### Recall Question

The process whereby one health care professional updates another on the status of a patient(s) in order to take over their care is known as

- A. Patient huddle
- B. Patient debriefing
- C. Patient handoff
- D. Patient closed-loop communication
- E. Physician-based strategic communication

Answer: C

### Review Questions

1. A 64-year-old man is admitted to the hospital for treatment of bacterial pneumonia. The treating clinician forgets to ask about allergies and the patient is unaware that his severe allergy to penicillin is not known to the treatment team. The patient receives a dose of intravenous penicillin and suffers an anaphylactic response but is successfully resuscitated by the medical team. Which of the following is the most accurate description of the medical error?
  - A. Slip resulting in a near miss
  - B. Violation resulting in a near miss
  - C. Lapse resulting in an adverse event
  - D. Violation resulting in patient injury
  - E. Non-preventable adverse event





2. A new intern who is not being supervised is asked to see a patient who is being discharged following treatment of a lower extremity deep vein thrombosis. The intern prescribes a 6-month course of warfarin without reviewing the patient's other medications. Unknown to the intern, the patient is taking an antibiotic which increases the anticoagulant activity of warfarin. The pharmacy computer system is broken and the drug is filled manually, which does not enable the computer system to alert to the drug-drug interaction. An overworked nurse fails to check for drug interactions during the medication reconciliation and gives the patient the prescription upon discharge. The patient fills the prescription at a local drug store and suffers a significant bleeding complication requiring re-hospitalization and surgery.

According to James Reason's Swiss cheese model of error, which one of the following would be the most effective approach to preventing this adverse event in the future?

- A. Identifying and correcting the single overarching failure in the health care system responsible for the adverse event
  - B. Identifying and weeding out the individuals involved in this medical error
  - C. Applying a systemic approach to eliminating all causes of human error
  - D. Building successive layers of safety barriers into the system that prevent medical error from resulting in patient harm
  - E. Initiating a campaign to remind clinicians to be more vigilant and to follow established safety protocols
3. As a member of the clinical team you are interested in developing a new system to more closely monitor blood glucose levels of diabetic patients admitted to the hospital for vascular wound care. In order to assess the impact of this new system on patient quality, you and your team conduct a PDSA cycle. Which of the following statements is correct regarding the PDSA cycle?
- A. The PDSA cycle begins with full scale implementation.
  - B. The PDSA cycle consists of small, rapid tests of new initiatives.
  - C. Changes from PDSA are based on expert intuition, and do not require data collection or interpretation.
  - D. PDSA is a means of analyzing past errors in order to design system based interventions.
  - E. The PDSA cycle requires a randomized control trial.

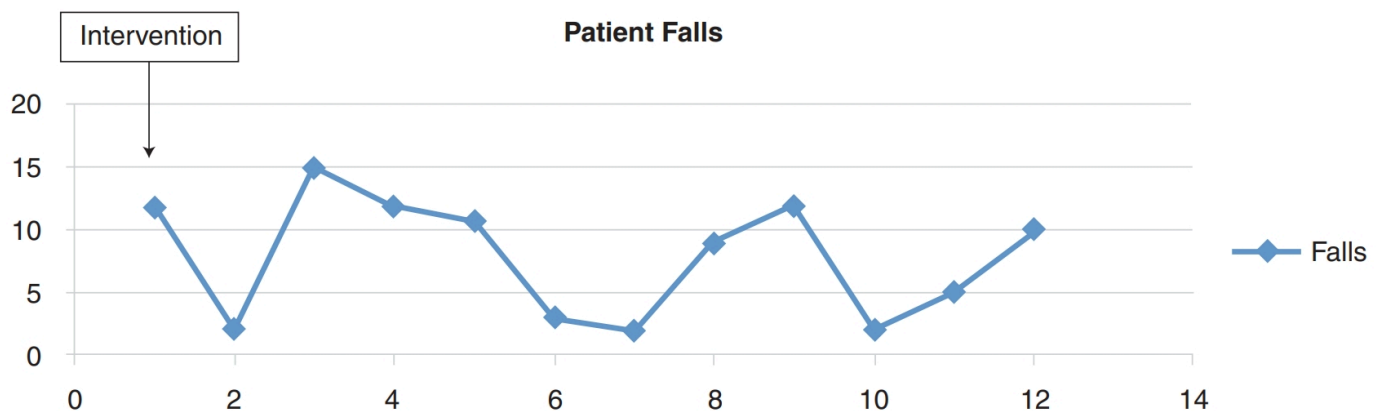
4. A 23-year-old man with a history of depression is admitted to the inpatient psychiatry ward after the third attempt at suicide with an intentional drug overdose. The patient has been stabilized medically; however, is under 24-hour monitoring by the nursing staff due to repeated attempts at self-harm. During change of shift, there is a mistake in communication and no one is assigned to the patient. The mistake is noticed 15 minutes into the new shift, and a member of the nursing team is assigned to watch the patient. Fortunately, during the 15-minute period the patient did not make any attempts to harm himself. Which of the following statements about this event is correct?
- A. This is a sentinel event and should be reported to the medical board.
  - B. This is a sentinel event and should be reported to the hospital and family.
  - C. This is a near miss and should be reported to the hospital.
  - D. This is a near miss and should be reported to the patient and family.
  - E. This is a near miss and no reporting is required since the patient was not harmed.
5. A nurse practitioner receives a phone call from the mother of one of the pediatric patients in the practice who frequently suffers from ear infections. The mother typically sees the physician and receives antibiotics to treat her child's condition. Given that it is a weekend and the office is closed, the nurse practitioner phones in the antibiotic prescription based on the mother's recollection of the name of the medication used in the past. The prescription is filled at a new pharmacy that does not have the patient's prior medical records on file. The child suffers an allergic reaction after which it is discovered that the wrong antibiotic was ordered. Which of the following statements is correct regarding root cause analysis (RCA)?
- A. RCA involves a retrospective, systems approach to error analysis.
  - B. RCA is a prospective approach to systems redesign.
  - C. RCA involves only the individual(s) directly involved in the error.
  - D. RCA is only performed for errors resulting in patient death.
  - E. Due to privacy laws the results of RCA are confidential and not shared.



6. A critical and respiratory care unit is attempting to decrease their rate of ventilator-acquired pneumonia. The team develops a new clinical protocol to help reduce hospital-acquired pneumonia in ventilated patients. The protocol includes several new activities which have not previously been followed uniformly in the unit. The changes includes head of bed elevation, daily oral care, daily assessment of readiness to extubate and having access to infectious disease specialists for consultation in the treatment of ventilator-associated pneumonia.

Which one of the following represents an outcomes measure of quality?

- A. Measure the compliance rate in following guidelines for head of bed elevation over a three-month period following the new protocol.
  - B. Determine the number of infectious disease specialists available for consultation during a three-month period following the new protocol.
  - C. Monitor the number of patients who self-extubate prematurely during the daily assessment of readiness to extubate over a three-month period following implementation of the new protocol.
  - D. Monitor the number of infections over three months following implementation of the new protocol.
  - E. Determine the wait time for starting antibiotics in patients with suspected ventilator-associated pneumonia.
7. A geriatric team is interested in decreasing the number of patient falls in their nursing home. After convening as a group to discuss possible interventions, a new system of identifying patients at high risk for falling and providing these patients with fall prevention interventions is implemented. Following this intervention, the rate of patient falls per month is followed for 12 months on a run chart. No baseline data was collected. Which of the following best describes the results of the run chart?



- A. The intervention led to a significant decrease in patient falls.
- B. The intervention led to a significant increase in patient falls.
- C. The intervention resulted in no change in patient falls.
- D. The impact of the intervention is subjective.
- E. The impact of the intervention is inconclusive.



