

# Chapter 1

## Foundations of Epidemiology

### HEALTH AND POPULATIONS

Historically, health was defined as the absence of illness such as plague, cholera, and tuberculosis. In 1948, the World Health Organization proposed, “health is the state of complete physical, mental, and social well-being, not just the absence of disease or infirmity.”<sup>1</sup> Thinking of health as more than just the absence of illness was novel at the time. Nevertheless, this new definition of health was quickly adopted. More recently, emotional, spiritual, and environmental dimensions have been added to the definition of health (Table 1.1).

Consideration of the six dimensions of health of a population (a group of people sharing one or more characteristics) is the essence of public health. Public health is concerned with threats to the health of a population. The mission of public health is to secure the conditions that promote the six dimensions of health of a population as a whole. It is the science and art of promoting health and extending life on an aggregate level.

#### Question 1

Public health is concerned with threats to the health of a population. What is the meaning of “population”?

#### ANSWER

*“Population” refers to a collection of individuals who share one or more observable personal or observational characteristics from which data may be collected and evaluated. Social, economic, family (marriage and divorce), work and labor force, and geographic factors may characterize populations.*

### SUBFIELDS AND FUNCTIONS OF PUBLIC HEALTH

There are many subfields of public health, including epidemiology, biostatistics, and health services. Because of its central role in public health, epidemiology is commonly referred to as the foundation of public health. Epidemiology, along with biostatistics, health services, and other subfields of public health make it possible for the three core public health functions to be carried out. The three core functions of public health are:

- Assessing and monitoring the health of communities and populations at risk to identify health problems and priorities;
- Formulating public policies designed to solve identified local and national health problems and priorities; and

TABLE 1.1

Six Dimensions of Health

Physical	Ability of the human body to function properly; includes physical fitness and activities of daily living
Social	Ability to have satisfying relationships; interaction with social institutions and societal mores
Mental	Ability to think clearly, reason objectively, and act properly
Emotional	Ability to cope, adjust, and adapt; self-efficacy and self-esteem
Spiritual	Feeling as if part of a greater spectrum of existence; personal beliefs and choices
Environmental	External factors (i.e., one's surroundings, such as habitat or occupation) and internal factors (i.e., one's internal structure, such as genetics)

- Ensuring that all populations have access to appropriate and cost-effective care, including health promotion and disease prevention services, and evaluating the effectiveness of that care.<sup>2</sup>

### Question 2

Health has been defined as consisting of six interactive dimensions. Are there any of these six dimensions that are not important to your own health?

#### ANSWER

*Because of the interactive nature of these dimensions of health, it is unlikely that you came up with one or more of these six dimensions as being unnecessary. Yet, circumstances at any given time in life may influence the importance placed on any one or combination of the six dimensions of health.*

### Question 3

What is wellness?

#### ANSWER

*The definition of "wellness" is not universally agreed upon. Nevertheless, here are some possibilities:*

- *To be healthy and disease free*
- *The state or quality of being in good health*
- *The achievement of the highest level of health in each of the six dimensions of health*

- *The optimal state of health*
- *The pursuit of a healthy and balanced life-style*

### Question 4

Describe how public health relates to the six interactive dimensions of health.

#### ANSWER

*Public health aims to promote these six interactive dimensions of health in the community based on population health analysis. The population may range from a handful of people to the inhabitants of large geographic areas; may involve certain racial or ethnic groups, or other selected demographic features; or may consist of people of selected religions or social organizations.*

### Question 5

It has been said that public health intervention focuses on prevention rather than treatment. What are some ways that you think prevention of health problems may be achieved?

#### ANSWER

*Health education to influence behavior change (e.g., nutrition or physical activity); health education and resource allocation to improve immunization levels; regulations to improve housing conditions, sanitation, and water supply; and quarantining to stop the spreading of illness.*

## DEFINING EPIDEMIOLOGY

The word “epidemiology” is based on three Greek words: *epi*, the prefix, meaning “on, upon, or befall”; *demos*, the root, meaning “the people”; and *logos*, the suffix, meaning “the study of.” In accordance with medical terminology, the suffix is read first and then the prefix and

the root, such that the word “epidemiology” literally means “the study of that which befalls the people.” Epidemiology is the study of the distribution and determinants of health-related states or events in specified human populations, and the application of this study to prevent and control health problems (Table 1.2).<sup>3</sup>

