

# WHY EPIDEMIOLOGY?



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## LEARNING OBJECTIVES

On completing this chapter, you will be able to

Define epidemiology

Discuss the concept of populations and population health

Describe population trends and characteristics

Describe global health threats

Discuss the relationship and distinction between public health and medicine

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## Introduction

Epidemiology is, for most, a word that seems to be from another language. It is certainly not a word we use in everyday conversation. But epidemiology is a science that affects all of us every day of our lives. We shop for food each day with little regard to or worry about whether what we purchase and eat is unsafe. For many of us, smallpox, polio, plague, diphtheria, yellow fever, and cholera are diseases that either we have never heard of or we do not give much thought or attention to. Human immunodeficiency virus (HIV) infection and acquired immunodeficiency syndrome (AIDS) are diseases that are well known, but they are becoming less of a daily concern. New, so-called emerging diseases such as bird flu are now garnering a great deal of our attention.

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## Public Health and Community Medicine

Before continuing the discussion on “why epidemiology,” the concept of public health must be explained further. *Public health* is the science and practice of protecting and improving the health of a community. This can be done with preventive medicine, health education, the control of communicable diseases, the use of sanitary measures, and the monitoring of environmental conditions. Public health is concerned with the health of the community as a whole. In other words, public health and community health are synonymous.

Public health is focused on three areas: assessment and monitoring of health and disease, development of public health policies that assist in addressing health problems, and allowing for access to public health care services. These

public health care services include disease prevention, health education, and health promotion. Often public health services are considered to be the same as medical care services because of the assumed similarities. The distinction is that public health services are focused on populations, not individuals. It is true that populations are made up of individuals, so public health acknowledges the importance of the welfare of individuals, but the focus of services is on larger populations. Public health services are centered on diagnosing and monitoring health issues and providing health education and health promotion services to communities.

An example of this communitywide perspective of public health is considered an accomplishment. Public health is concerned with immunization for preventable disease, such as smallpox, poliomyelitis, measles, rubella, tetanus, diphtheria, and *Haemophilus influenzae* type b. Since immunization programs (also referred to as vaccination programs) were established, smallpox has been eradicated, poliomyelitis has been eliminated in the United States, and the other diseases are now under control. Other infectious diseases (cholera, tuberculosis, and sexually transmitted diseases) also are under control, in part due to the efforts of public health agencies and programs.

Is public health the same as medicine? Despite the fact that medical and public health services both seek to improve health, they are not the same. Two easy-to-remember differences are (1) public health services are directed at populations, and medical services are focused on the individual; and (2) public health services are mostly concerned with the prevention of disease whereas medical services are concerned with the diagnosis and treatment of disease. Public health and medicine are different, but they have the same objective of improving health and eliminating disease.

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## Definition of Epidemiology

Epidemiology is a word with Greek origins: from the Greek prefix *epi*, meaning “on, upon, or befall”; the Greek root *dem*, meaning “the people”; and the Greek suffix *logos*, meaning “the study of.” In other words, epidemiology studies that which befalls on people, which is disease. The word epidemiology was first used in the 1700s to describe the science and methods used to study epidemics. In the twentieth century, with the decline of infectious diseases, epidemiology expanded to study more than epidemics. This decline in infectious diseases can be attributed to improvements in nutrition, sanitation, and general living conditions that in part resulted from public health interventions. Of course, these

public health interventions were established using information provided by epidemiology.

Given this new need for *epidemiology*, it has been defined as the study of the distribution and determinants of health-related states or events in specified populations and the application of this study to control health problems.<sup>1</sup> This means that epidemiology is used to identify the diseases in a population and to understand why these diseases exist. Another often-used definition is that epidemiology is the study of the distribution and determinants of health-related states and events in *defined* populations and the application of this study to the control of health problems.<sup>2</sup>

The Greek root of epidemiology and the two definitions have a common theme, namely, the people. The people are considered as a group, which is referred to as a *population*. This population-centered nature of epidemiology leads to one of the differences between public health services and medical services. Populations are groups of people who share some common characteristics. These characteristics are personal (age, sex, race, health behaviors), geographical (live in the same neighborhood, city, region, country, continent), and time. Populations may be large groups of people (population of the United States) or small groups (people in a neighborhood or in a factory).

Epidemiology is the study of factors affecting the health and illness of populations. It serves as the foundation of interventions made in the interest of public health and preventive medicine. It is considered a cornerstone method of public health research and is highly regarded in medicine for identifying risk factors for disease and determining the best treatment approaches to clinical practice. Epidemiology is considered by many to be a critical branch of public health. In fact, it is often referred to as the basic science of public health.