8. An 85-year-old woman is being transferred to an acute rehabilitation facility following a hospital admission for hip replacement surgery. Postoperatively during her hospital stay she was started on deep vein thrombosis (DVT) prophylaxis medication with plans to continue the medication upon discharge. The intern and nurse discharging the patient failed to convey this new medication to the receiving treatment team at the rehabilitation center. The patient is not continued on her anticoagulation medication and sustains a DVT leading to a fatal pulmonary embolus 3 weeks after transfer. Which of the following actions will facilitate quality improvement and the prevention of a similar error in the future?
- Determine which staff member(s) failed to order the medication.
  - Develop a process to increase the use of medication reconciliation.
  - Send a memo to all staff about the importance of DVT prophylaxis.
  - Educate patients about the dangers of DVT following hip surgery.
  - Conduct monthly audits to monitor medication errors at transitions of care.

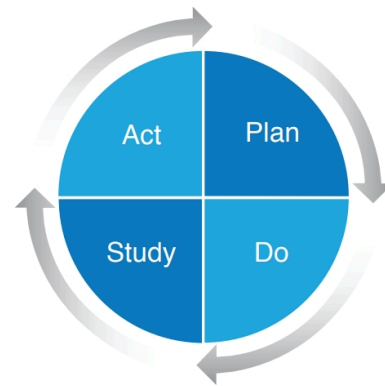
## Answers and Explanations

- Answer: C.** A lapse is an internal event that generally involves a failure in memory; as opposed to a slip which is an observable action commonly associated with attentional or perceptual failures resulting in an unintended execution of a correctly intended action. The result of the described error was harm to the patient in the form of anaphylaxis with the need for resuscitation, and therefore is categorized as an adverse event. An adverse event is any harm or undesirable clinical outcome resulting from medical care as opposed to the underlying disease process, and does not have to result in permanent disability or death. A violation is a deliberate act of not following policy or procedures, which was not the situation in this scenario. A near miss is an event or a situation that does not produce patient harm, but only because of intervening factors or good fortune. The adverse event described is the result of an error and is completely preventable.
- Answer: D.** The most effective approach to improving patient safety and quality is to address system-level causes of failure. In the Swiss cheese model, safety barriers are recognized as having unintended weaknesses (i.e., holes) which can occasionally align and allow an error to result in patient harm. In order to improve patient safety, the system must be redesigned to have effective safety barriers capable of preventing errors from resulting in patient harm. Attempting to penalize individuals who make honest errors or eliminate the potential for human error yields limited results.
- Answer: B.** The PDSA Cycle is a systematic series of steps for gaining valuable learning and knowledge for the continual improvement of a product or process. The PDSA cycle consists of developing a plan to test an intervention (Plan), carrying out the intervention (Do), observing and measuring the impact of the intervention (Study), and determining what modifications should be made to the system or process as a result of the study observations (Act). These interventions are small scale, rapid tests of new initiatives. Interventions with promising results are then selected for larger scale implementation. They do not require the rigor of randomized controlled trials.





These 4 steps are repeated over and over as part of a never-ending cycle of continual improvement.



4. **Answer: C.** The event described is a near miss; there was an error which fortunately did not result in patient harm. Most near misses need not be disclosed to patients or families; however, they should be reported to the hospital in order for the error to be studied in an attempt to learn how to prevent it in the future. A sentinel event is an adverse event resulting in serious or permanent injury to a patient.
5. **Answer: A.** The root cause analysis is a retrospective approach to error analysis. It is typically performed for errors resulting in significant patient harm, but can be performed for any adverse event that a team wishes to review. The RCA process usually involves the individual(s) involved in the event as well as any other members of the team typically involved in the care delivery process related to the event. Although the details such as the names of the individuals involved in the event are not shared publicly, the general findings of the RCA can be shared throughout the system in order to improve the quality of the system.
6. **Answer: D.** The number of infections over 3 months following implementation of the new protocol is an outcomes measure. Compliance rates in following guidelines are a process measure. The number of infectious disease specialists would be a structure measure. The number of patients prematurely self-extubating would be a balancing measure. Wait times for starting antibiotics is another process measure.
7. **Answer: E.** A run chart provides a dynamic display of a process over time. Run charts help to determine using minimal mathematical complexity if interventions made in a process or system over time lead to improvements. Run charts also provide the foundation for the more sophisticated method of statistical analysis using control charts. The run chart allows a team to understand the stability of a process as well as determine any shifts, trends or runs which may indicate changes based on interventions. However, without a baseline for comparison, one cannot determine from this run chart whether or not any significant change has occurred.

8. **Answer: B.** Quality assurance (QA) is an older term describing a process that is reactive and retrospective in nature. It is a form of 'policing' to ensure that quality standards have been followed. It often relies on audits and traditionally has focused on punitive actions for failures in quality. It often involves determining who was at fault after something went wrong. QA has not proven to be very effective in transforming care. The goal of quality improvement (QI), on the other hand, is to achieve improvement by measuring the current status of care and then developing systems-based approaches to making things better. It involves both prospective and retrospective reviews and specifically attempts to avoid attributing blame. Rather, QI seeks to create systems to prevent errors from happening. In the case above, developing a process to increase the use of medication reconciliation would be following the principles of QI. The other interventions are QA-based and/or simply not as effective in creating and sustaining a positive change.



# Index

Note: Page numbers followed by *f* and *t* indicate figures and tables, respectively.

## A

AA (Alcoholics Anonymous), 87  
 Abandonment of patient, 151  
 Abdominal aortic aneurysm screening for  
   older adults, 59  
 Abortion legalizing decision, 136–137  
 Absolute risk reduction (ARR), 20  
 Abuse, 146, 147*t*  
 Acamprosate, 87  
 Accuracy, 14  
 Acetylcholine (ACh), 128–129  
   and sleep, 95  
 Acting out, 74  
 Action stage of change, 86*f*  
 Active errors, 182  
 Acupuncture, 152  
 Acute stress disorder, 107–108  
 Addiction pathway, 84  
 ADHD (attention deficit hyperactivity disorder), 101  
 Adherence, 151  
 Adjusted rate, 9  
 Adjustment disorder, 108  
   older adults, 59  
 Adjustment stages, 61  
 Adolescent psychiatric disorders,  
   99–101  
   attention deficit hyperactivity, 101  
   autism spectrum, 100  
   conduct vs. oppositional defiant, 101*t*  
   intellectual disability, 99  
   Tourette syndrome, 100  
 Advance directives, 140, 141–142  
 Adverse events, 168, 181  
 Adverse reaction, 181  
 Affect, isolation of, 74  
 Aging, 58–61  
   elder abuse, 147*t*  
   end-of-life care, 60–61  
   financial considerations, 60  
   medical considerations, 59  
   physiological considerations, 60  
   psychiatric considerations, 59  
 Akathisia, medication side effect, 118*t*  
 Alcohol consumption, and sleep, 96  
 Alcoholics Anonymous (AA), 87  
 Alcoholism, 83–87  
   complications, 86  
   diagnosis, 86, 87  
   epidemiology, 83  
   genetics, 84

  physiology, 84  
   pregnancy, 85  
   self-awareness, 85–86  
   treatment, 87, 88*t*  
 $\alpha$  error, 34–35  
 Alpha 1 receptor, 117*t*  
 Alternative hypothesis, 33  
 Alzheimer disease, neurocognitive disorder  
   due to, 131, 132*t*  
 Amnesia, 111  
 Amphetamine intoxication, 88*t*  
 Anabolic steroid intoxication, 89*t*  
 Anal stage, 56*t*  
 Analysis, Six Sigma model, 177  
 Analysis of medical errors, 173–175  
 Analysis of variance (ANOVA), 37*t*, 39  
 Anchoring bias, 169  
 Angry patients, 153  
 Anomic aphasia, 128*f*  
 Anorexia nervosa, 109  
 ANOVA (analysis of variance), 37*t*, 39  
 Antianxiety medications, 123  
 Anticholinergic effects, 118*t*  
 Antidepressant medications, 119–121  
   MAOIs, 120  
   other, 121  
   SNRIs, 121  
   SSRIs, 120  
   tricyclic, 119–120  
 Antipsychotic medications, 117–119  
   mechanism of action, 117–118  
   typical vs. atypical, 118–119  
 Antisocial personality disorder, 112  
 Anxiety  
   performance, 106  
   social, 106  
 Anxiety defenses, 73–75  
 Anxiety disorders, 75, 106  
   generalized, 106  
   illness, 110  
 Anxious personality disorders, 113  
 Aphasia, 127–128  
 AR (attributable risk), 20–21  
 ARR (Absolute risk reduction), 20  
 Asexuality, 58  
 Assisted suicide, 145, 153  
 Athetoid movements, medication side  
   effect, 118  
 Attachment in children, 61  
 Attack rate, 5  
 Attack ratio, 5