**TABLE 1.2**

**Understanding Epidemiology**

Term	Description
Study	Study implies sound methods of scientific investigation. Contributing factors to epidemiology include advances in biology, medicine, statistics, and social and behavioral sciences.
Distribution	Distribution refers to the frequency and pattern of a health-related state or event. Frequency is the number of occurrences of a health-related state or event; pattern involves presenting the distribution by person, place, and time characteristics.
Determinants	<p>Determinants are factors that produce an effect, result, or consequence in another factor. A determinant is a cause. Determinants may be:</p> <ul style="list-style-type: none"> <li>■ Physical stresses—excessive heat, cold, and noise; radiation (electromagnetic, ultrasound, microwave, or x-irradiation); climate change; ozone depletion; housing; and so on.</li> <li>■ Chemicals—drugs, acids, alkali, heavy metals (lead and mercury), poisons (arsenic), and some enzymes.</li> <li>■ Biological—disease-causing infectious agents or pathogens (viruses, bacteria, fungi, and parasites).</li> <li>■ Psychosocial milieu—families and households, socioeconomic status, social networks and social support, neighborhoods and communities, access to health care, formal institutions, and public policy.</li> </ul>
Health-related states or events	<p>“Health-related states or events” refers to the fact that epidemiology involves more than just the study of disease states, but also includes the study of events, behaviors, and conditions associated with health:</p> <ul style="list-style-type: none"> <li>■ A <i>disease</i> is an interruption, cessation, or disorder of body functions, systems, or organs (e.g., cholera, angina, breast cancer, influenza).</li> <li>■ An <i>event</i> is something that takes place (e.g., vehicular collisions, workplace injuries, drug overdose, suicide).</li> <li>■ A <i>behavior</i> is a manner of conducting oneself (e.g., physical activity, diet, safety precautions).</li> <li>■ A <i>condition</i> is an existing circumstance (e.g., an unhealthy state, a state of fitness, something that is essential to the occurrence of something else).</li> </ul>
Application	Application refers to the fact that the information obtained through epidemiology is applied to better prevent and control health problems.

**Question 6**

The definition of epidemiology includes the term “distribution.” Which of the following best describes this term?

- Frequency and determinants
- Determinants and application
- Frequency and pattern
- Frequency and application

ANSWER

c

**Question 7**

Epidemiology is defined as the study of something. What is it the study of?

ANSWER

*It is the study of the distribution (frequency and pattern) and determinants (causes) of health-related states or events. Note that a common term used in epidemiology is “risk factor.” A risk factor is something that is associated with an increased probability of experiencing a given health problem, and is not necessarily a cause. The presence of a risk factor may not be sufficient to cause a disease, but increases the chance of developing the disease. A risk exposure or behavior may be concluded from a series of consistent findings in epidemiologic investigations.*

**Question 8**

Classify each of the following as referring to (A) distribution or (B) determinant.

- \_\_\_ Identify the extent of a public health problem.
- \_\_\_ Monitor disease and other health-related events over time.
- \_\_\_ Identify those who are at greatest risk for disease, injury, disability, or death.
- \_\_\_ Identify the source of a disease outbreak in a given community.

ANSWER

A, A, A, B

**Question 9**

What is meant by the phrase “application of this study” in the definition of epidemiology?

ANSWER

*The study of the distribution and determinants of health-related states or events in human populations can provide useful information for informing public health policy and individual decision making.*

**Question 10**

Why is epidemiology considered by many to be the foundation of public health?

ANSWER

*Epidemiology plays a foundational role because of its central role in carrying out the three core public health functions. Epidemiology provides an approach to assess and monitor the health of populations at risk and identify health problems and priorities, identify risk factors for health problems, and provide a basis for predicting the effects of certain exposures. In turn, epidemiologic information is useful in formulating policies and priorities designed to solve identified health problems and allocating scarce health resources for preventing, protecting, and promoting the public’s health.*

In epidemiology there is a defined population of interest (i.e., the population at risk). Epidemiologic study may involve all those in the population or a representative sample of the population. The population focus of epidemiology may be better understood by comparing the clinical focus with the epidemiology focus (see Table 1.3).

**Question 11**

How would an epidemiologist’s focus on a health problem differ from that of the clinician in terms of treatment?

ANSWER

*The clinician treats and cares for the patient based on scientific knowledge, experience, and clinical judgment; the epidemiologist explores the source or exposure that caused the adverse health outcome, the number of persons exposed, and the potential for further spread and applies this information in the development of interventions to prevent additional cases or recurrences.*

**Question 12**

Compare the role of epidemiology in public health practice with its role in individual decision making.

ANSWER

*See Table 1.4.*

**TABLE 1.3**

**Clinical Focus vs. Epidemiological Focus**

Clinical Focus	Epidemiological Focus
Health of the individual	The collective health of the people in a population of interest (i.e., the population at risk)
Treating and caring for the patient	Identifying the source or exposure that caused an adverse health outcome, the number of persons exposed, the potential for further spread, and interventions to prevent additional cases or recurrences
Treating the patient based on scientific knowledge, experience, and clinical judgment	Using descriptive and analytic epidemiologic methods to provide information that will ultimately help determine appropriate public health action to control and prevent the public health problem

**TABLE 1.4**

**Public Health Practice vs. Individual Decision Making**

Public Health Practice	Individual Decision Making
Community health assessment includes identifying where the health problem is greatest, who is at risk, whether the problems are increasing or decreasing over time, and how these patterns relate to the level and distribution of available health resources.	Epidemiologic information about risk factors for disease and health-related events can influence healthy dietary and life-style changes.

## THE SCIENTIFIC METHOD

Epidemiology uses the scientific method to describe and analyze health-related states or events. The scientific method involves using appropriate study designs and statistical techniques for investigating an observable occurrence and acquiring new knowledge. The presence of a health problem is established through epidemiologic methods, which involve observation, definitions, measurements, interpretations, and dissemination. Once the research problem is established, hypotheses are formulated to explain observed and measured associations in the population of interest. Hypotheses are tested using appropriate statistical tests. Analyses are followed by interpretation and dissemination of the health findings.

### Question 13

What role does hypothesis testing play in the scientific method?