Attention deficit hyperactivity disorder  
   (ADHD), 101  
 Attributable risk (AR), 20–21  
 Atypical antipsychotics, 118, 119  
 Authority gradient, 181  
 Autism spectrum disorders, 100  
 Automobile safety industry, 171  
 Autonomy, 56*t*, 137  
 Availability bias, 169  
 Aversive conditioning, 69  
 Avoidant personality disorder, 113

## B

Babinski reflex, 53*t*  
 Bad apple approach, 170  
 Balancing measures of quality, 176  
 Barbiturates  
   intoxication, 90*t*  
   and sleep, 96  
 Bath salts intoxication, 88*t*  
 Behavioral change, stages of, 86  
 Behavioral models of depression, 69–70  
 Behavioral modification, 68–70  
   behavioral models of depression,  
     69–70  
   classical conditioning, 68–69  
   operant conditioning, 69  
 “Bell-shaped” curve, 28  
*La belle indifférence*, 110  
 Benzodiazepines  
   for anxiety, 123  
   intoxication, 90*t*  
   and sleep, 96  
 Bereavement, 61–62  
 Best interest standard, 136, 141  
 $\beta$  error, 34–35  
 Bias, 16–18  
   anchoring, 169  
   availability, 169  
   confirmation, 169  
   confounding, 17, 18*t*  
   design, 17, 18*t*  
   experimenter expectancy, 17, 18*t*  
   late-look, 17, 18*t*  
   lead-time, 17, 18*t*  
   measurement, 17, 18*t*  
   recall, 17, 18*t*  
   selection (sampling), 17, 18*t*  
 Binge eating disorder, 109  
 Binging, 109  
 Biofeedback, 69





- Biostatistics, 25–39  
  descriptive, 28–31  
  distributions, 28–30  
  measures of central tendency, 28–29  
  measures of variability, 28, 29–30  
  inferential, 31–35  
  confidence interval, 31–33  
  statistical inference, 33–35  
  probability rules, 25–27  
  independent events, 25  
  mutually exclusive events, 25–26  
  scale, 36–37  
  statistical tests, 37–39  
    analysis of variance (ANOVA), 39  
    *chi*-square, 39  
    correlation, 37–38  
    *t* test, 38
- Bipolar disorder, 104, 105*t*  
Bipolar I, 104, 105*t*  
Bipolar II, 104, 105*t*  
Bisexuality, 58  
Blame culture, 170, 171  
Blocking, 72  
Bloodstream infection, central line  
  associated, 164  
Body dysmorphic disorder, 107  
Borderline personality disorder, 112  
  and defense mechanisms, 72, 74, 75  
Brain function, 125–134  
  aphasia, 127–128  
  areas of brain, 126–127  
  left and right brain dominance, 125  
  neurocognitive disorders, 131–134  
    defined, 131  
    delirium *vs.*, 131, 134*t*  
    due to Alzheimer disease, 131, 132*t*  
    due to HIV infection, 133–134  
    due to Huntington disease, 133  
    due to Parkinson disease, 133  
    due to prion disease, 132–133  
    due to Wilson disease, 134  
    frontotemporal (Pick disease), 132  
    with Lewy bodies, 133  
    major, 131  
    mild, 131  
    normal pressure hydrocephalus, 134  
    pseudodementia, 134  
    vascular (multi-infarct), 131, 132*t*  
  neurotransmitters, 128–130  
    acetylcholine, 128–129  
    dopamine, 129  
    enkephalins, 130  
    gamma aminobutyric acid, 130  
    glutamic acid, 130  
    norepinephrine, 129  
    serotonin (5-hydroxytryptamine), 130  
    substance P, 130  
Brain stem, 126*f*, 127*t*  
Breast development, 58*t*  
Brief psychotic disorder, 102*t*, 181  
Broca aphasia, 128*f*  
Broca area, 126*f*  
Brother Fox case, 136  
Bruxism, 98*t*  
Bulimia nervosa, 109  
Bupropion, 121  
Buspirone, 123
- C**  
CAGE questionnaire, 85  
Call-backs, 166, 184  
Cancer screening for older adults, 59  
Cannabis intoxication, 88*t*  
Capacity, 139  
Capitation, 158  
Carbamazepine, 122  
Case-control study, 19, 22–23, 23*t*  
Case-fatality rate, 9  
Case report, 19  
Case series report, 19  
Cataplexy, 96  
Catastrophic coverage, 158  
Categorical scale, 36  
Cause and effect diagram, 174  
Cause-specific mortality rate, 9  
Central line associated bloodstream  
  infection (CLABSI), 164  
Central nervous system (CNS) effects of  
  sedative-hypnotics, 90*t*  
Central sleep apnea, 97  
Central tendency, 28  
  measures of, 28–29  
Cerebellum, 126*f*, 127*t*  
Change, stages of behavioral, 86  
Checklist, 181  
*chi*-square test, 37*t*, 39  
Child abuse, 146, 147*t*  
Children  
  attachment and loss in, 61  
  psychiatric disorders, 99–101  
  attention deficit hyperactivity, 101  
  autism spectrum, 100  
  conduct *vs.* oppositional defiant, 101*t*  
  intellectual disability, 99  
  Tourette syndrome, 100  
  sexual abuse, 147*t*  
  treatment of, 143  
  withholding, 144  
Choreiform movements, medication side  
  effect, 118  
Cigarette smoking, 83  
Circumcision, female, 146  
CLABSI (central line associated  
  bloodstream infection), 164  
Classical conditioning  
  behavioral modification, 68–69  
  learning theory, 65, 67*t*  
Clinical trials, 23–24  
Close call, 168, 183  
Closed-loop communication, 181  
Cluster A personality disorders, 111  
Cluster B personality disorders, 112  
Cluster C personality disorders, 113  
CNS (central nervous system) effects of  
  sedative-hypnotics, 90*t*  
Co-insurance, 157, 158  
Cocaine intoxication, 88*t*  
Cognitive development theories, 55–57  
Cognitive errors, 169  
Cohort study, 19, 20–22, 23*t*  
Coining, 152  
Committed patients, 138–141  
Communication  
  closed-loop, 181  
  failures of, 166–167  
  structured, 166  
Community, 24  
Community trial, 24  
Competence, 139  
Compulsions, 107  
Computerized physician order entry  
  (CPOE), 163  
Concrete operational stage, 56*t*  
Conditioned response (CR), 65  
Conditioned stimulus (CS), 65  
Conditioning  
  aversive, 69  
  classical  
    behavioral modification, 68–69  
    learning theory, 65, 67*t*  
  operant  
    behavioral modification, 69  
    learning theory, 66, 67*t*  
Conduct disorder, 101*t*  
Conduction aphasia, 128*f*  
Confidence interval, 31–33  
Confidentiality  
  minors, 143  
  patient, 142–143  
Confirmation bias, 169  
Confounding bias, 17, 18*t*  
Confrontation, 150  
Consent, informed, 137–138  
  minors, 143–144  
Contemplation stage of change, 86*f*  
Continuous reinforcement, 67  
Control, Six Sigma model, 177  
Control chart, 179  
Control group, 23  
Convenience sample, 179  
Conversion disorder, 110  
Copayment, 158  
Coprophilia, 114  
Correlation, 37–38  
Countertransference, 155  
Court cases, selected important, 135–137  
CPOE (computerized physician order  
  entry), 163  
CR (conditioned response), 65  
Criterion-referenced tests, 81  
Cross-over study, 24  
Cross-sectional study, 19, 23*t*

- Crude mortality rate, 9  
 Crude rate, 8, 9  
 CS (conditioned stimulus), 65  
 Cultural differences, 152  
 Culture of blaming, 170, 171  
 Cupping, 152  
 Cyclothymic disorder, 104, 105*t*
- D**
- Death  
   and bereavement, 61–62  
   do not resuscitate (DNR) orders, 60, 142  
   end-of-life care, 60–61  
   right to refuse treatment, 145  
   suicide, 63  
     assisted, 145, 153  
     time of, 153  
 Debrief, 181  
 Decision-making standards, 139  
 Deductible, 157–158  
 Defense mechanisms, 71–76  
   anxiety, 73–75  
   immature, 72–73  
   mature, 76  
   narcissistic, 72  
 Defining the problem, Six Sigma model, 177  
 Definitive test, 23  
 Delayed diagnoses, 169  
 Delirium *vs.* neurocognitive disorders, 131, 134*t*  
 Delta sleep, 93*f*–95*f*  
 Dementia. *See* Neurocognitive disorders  
 Deming, W. Edwards, 176  
 Denial, 72  
 Dependent personality disorder, 113  
 Depersonalization disorder, 111  
 Depression  
   behavioral models, 69–70  
   bipolar disorder, 104  
   grief *vs.*, 62  
   major depressive disorder, 103, 104*t*  
   persistent depressive disorder, 103, 104*t*  
   screening for older adults, 59  
   and sleep, 96  
 Depressive disorder  
   major, 103, 104*t*  
   persistent, 103, 104*t*  
 Descriptive statistics, 28–31  
   distributions, 28–30  
   measures of central tendency, 28–29  
   measures of variability, 28, 29–30  
 Design bias, 17, 18*t*  
 Desomorphine intoxication, 89*t*  
 Despair, 57*t*  
 Detailed flowcharts, 178  
 Developmental life cycle, 53–63  
   aging, 58–61  
   end-of-life care, 60–61  
   financial considerations, 60  
   medical considerations, 59  
   physiological considerations, 60  
   psychiatric considerations, 59  
   death and bereavement, 61–62  
   sexuality, 57–58  
   stages of development, 53–57  
     cognitive development theories, 55–57  
     milestones, 54–55  
     newborns, 53  
     suicide, 63  
 Developmental milestones, 54–55  
 Developmental stages, 53–57  
   cognitive development theories, 55–57  
   milestones, 54–55  
   newborns, 53  
 Deviation from the norm method, 80  
 Diagnosis(es), missed or delayed, 169  
 Diagnostic errors, 167, 168–169  
 Difficult patients, 152  
 Direct questions, 150  
 Disclosure of error, 172–173  
 Displacement, 73  
 Dissociation, 75, 111  
 Dissociative disorders, 75, 111  
 Distributions, 28–30  
 Disulfiram, 87  
 DMAIC steps, Six Sigma model, 177  
 Do not resuscitate (DNR) orders, 60, 142  
 Domestic abuse, 147*t*  
 Dopamine, 129  
   schizophrenia, 103*t*  
   sleep and wakefulness, 95, 96  
 Dopamine blockers, and sleep, 96  
 Dopamine tracts, 118  
 Double-blind randomized controlled clinical trial, 24  
 Double hump graph, 15–16  
 Doubt, 56*t*  
 Down syndrome, 99  
 Dramatic personality disorders, 112  
 Drug administration, 5 Rs of, 163  
 Drug(s). *See* Psychopharmacology  
 Duty  
   to patient, 150–151  
   to protect, 137, 142–143  
   to warn, 137, 142–143  
 Dystonic reaction, medication side effect, 118*t*
- E**
- E intoxication, 89*t*  
 Eating disorders, 109  
 Eccentric personality disorders, 111  
 Ecstasy intoxication, 89*t*  
 Effective prevalence, 15  
 Effectiveness as aim of health care, 175  
 Efficiency as aim of health care, 175  
 Ego, 71  
*Eichner v. Dillon*, 136  
 Ejaculation, premature, 114  
 Elder abuse, 147*t*  
 Elderly. *See* Aging  
 Emancipated minors, 143  
 Emergency situation, informed consent in, 138  
 Emotional personality disorders, 112  
 Empathy, 152  
 End-of-life care, 60–61  
 Endemic disease, 3–4  
 Enkephalins, 130  
 Epidemic curve, 3  
 Epidemic disease, 3–4  
 Epidemiologic measures, 3–9  
   crude, specific, and standardized rates, 8–9  
   endemic, epidemic, and pandemic cases, 3–4  
   incidence and prevalence, 4–8  
 Epidemiology, 3–24  
   epidemiologic measures, 3–9  
     crude, specific, and standardized rates, 8–9  
     endemic, epidemic, and pandemic cases, 3–4  
     incidence and prevalence, 4–8  
   prevention, 10  
   screening tests, 11–16  
     double hump graph, 15–16  
     effective prevalence, 15  
     measures of test performance, 11–13  
     post-test probabilities, 14–15  
     true-positives, false-positives, true-negatives, and false-negatives, 11  
   study designs, 16–18  
     bias, 16–18  
   types of research studies, 19–24  
     case-control, 19, 22–23, 23*t*  
     case report, 19  
     case series report, 19  
     clinical trials, 23–24  
     cohort, 19, 20–22, 23*t*  
     community, 24  
     cross-over, 24  
     cross-sectional, 19, 23*t*  
     observational, 19, 23*t*  
     prospective, 19*f*  
     retrospective, 19*f*  
 Equitability as aim of health care, 175  
 Erectile disorder, 113  
 Erikson, Erik, 55*t*–57*t*  
 Error(s)  
   active, 182  
   cognitive, 169  
   defined, 182  
   diagnostic, 167, 168–169  
   latent, 182  
   medical (*See* Medical error(s))  
   medication, 163, 183  
   no-fault, 169  
   of omission, 182  
   preventive, 167





random vs. systematic, 19  
system-related, 169  
treatment, 167  
type I vs. type II, 34–35  
vs. violations, 168

Estimate, 31

Ethical issues. *See* Legal and ethical issues

Euthanasia, 153

Excessive daytime sleepiness, 96

Exhibitionism, 114

Experimenter expectancy, 17, 18*t*

Exposure, 69

Extinction, 66, 67*t*

Extrapyramidal reactions, 118

## F

Facilitation, 150

Factitious disorder, 110, 111*t*

Fading, 69

Failure mode effects analysis (FMEA), 174

Failure(s)

communication and teamwork,  
166–167

systems approach to, 170–172

Falls, patient, 164–165

False-negative (FN) result, 11

False-positive (FP) result, 11

FAS (fetal alcohol syndrome), 85, 99

Fearful personality disorders, 113

Female circumcision, 146

Female orgasm disorder, 114

Female sexual interest/arousal disorder, 113

Fetal alcohol syndrome (FAS), 85, 99

Fetishism, 114

Fetus, rights of, 136–137

Figures copied, 54*f*

Financial instability in older adults, 60

Fishbone diagram, 174

Fixed interval schedule, 67, 68*t*

Fixed ratio schedule, 67*f*, 68

Flakka intoxication, 88*t*

Flooding, 69

Flowcharts, 178

FMEA (failure mode effects analysis), 174

FN (false-negative) result, 11

“Folk medicine” practices, 152

Forcing function, 182

Formal operational stage, 56*t*

FP (false-positive) result, 11

Fragile-X syndrome, 99

Freud, Sigmund, 55*t*–57*t*, 71

Frontal lobe, 126*f*, 126*t*

Frontotemporal neurocognitive disorder,  
132

Frotteurism, 114

Fugue, 111

## G

Gamma aminobutyric acid (GABA), 130  
schizophrenia, 103*t*

Gaussian curve, 28

Gender dysphoria, 57

Gender identity, 57

Gender role, 57

Generalized anxiety disorder, 106

Generativity, 57*t*

Genital stage, 56*t*

Genitalia, development of, 58*t*

Genito-pelvic pain disorders, 114

Geriatric patients. *See* Aging

Global aphasia, 128*f*

Glutamate, schizophrenia, 103*t*

Glutamic acid, 130

Good Samaritan laws, 145–146

Grasp reflex, 53*t*

Grief, 61–62

Guilt, 56*t*

## H

HAI (hospital-acquired infections), 164

Hallucinations

hypnopompic and hypnagogic, 96

thought disorders, 102*t*

Hallucinogen intoxication, 88*t*

Handoffs, 182–183

errors at time of, 166

HAP (hospital-acquired pneumonia), 164

Harm, 183

Hazard, 183

Health care aims, 175

Health care delivery systems, 157–158

Health care power of attorney (HCPOA),  
60, 141, 142

Health insurance, 157–158

Health Insurance Portability and  
Accountability Act (HIPAA), 143

Health maintenance organization (HMO),  
157*t*

Helplessness, learned, 69–70

Hemispheres, left vs. right, 125

Heterosexuality, 58

High-level flowcharts, 178

HIPAA (Health Insurance Portability and  
Accountability Act), 143

Histamine receptor, 117*t*

Histrionic personality disorder, 112

HIV (human immunodeficiency virus)  
infection, neurocognitive disorder  
due to, 133–134