#### ANSWER

*Hypothesis testing is central to the scientific method and is based on a particular conception of causality in a given situation. Once the research hypothesis is in place, data are collected and assessed to either support or fail to support the research hypothesis. If the hypothesis is rejected, alternatives are considered. If the data are consistent with the purported hypothesis, the hypothesis is retained. Information is analyzed in epidemiology in much the same way as it is analyzed in prospective laboratory experiments, but because the investigator often does not have control over the exposure and outcome measures, extra care must be taken to find convincing evidence that the hypothesized chain of events is not due to bias or confounding.*

## STUDY DESIGNS IN EPIDEMIOLOGY

A study design is a detailed plan or approach for systematically collecting, analyzing, and interpreting results; it is a formal approach of scientific or scholarly investigation. Study designs in epidemiology are classified as either descriptive or analytic. Descriptive epidemiologic studies are used to assess and monitor the health of communities and identify health problems and priorities according to person, place, and time. Descriptive epidemiologic studies also lend support to more definitive evaluation using analytic methods. Analytic epidemiologic study designs employ comparison groups and are used to test one or more predetermined hypotheses about associations between exposure and outcome variables. Analytic epidemiology provides information on how and why a health-related state or event occurred.<sup>4</sup>

### Question 14

Discuss the primary purposes of descriptive and analytic epidemiology studies.

#### ANSWER

*A descriptive epidemiologic study is used to answer questions such as who is affected, where they are affected, and when they were most likely affected. It also involves describing what the health problem is (e.g., clinical characteristics). This knowledge is prerequisite to effective education, screening, prevention, and control efforts. An analytic epidemiologic study involves a comparison group that allows us to identify and quantify associations and to test hypotheses. Analytic studies provide greater evidence than do descriptive studies to support a hypothesis of causal association. Analytic studies attempt to explain why and how health-related states or events occur.*

### Question 15

Classify each of the following as (A) descriptive epidemiology, (B) analytical epidemiology, or (C) both.

- \_\_\_ The ongoing systematic collection, analysis, interpretation, and dissemination of health data in order to identify patterns of disease occurrence
- \_\_\_ The study of the natural history of disease (or the progression of the disease process over time without the influence of an intervention) from exposure to or accumulation of factors that lead to pathologic change, to the onset of symptoms, and to recovery, disability, latency, or death

- \_\_\_ Comparative study that attempts to identify and quantify associations, test hypotheses, and identify causes
- \_\_\_ The process that attempts to determine as systematically and objectively as possible the relevance, effectiveness, and impact of activities in light of their objective

#### ANSWER

- A. This is the definition for public health surveillance.*
- B. To fully understand the natural history of a disease, both descriptive and analytic epidemiology are required.*
- C. Evaluation may involve monitoring of a health-related state or event over time (descriptive) or whether those involved in an intervention perform better than those not involved (analytic).*

### Question 16

Describe the role of program evaluation in public health practice.

#### ANSWER

*Various programs are offered by state health departments to prevent illnesses such as vaccine-preventable diseases or sexually transmitted diseases. An outbreak of a disease may suggest a weakness of a program. Investigation of causes of the disease may identify populations overlooked by the program, weakness in an intervention strategy, and so on. Thus, evaluation of the program at the time of an outbreak can provide direction and strategies for improving the program.*

## ACTIVITIES IN EPIDEMIOLOGY

To support the core public health objectives listed earlier, epidemiology involves a range of activities,<sup>4</sup> including but not limited to:

- Applying valid and reliable instruments for acquiring and measuring the health-related state or event of interest
- Identifying the presence or absence of a health-related state or event by observation, measurement, or experiment of the appropriate variables
- Evaluating in an experiment the effects of an assigned intervention on an outcome of interest
- Identifying the probable course of a health problem, from a susceptible host to clinical symptoms to likely outcomes (recovery, disability, or death)
- Identifying who is at greatest risk for disease, injury, disability, and death

- Understanding where and when the health problem is greatest
- Identifying the primary risk factors associated with the health-related state or event
- Identifying the mode of transmission
- Combining laboratory evidence with epidemiologic findings
- Making statements about causality based on the totality of evidence
- Monitoring health-related states or events over time
- Monitoring potential exposures over time
- Evaluating the efficacy (ability of a program to produce benefits among those who participate versus those who do not) and effectiveness (ability of a program to produce benefits among those who are offered the program) of prevention and treatment programs
- Providing information useful in health planning and decision making for establishing health programs with appropriate priorities
- Assisting in carrying out public health programs
- Being a resource person
- Communicating public health information

As you progress through the workbook, the role of the epidemiologist in performing these activities will become clear.

### Question 17

Provide an example of assessing individual and community needs for health education.

#### ANSWER

*Epidemiology allows us to understand the natural history of disease, from a given exposure or behavior to a disease or a health-related outcome. It is often only after an event or characteristic has been identified as causing a disease and the extent of that event or characteristic has been determined, that needs assessment can be effectively formulated and a prevention program developed and critically evaluated. For example, an epidemiologic study identified that human papillomavirus (HPV) explains almost all cancer of the uterine cervix. HPV has also been identified as an important cause of anal, vulvar, and penile cancers, and to a lesser extent a cause of oropharynx and skin cancers. The primary mode of transmission of HPV is sexual intercourse, especially at a young age and with multiple sexual partners. Health educators should focus their interventions of abstinence or safe-sex practices on populations in*

*which descriptive epidemiology identifies high levels of HPV or cancers related to the virus.*

### Question 18

How might epidemiology help to establish programs based on appropriate priorities?