HMO (health maintenance organization),  
157*t*

Hoarding disorder, 107

Holmes and Rahe scale, 78–80

Homosexuality, 58

Hospice care, 61

Hospital-acquired infections (HAI), 164

Hospital-acquired pneumonia (HAP), 164  
5-HT (5-hydroxytryptamine), 130

schizophrenia, 103*t*

and sleep, 95

Huddle, 183

Human immunodeficiency virus (HIV)  
infection, neurocognitive disorder  
due to, 133–134

Humor as defense mechanism, 76

Huntington disease, neurocognitive  
disorder due to, 133

Hydrocephalus, normal pressure, 134

5-Hydroxytryptamine (5-HT), 130

schizophrenia, 103*t*

and sleep, 95

Hypertensive crisis, 120

Hypnagogic hallucinations, 96

Hypnopompic hallucinations, 96

Hypocretin, sleep and wakefulness, 95

Hypomania, 104, 105*t*

Hypothesis

alternative, 33

null, 33–34

testing, 33

Hypoxiphilia, 114

## I

Iatrogenic, 183

Id, 71

Identification as defense mechanism, 73

Identity, 56*t*

IHI (Institute for Health Care  
Improvements) Triple Aim,  
175–176

Illness, stress and, 78–80

Illness anxiety disorder, 110

IM SAFE mnemonic, 166

Immature defenses, 72–73

Impaired physician, 146

Impotence, 113

Improvement, Six Sigma model, 177

Incidence, 4–5, 8

cumulative, 5

defined, 6

vs. prevalence, 6, 7*f*, 7*t*, 15

Incidence rate (IR), 4–5

Incident reporting, 183

Incompetent patient

court cases, 135, 136

determination, 139–140

informed consent, 138

Independent events, 25

Industry, 56*t*

Infant Doe case, 136

Infection(s)

central line associated bloodstream, 164

hospital-acquired, 164

surgical site, 164

urinary catheter-related, 164

Inferential statistics, 31–35

confidence interval, 31–33

statistical inference, 33–35

Inferiority, 56*t*

Informed consent, 137–138

minors, 143–144

Inhalant intoxication, 89*t*

Initiative, 56*t*

Insomnia, 97

Institute for Health Care Improvements  
(IHI) Triple Aim, 175–176

- Insurance coverage, 157–158
  - Integrity, 57*t*
  - Intellectual disability, 99
  - Intellectualization, 74
  - Intelligence quotient (IQ), 80
  - Intelligence testing, 80
  - Intermittent reinforcement, 67
  - Interpreters, 152
  - Interval scale, 36, 37*t*
  - Interval schedules, 67, 68*t*
  - Interview, patient-centered, 148–150
  - Intimacy, 56*t*
  - Intoxication, 87, 88*t*–90*t*
  - Introjection, 73
  - IQ (intelligence quotient), 80
  - IR (incidence rate), 4–5
  - Ishikawa diagram, 174
  - Isolation, 56*t*
    - of affect, 74
- J**
- Judgment, substituted, 135, 141
- K**
- K complexes, 94*f*
  - K2/spice intoxication, 88*t*
  - Krokodil intoxication, 89*t*
  - Kubler-Ross, Elizabeth, 61
- L**
- Lamotrigine, 122
  - Lapses, 168
  - Late-look bias, 17, 18*t*
  - Latency stage, 56*t*
  - Latent errors, 182
  - Lead-time bias, 17, 18*t*
  - Leadership, 180
  - Leading questions, 150
  - Lean Enterprise, 177
  - Learned helplessness, 69–70
  - Learning, 65–68
    - classical conditioning, 65, 67*t*
    - modeling, 68
    - operant conditioning, 66, 67*t*
    - reinforcement schedules, 67–68
    - types of reinforcement, 67
    - types of reinforcers, 66–67
  - Left hemisphere, 125
  - Legal and ethical issues, 135–148
    - abuse, 146, 147*t*
    - advance directives, 141–142
    - autonomy, 137
    - committed patients, 138–141
    - Good Samaritan laws, 145–146
    - impaired physician, 146
    - informed consent, 137–138
    - negligence, 146
    - patient confidentiality, 142–143
    - physician-assisted suicide, 145
    - selected important court cases, 135–137
    - treatment of minors, 143
    - withholding treatment from minors, 144
  - Lewy bodies, neurocognitive disorder
    - with, 133
  - Life Stress Inventory, 78–80
  - Life support, removal, 135
  - Lifesaving surgery, foregoing, 136
  - Lithium, 121–122
  - Living will, 60, 141, 142
  - Look-alike drugs, 163
  - Loss
    - in adults, 61
    - in children, 61
- M**
- MA (mental age), 80
  - Maintenance stage of change, 86*f*
  - Major depressive disorder, 103, 104*t*
  - Male erectile disorder, 113
  - Male hypoactive sexual desire disorder, 113
  - Malingering, 110, 111*t*
  - Mania, 104, 105*t*
  - MAOIs (monoamine oxidase inhibitors), 120
  - Marijuana intoxication, 88*t*
  - Masochism, 114
  - Masturbation, 58
  - Matched pairs *t* test, 37*t*, 38
  - Mature defenses, 76
  - MDMA intoxication, 89*t*
  - Mean, 28
    - deviations from, 29, 29*t*, 30*f*
  - Measurement, Six Sigma model, 177
  - Measurement bias, 17, 18*t*
  - Measures of central tendency, 28–29
  - Measures of variability, 28, 29–30
  - Median, 28
  - Medicaid, 157*t*
  - Medical care of older adults, 59
  - Medical error(s), 161–185
    - analysis, 173–175
    - cases, 161–162
    - causes, 165–167
    - disclosure and reporting, 172–173
    - medication, 163
    - quality improvement, 175–179
      - measures of quality, 176
      - models, 176–179
    - scope of problem, 162–165
    - systems approach, 170
    - systems failures, 170–172
    - types, 167–169
  - Medical power of attorney, 60, 141, 142
  - Medically indigent adults (MIAs), 158
  - Medicare, 157*t*
  - Medication errors, 163, 183
  - Medication reconciliation, 183
  - Melatonin and sleep, 96
  - Mental age (MA), 80
  - Mesocortical tract, 118, 129
  - Mesolimbic tract, 118, 129
  - MIAs (medically indigent adults), 158
  - Milestones, developmental, 54–55
  - Minnesota Multiphasic Personality Inventory (MMPI-2), 81
  - Minors
    - emancipated, 143
    - treatment of, 143
    - withholding, 144
  - Mirtazapine, 121
  - Missed diagnoses, 169
  - Mistakes, 168
  - Mistrust, 55*t*
  - Mixed non-fluent aphasia, 128*f*
  - Mixed sleep apnea, 97
  - MMPI-2 (Minnesota Multiphasic Personality Inventory), 81
  - Mode, 28
  - Modeling, 68
  - Modifiable risk factors, 59
  - Molly intoxication, 89*t*
  - Monoamine oxidase inhibitors (MAOIs), 120
  - Mood disorders, 103–105
    - bipolar, 104, 105*t*
    - cyclothymic, 104, 105*t*
    - major depressive, 103, 104*t*
    - persistent depressive, 103, 104*t*
  - Mood stabilizers, 121–122
  - Morbidity rate, 7
  - Moro reflex, 53*t*
  - Mortality rate, 7, 9
  - Mother, rights of, 136–137
  - Motor area, 126*f*
  - Motor developmental milestones, 54*t*–55*t*
  - Motor tics, 100
  - Motor vehicle collision (MVC) deaths, 171
  - Mourning, 61–62
  - Moxibustion, 152
  - Multi-infarct neurocognitive disorder, 131, 132*t*
  - Muscarine receptor, 117*t*
  - Mutually exclusive events, 25–26
  - MVC (motor vehicle collision) deaths, 171
- N**
- NAc (nucleus accumbens) pathway, 84*f*
  - Naltrexone, 87
  - Narcissistic defenses, 72
  - Narcissistic personality disorder, 112
  - Narcolepsy, 96
  - Natural process limits, 179
  - NE (Norepinephrine), 129
  - NE (norepinephrine), and sleep, 95
  - Near-misses, 168, 183
  - Necrophilia, 114
  - Negative correlation, 38
  - Negative predictive value (NPV), 14
  - Negative reinforcer, 66
  - Negative skew, 28, 29*f*
  - Negligence, 146