#### ANSWER

*Establishing priorities presupposes that we know our target audience. For example, are people failing to practice safe sex because they are not aware of the associated risks or because of other reasons? If for some other reason, what is it? Descriptive epidemiologic methods such as a cross-sectional survey may be a useful tool for providing answers to such questions.*

### Question 19

How does epidemiology help us establish goals and objectives?

#### ANSWER

*Descriptive epidemiology provides a description of the who (person), what (clinical characteristics), when (time), and where (place) aspects of health-related states or events in the population. Characterizing risk factors and disease outcomes in this manner is an effective approach for establishing relevant and realistic goals and objectives. This is the approach taken in several key health documents in the United States. For example, on the basis of descriptions of patterns and trends of risk factors and disease data, Healthy People 2000 proposed 319 specific objectives for improving health status.<sup>5</sup> Healthy People 2010 proposed 467 objectives for improving health status.<sup>6</sup>*

### Question 20

How might knowledge gained through epidemiology be useful for carrying out a public health program?

#### ANSWER

*Carrying out health interventions requires proper clearances from institutional review boards and, often, other organizations and funding agencies. These groups often mandate a scientific approach with quantifiable justification of needs and evidence for the likelihood of program success. Epidemiologic methods provide the scientific approach for satisfying the standards established by institutional review boards, organizations, and funding agencies.*

**Question 21**

What role does epidemiology play in evaluating public health interventions?

**ANSWER**

*The scientific approach taken in epidemiology is often unambiguous and convincing. For example, an intervention used in determining the efficacy of a vaccination against hepatitis B virus (HBV) may minimize potential biases by employing a large sample size and using randomization and blinding procedures. Otherwise, even well-intentioned researchers may promote interventions that are ineffective and possibly damaging. In addition, once the value of an intervention has been established, continued monitoring of the health outcome associated with the intervention can be beneficial. For instance, monitoring HBV over time through a series of cross-sectional assessments of the population will allow us to determine the level of adoption of the vaccine and where breakdowns in the vaccination program may occur.*

**Question 22**

Can training in epidemiology assist a person in being a resource in the public health process?

**ANSWER**

*Yes. A resource person should have a good understanding of the health problem as it relates to the individual and community, of the rationale and justification for intervention efforts with corresponding goals and objectives, and of what is needed to communicate these in a clear and concise manner. Without a basic knowledge of epidemiology, it is unlikely that the intended resource person will understand who is at greatest risk for the disease, the types of exposures capable of causing the disease, the pathological changes and the types of symptoms that characterize the disease, and so on.*

**Question 23**

Does familiarity with epidemiology assist the public health worker in communicating important health information?

**ANSWER**

*Public health workers should have an ability to communicate technical information clearly, concisely, and accurately. If a public health worker does not understand epidemiologic mea-*

*asures commonly used for describing patterns and trends of disease and health-related conditions, effective communication is unlikely. On the other hand, familiarity with epidemiology will allow the health worker to describe effectively and justify in a clear and concise way to those who need to know, what should be done to promote health and well-being.*

**EPIDEMIC, ENDEMIC, AND PANDEMIC**

An epidemic is an increase above the expected level over a given time period of disease or health-related events in a defined population. An endemic is the persistent, usual, or expected level of disease or health-related events in a defined population. A pandemic involves epidemics affecting a large number of people across many countries, continents, or regions.<sup>3</sup> “Outbreak” carries the same meaning as epidemic, but is typically used when the cases are confined to a more limited geographic area and a smaller number of people. The word is also perhaps less alarming.

**Question 24**

Classify each of the following as an (A) epidemic, (B) endemic, (C) pandemic, or (D) outbreak.

- \_\_\_ Annually, there are approximately 350–500 million cases of malaria, killing between one and three million people, the majority of whom are young children in sub-Saharan Africa.
- \_\_\_ Mexico City closed schools across the metropolis of 20 million people after at least 16 people died and more than 900 others fell ill from what health officials suspect is a new strain of swine flu.
- \_\_\_ Known as “Spanish Flu” or “La Grippe,” the influenza of 1918–1919 was a global disaster, killing between 20 and 40 million people.
- \_\_\_ An unusual cluster of eight breast cancer and eight other malignant tumor cases (ovarian, uterus, lung, colon, and brain tumors and malignant melanoma) developed in a period of 12 years among 98 nurses exposed to ethylene oxide (EtOx) for 5–15 years in a unit using gas sterilizer in a hospital of the archiepiscopal city of Eger, Hungary.

**ANSWER**

B, A, C, D



## COMMON SOURCE, PROPAGATED, AND MIXED EPIDEMICS

Epidemics may arise from exposure to a common source (common exposure to a source over a short period of time [point source] or through intermittent or continuous exposure to a source over days, weeks, or years); propagated through gradual spread from person to person; or from a common source and then by secondary spread from person to person (mixed).

### Question 25

Classify each of the following as (A) common source epidemic, (B) propagated epidemic, or (C) mixed epidemic.

- \_\_\_ Attack of gastroenteritis occurred following a church supper.
- \_\_\_ Beethoven saw physician after physician in search of a cure for his physical ailments. A team of experts in chemical analysis found unusually high levels of lead concentration in eight strands of Beethoven's hair.
- \_\_\_ Sick building syndrome.
- \_\_\_ Swine flu epidemic.
- \_\_\_ Cryptosporidiosis, also known as crypto, is a parasitic disease caused by *Cryptosporidium*, a protozoan parasite in the phylum Apicomplexa. An outbreak of the illness began at a local swimming pool and then spread to individuals who had not visited the swimming pool.