Neurocognitive disorders, 131–134  
  defined, 131  
  delirium *vs.*, 131, 134*t*  
  due to Alzheimer disease, 131, 132*t*  
  due to HIV infection, 133–134  
  due to Huntington disease, 133  
  due to Parkinson disease, 133  
  due to prion disease, 132–133  
  due to Wilson disease, 134  
  frontotemporal (Pick disease), 132  
  with Lewy bodies, 133  
  major, 131  
  mild, 131  
  normal pressure hydrocephalus, 134  
  pseudodementia, 134  
  vascular (multi-infarct), 131, 132*t*  
Neurofeedback, 69  
Neuroleptic malignant syndrome, 118*t*  
Neuroleptic medications, 117–119  
  mechanism of action, 117–118  
  typical *vs.* atypical, 118–119  
Neuropathology, schizophrenia-associated, 103*t*  
Neurotransmitters, 128–130  
  acetylcholine, 128–129  
  dopamine, 129  
  enkephalins, 130  
  gamma aminobutyric acid, 130  
  glutamic acid, 130  
  norepinephrine, 129  
  schizophrenia, 103*t*  
  serotonin (5-hydroxytryptamine), 130  
  and sleep, 95–96  
  substance P, 130  
Neutral stimulus, 65  
Newborns, 53  
Nicotine, schizophrenia, 103*t*  
Night terror, 98*t*  
Nightmares, 98*t*  
Nigrostriatal tract, 118, 129  
NNT (Number needed to treat), 20  
No-fault errors, 169  
Nominal scale, 36, 37*t*  
Non-adherence, 151  
Nonrapid eye movement (NREM) sleep, 93, 94*f*, 95*f*  
Norepinephrine (NE), 129  
  and sleep, 95  
Norm-referenced tests, 81  
Normal curve, 28, 29*f*, 30, 30*f*  
Normal pressure hydrocephalus, 134  
NPV (negative predictive value), 14  
NREM (nonrapid eye movement) sleep, 93, 94*f*, 95*f*  
Nucleus accumbens (NAc) pathway, 84*f*  
Null hypothesis, 33–34  
Number needed to treat (NNT), 20

## O

Objective tests, 81  
Obligations of patient, 154  
Observational study, 19, 23*t*

Obsessions, 107  
Obsessive-compulsive disorder, 75, 107  
Obsessive-compulsive personality disorder, 113  
Obstructive sleep apnea, 97  
Occipital lobe, 126*f*, 126*t*  
Odd personality disorders, 111  
Odds ratio (OR), 22  
  confidence intervals for, 33  
Older adults. *See* Aging  
One-tailed null hypothesis, 33  
One-way ANOVA, 37*t*, 39  
Open-ended questions, 150  
Operant conditioning  
  behavioral modification, 69  
  learning theory, 66, 67*t*  
Opiate intoxication, 89*t*  
Oppositional defiant disorder, 101*t*  
OR (odds ratio), 22  
  confidence intervals for, 33  
Oral stage, 55*t*  
Ordinal scale, 36  
Orexin, sleep and wakefulness, 95  
Orgasm disorders, 114  
Outcomes measures of quality, 176

## P

Pandemic disease, 3  
Panic attacks, 106  
Panic disorder, 106  
Paranoid personality disorder, 111  
  defense mechanisms, 72, 74  
Paraphilic disorders, 114  
Parasomnias, 98*t*  
Parents  
  emancipated minors, 143  
  withholding treatment, 136, 144  
Pareto charts, 178  
Parietal lobe, 126*f*, 126*t*  
Parkinson disease, neurocognitive disorder  
  due to, 133  
Partial emancipation, 143  
Passive-aggression, 75  
Patient adherence, 151  
Patient-centered health care, 175  
Patient-centered interview, 148–150  
Patient confidentiality, 142–143  
Patient falls, 164–165  
Patient safety. *See* Safety  
Patient(s)  
  abandonment of, 151  
  angry, 153  
  committed, 138–141  
  cultural differences, 152  
  death of, 153  
  as decision-maker, 136–137  
  difficult, 152  
  duty to, 150–151  
  obligations of, 154  
  relationship with (*See* Physician-patient relationship)  
  reluctant, 153  
  rights of, 154  
  unconscious interactions with, 154–155  
Pavlov, Ivan, 65  
Payer systems, 157*t*  
PCP (phencyclidine) intoxication, 89*t*  
PDSA cycle, 176–177  
Pearson correlation, 37, 37*t*  
Pedophilia, 114  
Performance anxiety, 106  
Period prevalence, 6  
Persistent depressive disorder, 103, 104*t*  
Personalities, type A and type B, 78  
Personality disorders, 111–113  
  cluster A (odd, eccentric type), 111  
  cluster B (dramatic and emotional), 112  
  cluster C (anxious and fearful), 113  
Personality testing, 81  
Phallic stage, 56*t*  
Phase 1 trial, 23  
Phase 2 trial, 23  
Phase 3 trial, 23  
Phencyclidine (PCP) intoxication, 89*t*  
Phobias, 73, 106  
Physical developmental milestones, 54*t*–55*t*  
Physician, impaired, 146  
Physician-assisted suicide, 145, 153  
Physician behavior, 148–155  
  patient-centered interview, 148–150  
  physician-patient relationship, 150–154  
Physician-patient relationship, 150–154  
  abandonment, 151  
  angry patients, 153  
  boundaries, 150  
  cultural differences, 152  
  difficult patients, 152  
  duty to patient, 150–151  
  empathy, 152  
  obligations, 154  
  patient adherence, 151  
  reluctant patients, 153  
  rights, 154  
  sick role, 153  
  treatment issues, 152–153  
  unconscious interactions, 154–155  
Physiological changes in older adults, 60  
Piaget, Jean, 55*t*–57*t*  
Pick disease, 132  
PMR (proportionate mortality rate), 9  
Pneumonia  
  hospital-acquired, 164  
  ventilator-associated, 164  
Point prevalence, 6  
  pooled *t* test, 38  
Positive correlation, 37  
Positive predictive value (PPV), 14  
Positive reinforcer, 66  
Positive skew, 28, 29*f*  
Post-test probabilities, 14–15

- Post-traumatic stress disorder, 107–108  
 Power, statistical, 35  
 Power of attorney, health care (medical), 60, 141, 142  
 PPO (preferred provider organization), 157*t*  
 PPV (positive predictive value), 14  
 Precontemplation stage of change, 86*f*  
 Predictive value, positive *vs.* negative, 14  
 Preferred provider organization (PPO), 157*t*  
 Pregnancy, substance abuse during, 85  
 Premature ejaculation, 114  
 Preoperational stage, 56*t*  
 Preparation stage of change, 86*f*  
 Prevalence, 6–8  
   defined, 6, 15  
   effective, 15  
   incidence *vs.*, 6, 7*f*, 7*t*  
   period, 6  
   point, 6  
 “Prevalence pot,” 6  
 Prevention, 10  
   in aging patients, 58–59  
 Preventive errors, 167  
 Primary prevention, 10  
 Primary reinforcer, 66  
 Prion disease, neurocognitive disorder due to, 132–133  
 Privacy rules, 142–143  
 Private insurance, 157*t*  
 Probabilities, post-test, 14–15  
 Probability rules, 25–27  
   independent events, 25  
   mutually exclusive events, 25–26  
 Process measures of quality, 176  
 Projection, 72  
 Projective drawings, 81  
 Projective tests, 81  
 Proportionate mortality rate (PMR), 9  
 Prospective study, 19*f*  
 Pseudodementia, 134  
 Psychiatric care of older adults, 59  
 Psychiatric disorders, 99–115  
   anxiety, 106  
   childhood and adolescence, 99–101  
     attention deficit hyperactivity, 101  
     autism spectrum, 100  
     conduct *vs.* oppositional defiant, 101*t*  
     intellectual disability, 99  
     Tourette syndrome, 100  
   dissociative, 111  
   eating, 109  
   mood, 103–105  
     bipolar, 104, 105*t*  
     cyclothymic, 104, 105*t*  
     major depressive, 103, 104*t*  
     persistent depressive, 103, 104*t*  
   obsessive-compulsive and related, 107  
   personality, 111–113  
     cluster A (odd, eccentric type), 111  
     cluster B (dramatic and emotional), 112  
     cluster C (anxious and fearful), 113  
   sexual, 113–114  
   somatic symptom and related, 110–111  
   thought, 102–103  
   trauma and stressor-related, 107–108  
 Psychic structures, 71  
 Psychological health, 77–81  
   stress, 77–80  
     and illness, 78–80  
     type A and type B personalities, 78  
   testing, 80–81  
 Psychological testing, 80–81  
   intelligence, 80  
   personality, 81  
 Psychopharmacology, 117–123  
   anxiety medications, 123  
   antidepressant medications, 119–121  
     MAOIs, 120  
     other, 121  
     SNRIs, 121  
     SSRIs, 120  
     tricyclic, 119–120  
   antipsychotic (neuroleptic)  
     medications, 117–119  
     mechanism of action, 117–118  
     typical *vs.* atypical, 118–119  
   mood stabilizers, 121–122  
   side effects, 117*t*, 118*t*  
 Psychotic disorder, brief, 102*t*, 181  
 Pubic hair development, 58*t*  
 Punishment, 66  
 Purging, 109  
   *p*-value, 33–34  
 Pygmalion effect, 17, 18*t*
- ## Q
- Quality, measures of, 176  
 Quality assurance (QA), 184  
 Quality improvement (QI), 175–179  
   defined, 184  
   measures of quality, 176  
   models, 176–179  
     convenience sample, 179  
     flowcharts, 178  
     Lean Enterprise (Toyota Production System), 177  
     Pareto charts, 178  
     PDSA cycle, 176–177  
     run charts (time plots), 178–179  
     Shewhart chart (control chart), 179  
     Six Sigma, 177  
 Questions, interview, 150  
 Quinlan, Karen Ann, 135
- ## R
- Random error, 19  
 Randomized controlled clinical trial (RCT), 24  
 Range, 29  
 Rapid eye movement (REM) sleep, 93, 94*f*, 95*f*  
 Rate(s), 3  
 Ratio scale, 36  
 Ratio schedules, 67*f*, 68  
 Rationalization, 74  
 RCA (root cause analysis), 173–174, 184  
 RCT (randomized controlled clinical trial), 24  
 Reaction formation, 75  
 Read backs, 166, 184  
 Readmissions, unplanned, 165  
 Reason, James, 182  
 Recall bias, 17, 18*t*  
 Receiver operating characteristic (ROC) curves, 16  
 Reconciliation, medication, 183  
 Redirection, 150  
 Reflexes, newborn, 53*t*  
 Refusal of treatment  
   committed patient, 139  
   right to, 145  
 Regression, 73  
 Reinforcement  
   continuous *vs.* intermittent (partial), 67  
   low rate of response-contingent, 70  
   schedules, 67–68  
   types, 67  
 Reinforcers  
   positive *vs.* negative, 66  
   primary *vs.* secondary, 66  
   types, 66–67  
 Relapse stage of change, 86*f*  
 Relative risk (RR), 20–21  
   confidence intervals for, 33  
 Reliability, 16  
 Religious beliefs and practices, 152  
 Reluctant patients, 153  
 REM (rapid eye movement) sleep, 93, 94*f*, 95*f*  
 Repeated measures ANOVA, 37*t*, 39  
 Reported cases, 5  
 Reporting of error, 173  
 Repression, 73  
 Research question, 33  
 Research studies  
   design, 16–18  
   bias, 16–18  
   types, 19–24  
     case-control, 19, 22–23, 23*t*  
     case report, 19  
     case series report, 19  
     clinical trials, 23–24  
     cohort, 19, 20–22, 23*t*  
     community, 24  
     cross-over, 24  
     cross-sectional, 19, 23*t*  
     observational, 19, 23*t*  
     prospective, 19*f*  
     retrospective, 19*f*  
 Response  
   conditioned, 65  
   unconditioned, 65  
 Restrictive and repetitive behaviors (RRBs), 100





Retrospective study, 19f  
Rett syndrome, 100  
Rhythmic movements, medication side effect, 118  
Right hemisphere, 125  
Right(s)  
    of patient, 154  
    to refuse treatment, 145  
Rigidity, medication side effect, 118t  
Risk  
    absolute, 20  
    attributable, 20–21  
    relative, 20–21  
        confidence intervals for, 33  
Risk factors, modifiable, 59  
ROC (receiver operating characteristic)  
    curves, 16  
*Roe v. Wade* (1973), 136–137  
Role confusion, 56t  
Root cause analysis (RCA), 173–174, 184  
Rooting reflex, 53t  
Rorschach inkblot test, 81  
RR (relative risk), 20–21  
    confidence intervals for, 33  
RRBs (restrictive and repetitive behaviors), 100  
Run charts, 178–179

## S

S (standard deviation), 29–30  
    vs. standard error, 31–32  
SAD (seasonal affective disorder), 96, 103  
Sadism, 114  
Safety, 161–185  
    as aim of health care, 175  
    analysis of medical errors, 173–175  
    cases on, 161–162  
    causes of medical error, 165–167  
    defined, 184  
    error disclosure and reporting, 172–173  
    key definitions, 181–185  
    leading change in, 180  
    quality improvement, 175–179  
        measures of quality, 176  
        models, 176–179  
    scope of problem, 162–165  
    system-based redesigns for, 171–172  
    systems approach to failure, 170–172  
    systems approach to medical error, 170  
    types of medical error, 167–169  
Sampling bias, 17, 18t  
Sanity, 139  
SB5 (Stanford-Binet Intelligence Scales, Fifth Edition), 80  
SBAR, 166, 184  
Scale, 36–37  
Scatterplots, 38  
Schizoaffective disorder, 102t  
Schizoid personality disorder, 111  
Schizophrenia, 102–103  
Schizophrenia-associated neuropathology, 103t