ANSWER

A, A, A, B, C

### Question 26

Cholera is a serious infectious disease caused by the bacteria *Vibrio cholerae*, which affects the human intestinal system. John Snow investigated a cholera epidemic in London and found that the primary source of the epidemic was contaminated well water. However, after the handle was removed from the pump, the epidemic continued for a time. Explain.

ANSWER

*Cholera is very contagious. It is spread by the unintentional consumption of infected feces that contaminate food and water. The epidemic continued for a time after the pump handle was removed because infected persons who handled food and water could still spread the bacteria. This is an example of a mixed epidemic.*

### Question 27

In addition to removing the pump handle, what advice would you give people in this area in order to minimize the epidemic?

ANSWER

*Thoroughly wash your hands, especially if you are handling food and water that is consumed by others.*

## DISEASE TRANSMISSION

Infectious diseases can be transmitted (spread) through four routes of exposure: ingestion, inhalation, contact (direct or indirect), and injection. Disease transmission usually occurs by direct, person-to-person contact. However, disease may also be transmitted indirectly when the agent is transferred or carried by some intermediate item, organism, means, or process to a susceptible host.

### Question 28

Classify the following as involving (A) direct transmission or (B) indirect transmission.

- \_\_\_ Mosquito conveys the infectious agent.
- \_\_\_ Mucous membrane to mucous membrane (STDs).
- \_\_\_ Herpes type 1 acquired from contact with an infected animal.

ANSWER

B, A, A

Pathogens (organisms or substances such as bacteria, viruses, fungi, and parasites that are capable of producing disease) may be transmitted indirectly from an infected person or animal by a fomite (inanimate object) or a vector (invertebrate animal).

- **Bacterium**—Single-cell microorganism that multiplies by cell division and may be capable of causing disease. Bacteria may be beneficial, harmless, or harmful to the human body. Pathogenic bacteria are bacteria that cause infectious diseases such as cholera, syphilis, leprosy, tuberculosis, bubonic plague, and stomach cancer.
- **Virus**—An infectious agent that cannot reproduce or grow apart from living cells (i.e., lacks independent metabolism); able to enter into living cells and cause the infected cell to produce more copies of the virus. With a few exceptions, viruses are capable of passing through fine fil-

ters that retain most bacteria and are usually not visible through the light microscope. Some common diseases caused by viruses include the common cold, influenza, chickenpox, cold sores, acquired immunodeficiency syndrome (AIDS), and severe acute respiratory syndrome (SARS).

- **Fungus**—A member of a large group of eukaryotic organisms that grow in irregular masses, without roots, stems, or leaves, and are not capable of photosynthesis; unicellular; and surrounded by cell walls containing cellulose or chitin or both. Diseases that can be caused by fungi include aspergilloses, candidoses, coccidioidomycosis, cryptococcosis, histoplasmosis, mycetomas, and paracoccidioidomycosis.
- **Parasite**—An organism that lives on or in another organism from which it draws its nourishment. Parasites can adversely affect health by dumping toxins into the host's system or by extracting hormones, vitamins, minerals, and other elements from the host's intake. Some parasitic diseases include crabs (pubic lice), cryptosporidiosis (cryptosporidium infection), giardiasis (giardia infection), guinea worm disease, malaria (plasmodium infection), mite infestation (scabies), and trichinosis (trichinellosis).<sup>7</sup>

Three common types of indirect transmission are air-borne transmission, vector-borne transmission, and vehicle-borne transmission.

### Question 29

Give an example of airborne transmission.

#### ANSWER

*Droplets or dust particles carrying the H1N1 virus from a sneeze, coming in contact with a susceptible host, and causing infection*

### Question 30

Give two examples of vector-borne transmission.

#### ANSWER

*Malaria spread through mosquitoes  
Plague spread through fleas*

### Question 31

Give two examples of vehicle-borne transmission.

#### ANSWER

*Hepatitis A spread by a contaminated eating utensil  
Food-borne illness resulting from eating contaminated food*

### Question 32

Zoonoses are diseases and infections transmitted between vertebrate animals and humans.<sup>8</sup> Provide examples of direct and indirect transmission of a pathogen involving a vertebrate animal.

#### ANSWER

*Direct transmission—Rabies, a viral disease of mammals, transmitted from the infected saliva of a rabid animal to an uninfected animal through a bite*

*Indirect transmission—Rabies transmitted from a rabid animal to an uninfected animal through the air (water droplets or dust particles carrying the infectious agent)*

A carrier contains, spreads, or harbors an infectious organism. A carrier can be an animal or a human. Carriers may have different conditions or states.

### Question 33

Classify the following definitions as referring to (A) active carrier, (B) convalescent carrier, (C) healthy carrier, (D) incubatory carrier, or (E) intermittent carrier.

- \_\_\_ Individual who has been exposed to and harbors a pathogen and who can spread the disease in different places or intervals
- \_\_\_ Individual who has been exposed to and harbors a pathogen, is in the beginning stages of the disease, is showing symptoms, and has the ability to transmit the disease
- \_\_\_ Individual who has been exposed to and harbors a pathogen, but has not become ill or shown any symptoms of the disease
- \_\_\_ Individual who has been exposed to and harbors a pathogen and who has done so for some time, but has recovered from the disease
- \_\_\_ Individual who harbors a pathogen and who, although in the recovery phase of the course of the disease, is still infectious

#### ANSWER

*E, D, C, A, B*

## DEFINING THE CASE

A case definition involves a set of standard clinical criteria used to decide if a person has a particular disease or health-related condition. Using a standard case definition guarantees that every case is consistently diagnosed when or where a diagnosis occurs, and in spite of who identifies the case. A case definition may have several sets of criteria, depending on how certain the diagnosis is meant to be, and sometimes limitations on person, place, and time. There are certain communicable diseases that are rare but severe (e.g., plague, botulism), and a health official needs to be aware of them quickly. Hence, a loose case definition may be appropriate. On the other hand, when an investigator wants to identify the cause of a condition, it is necessary to be sure that the people being studied have the disease or health-related event. In this case, a strict case definition is required.<sup>4</sup>

For example, consider the clinical classifications of trichinosis, a disease caused by ingestion of larvae of *Trichinella spiralis*.

- **Confirmed case**—signs and symptoms plus laboratory confirmation
- **Probable case**—acute onset of at least three of the following: myalgia, fever, facial edema, or eosinophil count greater than 500/mm<sup>3</sup>
- **Possible case**—acute onset of signs and symptoms suggestive of trichinosis and physician diagnosis of trichinosis
- **Suspect case**—unexplained eosinophilia
- **Not a case**—no symptoms

### Question 34

In surveillance systems, it is critical that a case definition be applied consistently to avoid changes in frequency and patterns of cases simply because of inconsistent application of the case definition. List some possible explanations for observed changes in the frequency and pattern of cases in surveillance systems that are not due to changes in risk exposures.

#### ANSWER

- *Inconsistent interpretation and application of the case definition*
- *Change in the case definition*
- *Change in surveillance system/policy of reporting*

- *Improved diagnosis (e.g., new laboratory test, increased physician awareness, a new physician in town)*
- *Change in diagnostic criteria*
- *Change in reporting requirements*
- *Change in the population*
- *Change in the level of and emphasis on active case detection*
- *Random events*
- *Increased public awareness*

## SELECTED CAUSAL MODELS

The epidemiology triangle for infectious disease involves a host (an organism, usually a human or an animal), agent (cause of disease), and environment (circumstances needed for a disease to thrive, survive, and spread). Time-related issues also play a role. The interrelatedness of these factors often contributes to an outbreak of disease. More recently, this model has been refined to better reflect the behavior, life-style, and chronic disease issues found in modern times. Rothman's causal pies have also been developed to capture the multifactorial nature of causation for many health-related states or events.<sup>9</sup>

### Question 35

Consider Figure 1.1, where A, B, and C are referred to as component causes. Let's also think of them as risk factors. Suppose all three risk factors must be in place for a disease to occur. Give a real-world example that fits into this model of causality.

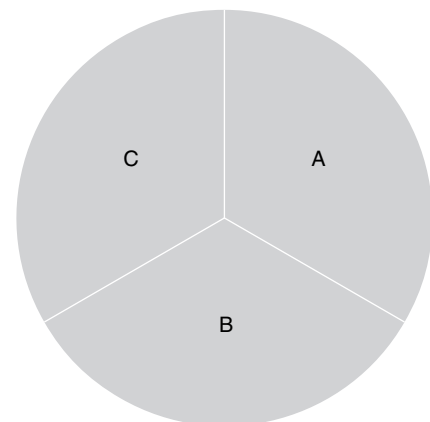


Figure 1.1 Question 35.

**ANSWER**

*Health outcome: Rubella-related birth defect*

*A—Exposure to Rubivirus*

*B—In the first few months of pregnancy*

*C—Not immune to the virus*

*Note that all three risk factors are needed to cause the health problem.*

**DEFINING PREVENTION**

Epidemiologic information is useful for designing prevention programs. Epidemiologic methods are also commonly used to assess and monitor prevention efforts of disease and conditions related to disease. Primary prevention is a process (immunization, sanitation, education, etc.) intended to eliminate specific environmental contaminants or influence behaviors associated with disease or health-related events. Secondary prevention includes screening, diagnostic, and treatment efforts. Tertiary prevention includes palliation (to reduce the complications of disease) and rehabilitation therapy.

**Question 36**

Classify each of the following as (A) primary prevention, (B) secondary prevention, or (C) tertiary prevention.

- \_\_\_ Vitamin-fortified foods
- \_\_\_ Fluoridation of public water supplies
- \_\_\_ Wearing protective devices
- \_\_\_ Health promotion
- \_\_\_ Cancer screening
- \_\_\_ Life-style changes
- \_\_\_ Physical therapy for stroke victims
- \_\_\_ Halfway houses for recovering alcoholics
- \_\_\_ Shelter homes for the developmentally challenged
- \_\_\_ Fitness programs for heart attack patients
- \_\_\_ Community health education
- \_\_\_ Ensuring healthy conditions at home, school, and workplace

**ANSWER**

A, A, A, A, B, A, C, C, C, C, A, A

## HOMEWORK 1

### Multiple-Choice Questions

1. In 1948, the World Health Organization proposed, “health is the state of complete physical, mental, and social well-being, not just the absence of disease or infirmity.” More recently, three additional dimensions of health have been added to the definition. What are they?
  - a. Chemical, biological, spiritual
  - b. Spiritual, biological, emotional
  - c. Emotional, spiritual, environmental
  - d. Environmental, self-efficacy, emotional
  