Schizophreniform disorder, 102t  
Schizotypal personality disorder, 111  
Screening tests, 11–16  
    double hump graph, 15–16  
    effective prevalence, 15  
    measures of test performance, 11–13  
    older adults, 59  
    post-test probabilities, 14–15  
    substance abuse, 85  
    true-positives, false-positives, true-negatives, and false-negatives, 11  
SD (standard deviation), 29–30  
    vs. standard error, 31–32  
Seasonal affective disorder (SAD), 96, 103  
Secondary prevention, 10  
Secondary reinforcer, 66  
Sedative-hypnotics, CNS effects of, 90t  
Selection bias, 17, 18t  
Selective serotonin reuptake inhibitors (SSRIs), 120  
Self-awareness, substance abuse, 85–86  
Sensitivity, 11–12  
Sensorimotor stage, 55t  
Sensory area, 126f  
Sentence completion test, 81  
Sentinel event, 184  
Separation anxiety, 54  
Serotonin, 130  
    schizophrenia, 103t  
    and sleep, 95  
Serotonin norepinephrine reuptake inhibitors (SNRIs), 121  
Serotonin syndrome, 120  
Sexual abuse, child, 147t  
Sexual arousal disorders, 113  
Sexual desire disorders, 113  
Sexual disorders, 113–114  
Sexual identity, 57  
Sexual orientation, 58  
Sexuality, 57–58  
    older adults, 60  
Shaken baby syndrome, 146  
Shame, 56t  
Shaping, 69  
Shewhart chart, 179  
Sick role, 153  
Side effects, 117t, 118t  
Six Sigma model, 177  
Skewed distribution, 28, 29f  
Skinner, B. F., 66  
Sleep  
    delta, 93f–95f  
    drugs that alter, 96  
    neurotransmitters, 95–96  
    nonrapid eye movement (NREM), 93, 94f, 95f  
    rapid eye movement (REM), 93, 94f, 95f  
Sleep apnea, 97  
Sleep architecture, 93–96  
Sleep attacks, 96  
Sleep deprivation, 95

Sleep disorders, 96–98  
    insomnia, 97  
    narcolepsy, 96  
    older adults, 60  
    parasomnias, 98t  
    sleep apnea, 97  
Sleep latency, 94f  
Sleep paralysis, 96  
Sleep spindles, 94f  
Sleep stages, 93, 94f, 95f  
Sleep waves, 94f  
Sleepwalking, 98t  
Slips, 168  
Smoking, 83  
SNRIs (serotonin norepinephrine reuptake inhibitors), 121  
Social anxiety, 106  
Social communication disorder, 100  
Somatic symptom disorder, 110, 111t  
Somatic symptoms disorders, 73  
Somatization, 73  
Somnambulism, 98t  
Sound-alike drugs, 163  
Spearman correlation, 37  
Specific rate, 8, 9  
Specificity, 11, 12–13  
Splitting, 72  
SSI (surgical site infection), 164  
SSRIs (selective serotonin reuptake inhibitors), 120  
Stage fright, 106  
Stages of behavioral change, 86  
Stagnation, 57t  
Standard deviation (S, SD), 29–30  
    vs. standard error, 31–32  
Standard error, 31–32  
Standardized rates, 9  
Stanford-Binet Intelligence Scales, Fifth Edition (SB5), 80  
Startle reflex, 53t  
Statistical inference, 33–35  
Statistical power, 35  
Statistical process control, 179  
Statistical significance, 33–34  
Statistical tests, 37–39  
    analysis of variance (ANOVA), 39  
    chi-square, 39  
    correlation, 37–38  
    t test, 38  
Statistics. *See* Biostatistics  
Stimulus  
    conditioned, 65  
    neutral, 65  
    unconditioned, 65  
Stimulus control, 69  
Stranger anxiety, 54  
Stress, 77–80  
    and illness, 78–80  
    type A and type B personalities, 78  
Stress disorders, 107–108  
Stressor-related disorders, 107–108  
Structure measures of quality, 176

- Structured communication, 166
  - Study designs, 16–18
    - bias, 16–18
  - Study result, 31
  - Subjective standard, 140
  - Sublimation, 76
  - Substance P, 130
  - Substance use disorders, 83–91
    - alcohol and tobacco use, 83
    - CNS effects, 90*t*
    - diagnosis, 87
    - genetics, 84
    - legal ramifications, 87
    - physiology, 84
    - pregnancy, 85
    - rationalization in, 74
    - self-awareness, 85–86
    - signs and symptoms of intoxication/withdrawal, 88*t*–90*t*
    - treatment, 87, 88*t*–90*t*
  - Substituted judgment, 135, 141
  - Successive approximations, 69
  - Suicide, 63
    - physician-assisted, 145, 153
  - Superego, 71
  - Suppression, 76
  - Surgical site infection (SSI), 164
  - Surrogate, 140
  - Swiss cheese model, 170–171
  - Synthetic cocaine intoxication, 88*t*
  - Synthetic marijuana intoxication, 88*t*
  - Synthetic opiate intoxication, 89*t*
  - System-based redesigns, 171–172
  - System-related errors, 169
  - Systematic desensitization, 68
  - Systematic error, 19
  - Systems approach
    - to failure, 170–172
    - to medical error, 170
- T**
- t* test, 37*t*, 38
  - Tanner, James, 58
  - Tanner Stages of Development, 58
  - Tarasoff decision, 137, 142–143
  - Tardive dyskinesia, medication side effect, 118*t*
  - TAT (thematic apperception test), 81
  - TCAs (tricyclic antidepressants), 119–120
  - Teamwork failures, 166–167
  - Teamwork training, 167
  - Teeth grinding, 98*t*
  - Temporal lobe, 126*f*, 127*t*
  - Terminal patient, 153
  - Tertiary prevention, 10
  - Test performance measures, 11–13
- Testing
- psychological, 80–81
  - intelligence, 80
  - personality, 81
  - screening (*See* Screening tests)
- Thematic apperception test (TAT), 81
- Therapeutic privilege and informed consent, 138
- Theta wave, 94*f*
- Thought disorders, 102–103
- Tics, 100
- Time plots, 178–179
- Timeliness as aim of health care, 175
- TN (true-negative) result, 11
- Tobacco use, 83
- Tolerance, 87
- Tourette syndrome, 100
- Toyota Production System, 177
- TP (true-positive) result, 11
- Transcortical motor aphasia, 128*f*
- Transcortical sensory aphasia, 128*f*
- Transference, 154
- Transitions, errors at time of, 166
- Translators, 152
- Trauma-related disorders, 107–108
- Trazodone, 121
- Treatment
  - committed patient, 138–139
  - errors, 167
  - issues related to, 152–153
  - minors, 143
  - withholding, 144
  - refusal of
    - committed patient, 139
    - right to, 145
    - withholding, 136
    - of minors, 144
- Tremors, medication side effect, 118*t*
- Trichotillomania, 107
- Tricyclic antidepressants (TCAs), 119–120
- Triple Aim, 175–176
- True-negative (TN) result, 11
- True-positive (TP) result, 11
- Trust, 55*t*
- Tuberoinfundibular tract, 118, 129
- Two-tailed null hypothesis, 33
- Two-way ANOVA, 39
- Type A personality, 78
- Type B personality, 78
  - type I error, 34–35
  - type II error, 34–35
- Typical antipsychotics, 118–119
- U**
- Unconditioned response (UCR), 65
  - Unconditioned stimulus (UCS), 65
- Unconscious interactions, 154–155
  - Undoing, 75
  - Unplanned readmissions, 165
  - Upper airway sleep apnea, 97
  - Urinary catheter-related infection, 164
  - Urinary tract infection (UTI), urinary catheter-related, 164
  - Urophilia, 114
  - Use disorders, 87
- V**
- Vaccinations for older adults, 59
  - Validity, 16
  - Valproic acid, 122
  - VAP (ventilator-associated pneumonia), 164
  - Variability, measures of, 28, 29–30
  - Variable interval schedule, 67, 68*t*
  - Variable ratio schedule, 67*f*, 68
  - Variance, 29, 30
    - analysis of, 39
  - Vascular neurocognitive disorder, 131, 132*t*
  - Ventilator-associated pneumonia (VAP), 164
  - Violations, 168, 185
  - Vocal tics, 100
  - Voyeurism, 114
- W**
- Waiver of informed consent, 138
  - Wechsler Adult Intelligence Scale IV (WAIS-IV), 80
  - Wechsler Intelligence Scale for Children V (WISC-V), 80
  - Wechsler Preschool and Primary Scale of Intelligence IV (WPPSI-IV), 80
  - Wernicke aphasia, 128*f*
  - Wernicke area, 126*f*
  - Wilson disease, 134
  - WISC-V (Wechsler Intelligence Scale for Children V), 80
  - Withdrawal, 87, 88*t*–90*t*
  - Withholding treatment, 136
  - Wrong-site procedure, 185
- X**
- X intoxication, 89*t*
- Z**
- Z score, 31–32
  - Zoophilia, 114