2. The first core public health function involves identifying health problems and priorities. Which of the following is necessary for accomplishing this function?
  - a. Cost evaluation
  - b. Health promotion
  - c. Formulation of public policies addressing problems and priorities
  - d. Assessment and monitoring
  
3. Public health intervention focuses on which of the following?
  - a. Control
  - b. Prevention
  - c. Causality
  - d. Treatment
  
4. Which of the answer sets below correctly indicates whether each of the following is referring to (A) distribution or (B) determinant?
  - \_\_\_ Identify the extent of a public health problem
  - \_\_\_ Monitor disease and other health-related events over time
  - \_\_\_ Identify those who are at greatest risk for disease, injury, disability, or death
  - \_\_\_ Identify the source of a disease outbreak in a given community
  - a. A, B, B, A
  - b. A, A, A, B
  - c. A, B, A, B
  - d. A, B, A, A
  
5. Think about the definition of epidemiology. How many of the following refer to the “application” of epidemiology?
  - \_\_\_ Assist in carrying out public health programs
  - \_\_\_ Act as a resource person
  - \_\_\_ Communicate public health information
  - \_\_\_ Sound methods of scientific investigation
  - \_\_\_ Measure the frequency of a disease relative to an at-risk population
  - \_\_\_ Describe the frequency of a disease according to race/ethnicity
  - \_\_\_ Draw conclusions about causality based on the totality of evidence
  - \_\_\_ Provide information useful in health planning and decision making for establishing health programs with appropriate priorities
  - a. 5
  - b. 4
  - c. 3
  - d. 2

6. Characterizing the distribution of health-related states or events according to person, place, and time is which of the following?
- Causal inference
  - Statistical inference
  - Descriptive epidemiology
  - Analytic epidemiology
7. Which of the answer sets below correctly matches each of the following as (A) direct transmission or (B) indirect transmission?
- \_\_\_ Bacteria on a pencil is ingested when the pencil is put in the mouth.
- \_\_\_ Bite of a mosquito transmits malaria.
- \_\_\_ Tuberculosis is contracted by breathing aerosol particles that have been suspended in the air for a long period of time.
- \_\_\_ Infected person gives you a kiss.
- A, A, A, B
  - B, B, A, A
  - B, A, B, A
  - B, B, B, A
8. Which of the answer sets below correctly matches each of the following activities as (A) descriptive epidemiology or (B) analytic epidemiology?
- \_\_\_ Identify the extent of a public health problem
- \_\_\_ Identify the efficacy of a new drug
- \_\_\_ Monitor the change in obesity for a given community over time
- \_\_\_ Identify primary risk factors for disease
- A, B, A, B
  - A, A, A, B
  - B, B, A, B
  - B, B, A, A
9. All of the following reflect a descriptive epidemiologic study **EXCEPT**:
- Generates hypotheses
  - Characterizes the distribution of disease
  - Provides an understanding of Who, What, When, and Where
  - Provides answers to the How and Why questions
10. Which of the following best defines “effectiveness”?
- The ability of a program to produce a desired effect among those who participate in the program compared with those who do not.
  - The ability of a program to produce benefits among those who are offered the program.
  - Both of the above define effectiveness.
  - Neither of the above defines effectiveness.
11. Which of the answer sets below correctly classifies each of the following as an (A) epidemic, (B) endemic, or (C) pandemic?
- \_\_\_ HIV went directly from Africa to Haiti; it then spread to the United States and much of the rest of the world beginning around 1969.
- \_\_\_ Several campers developed cholera after drinking water from a well.
- \_\_\_ Rocky Mountain spotted fever is the most lethal and most frequently reported rickettsial illness in the United States. It has been diagnosed throughout the Americas. About 800 cases are reported each year.
- C, A, B
  - A, B, C
  - C, B, A
  - B, A, C

12. Which of the answer sets below correctly classifies each of the following as (A) common source epidemic, (B) propagated epidemic, or (C) mixed epidemic?
- \_\_\_ Shigellosis occurred among a group of 3000 women attending a music festival. Over the next few weeks, subsequent generations of shigella cases spread by person-to-person transmission from festival attendees.
- \_\_\_ Influenza A virus subtype H1N1 pandemic.
- \_\_\_ Outbreak of *Salmonella* traced to turkey cooked and held at an improper temperature and served at a potluck supper.
- \_\_\_ Outbreak of hepatitis B spread by personal contact.
- \_\_\_ Episodic cases of Legionnaires' disease in hospitalized patients traced to showers and the hospital's water supply.
- a. C, B, A, B, A  
 b. C, B, B, B, A  
 c. B, A, B, C, B  
 d. C, B, A, A, A
13. Which of the following best defines a healthy carrier?
- a. An individual who harbors a pathogen and is infectious, although recovering  
 b. An individual who harbors a pathogen and is infectious, but has recovered  
 c. An individual who harbors a pathogen and is infectious, but has not become ill or manifested any symptoms of the disease  
 d. An individual who harbors a pathogen and is infectious, is in the beginning stages of the disease, and is showing symptoms
14. What is another term that is frequently used instead of the word "epidemic" when the cases are confined to a more limited geographic area?
- a. Pandemic  
 b. Endemic  
 c. Outbreak  
 d. Mixed epidemic
15. How many of the following involve primary prevention?
- \_\_\_ Elimination of offending allergens from asthmatic patients in their home environment  
 \_\_\_ Routine mammography screening for breast cancer  
 \_\_\_ Preventing reoccurrence of heart attack with anti-clotting medication  
 \_\_\_ Educating children about the harmful effects of tobacco smoking  
 \_\_\_ Physical modalities to regain function among stroke patients
- a. 0  
 b. 1  
 c. 2  
 d. 3
16. An analytic epidemiologic study involves which of the following?
- a. Frequency of disease according to person, place, and time  
 b. Use of a comparison group  
 c. A description of the clinical characteristics of a disease  
 d. Epidemic curve

17. Public health surveillance includes all of the following **EXCEPT**:
  - a. Collection of health data.
  - b. Analysis of health data.
  - c. Interpretation of health data.
  - d. Dissemination of health data.
  - e. Public health action.
  - f. All of the above are part of public health surveillance.
  
18. Selected epidemiologic factors often contribute to the outbreak of a disease. These include all of the following **EXCEPT**:
  - a. Host.
  - b. Agent.
  - c. Time.
  - d. Environment.
  - e. All of the above are factors that contribute to an outbreak.
  
19. In talking about disease transmission, you were introduced to the terms “vehicle” and “carrier.” Which of the following statements best characterizes a vehicle?
  - a. A nonliving intermediary such as a fomite, food, or water that conveys the infectious agent from its reservoir to a susceptible host.
  - b. An infected person (or animal) that contains, spreads, or harbors an infectious organism.
  - c. An individual who harbors a pathogen and who, although in the recovery phase of the course of the disease, is still infectious.
  - d. A subclinical case.
  
20. A large, unexpected number of cases of *salmonella* poisoning traced to chicken cooked and held at an improper temperature and served at a potluck supper is an example of which of the following?
  - a. Point source epidemic
  - b. Continuous source epidemic
  - c. Propagated epidemic
  - d. Mixed epidemic

### Short-Answer Questions

21. Describe the epidemiology triangle for infectious disease.
 

---



---
  
22. If a public health intervention is effective, does that imply that the program is also efficacious?
 

---



---
  
23. Using Rothman’s causal pie diagram, illustrate how a sufficient cause differs from a necessary cause.
 

---



---
  
24. Epidemiology uses the scientific method. Explain.
 

---



---
  
25. Suppose the number of neural tube defects in a given community is believed to be higher than expected. In this situation, how might training in epidemiology assist you in being a resource to the public health process?
 

---



---
  
26. Suppose you just completed evaluating an intervention program designed to improve cardiovascular risk factors. You find that the program is efficacious but not effective. As a resource person, what would you tell the organization that is sponsoring this intervention?
 

---



---
  
27. What are some public health reasons for assessing and monitoring the health of communities and populations at risk?
 

---



---
  
28. What are diseases called that can be directly or indirectly transmitted from animals to humans?
 

---



---



**Reading the Literature**

29. The CDC has identified common symptoms of swine flu. On the basis of the article available at <http://www.cdc.gov/mmwr/preview/mmwrhtml/mm5817a1.htm>,<sup>10</sup> which of the following two symptoms are most common among cases?
- a. Headache, diarrhea
  - b. Cough, sore throat
  - c. Fever, cough
  - d. Vomiting, fever

30. Continuing with the previous question, what percentage of influenza A (H1N1) virus in Mexico from March 1 to May 5, 2009 resulted in hospitalization?
- a. 6%
  - b. 10%
  - c. 13%
  - d. 2%

## REFERENCES

1. World Health Organization. Constitution of the World Health Organization. <http://apps.who.int/gb/bd/PDF/bd47/EN/constitution-en.pdf> (accessed May 4, 2010).
2. MedicineNet. Definition of public health. <http://www.medterms.com/script/main/art.asp?articlekey=5120> (accessed November 13, 2008).
3. Last, J. M. (ed.). *A Dictionary of Epidemiology*, 3rd ed. New York: Oxford University Press, 1995.
4. Merrill, R. M. *Introduction to Epidemiology*, 5th ed. Boston, MA: Jones and Bartlett, 2010.
5. Centers for Disease Control and Prevention. About Healthy People 2000. [http://www.cdc.gov/nchs/healthy\\_people/hp2000/about\\_hp2000.htm](http://www.cdc.gov/nchs/healthy_people/hp2000/about_hp2000.htm) (accessed May 18, 2010).
6. Centers for Disease Control and Prevention. About Healthy People 2010. [http://www.cdc.gov/nchs/healthy\\_people/hp2010.htm](http://www.cdc.gov/nchs/healthy_people/hp2010.htm) (accessed May 18, 2010).
7. *Stedman's Medical Dictionary for the Health Professions and Nursing*, 5th ed. New York: Lippincott Williams & Wilkins, 2005.
8. Acha, P. N., and B. Szyfres. *Zoonoses and Communicable Diseases Common to Man and Animals*, 2nd ed. Washington, DC: Pan American Health Organization, 1989.
9. Rothman, K. J. "Causes." *American Journal of Epidemiology* 104 (1976): 587–592.
10. Centers for Disease Control and Prevention. "Update: novel influenza A (H1N1) virus infections—Worldwide, May 6, 2009." *Morbidity and Mortality Weekly Report (MMWR)* 58, no. 17 (2009): 453–458.