Epidemiology provides a framework of methods and principles from which information can be reviewed and analyzed in a way that public health problems can be identified and addressed. The epidemiological methods allow for disease definition as well as classification, identification, and planning for disease control measures. Epidemiology also provides the way to understand the relationship between the presence of factors that cause disease, called *causal factors*, and the development of disease (for example, smoking and heart disease).

Epidemiologists are the people who work every day using epidemiological principles and methods to make our lives better. Epidemiologists identify, measure, count, and control diseases, injuries, and causes of death. They also look for connections between disease and genetic, environmental, and behavioral factors. Once these connections are established, epidemiologists plan and develop interventions to prevent disease and promote health. This process of identifying

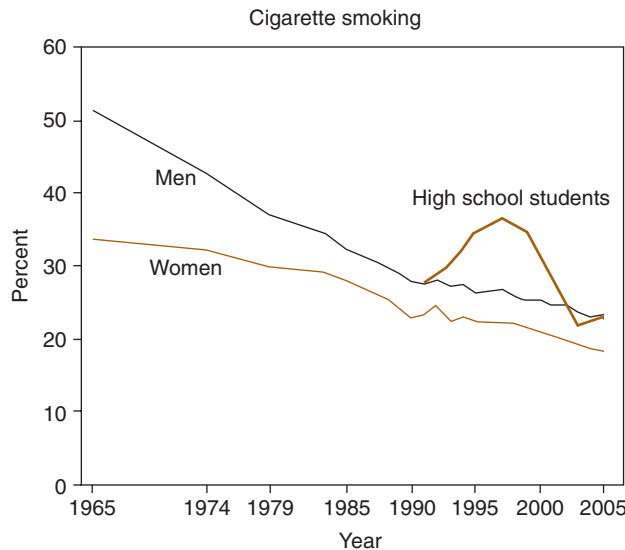
connections and developing interventions is how epidemiology touches our lives in a positive way every day.



Let's discuss some specific examples of how epidemiology has affected public health. In general terms, most of the significant improvements in the health of the people in the United States can be traced to accomplishments of public health.

An example of how public health policy improved the health and well-being of large groups of people happened in the United States in 1955. At that time, results of field tests of the polio vaccine were announced indicating that an inactivated poliovirus could produce immunity. Within days of this announcement, a national vaccination program was implemented. Today, polio has been eradicated from the United States.

Another accomplishment of public health initiatives with long-term beneficial effects is the identification of the relationship between cigarette smoking and

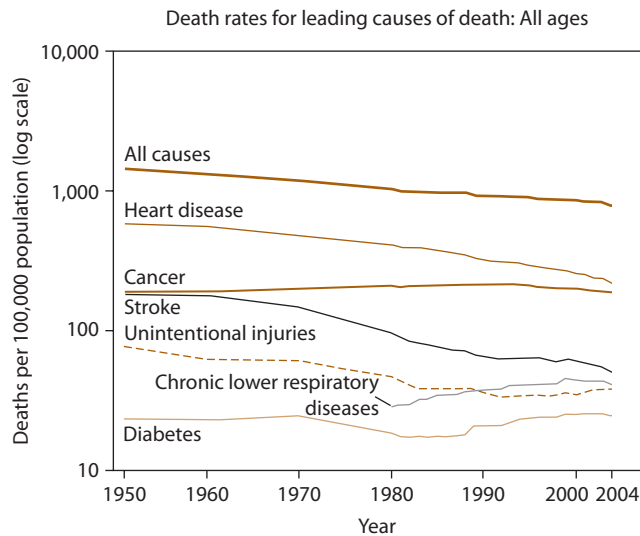
**FIGURE 1.1: Cigarette smoking in the United States, 1965 to 2005**

Source: CDC/NCHS, *Health, United States, 2009*, Figure 6. Data from the National Health Interview Survey and the Youth Risk Behavior Survey.

lung cancer and heart disease. Public health and epidemiological reports were instrumental in alerting people to the hazards of cigarette smoking, which led to the warning on cigarette packages from the U.S. Surgeon General. Public health, using epidemiological information as support, has worked hard in the past few decades to decrease the number of smokers in the United States. Figure 1.1 shows the results of this effort.

Figure 1.1 shows that the percentage of people who smoke has drastically decreased since 1965. This reduction has been most significant in men. In 1965 more than 50 percent of men in the United States were smokers. By 2005 the percentage dropped to less than 30 percent. Perhaps the best news is the decrease in the percentage of pregnant smokers. Smoking during pregnancy has been associated with infants with low birth weight and other associated health problems. Smoking among high school students is still a concern, but tobacco cessation efforts have targeted this group for the past few years.

It is interesting to note the decline in heart disease, which in part is due to smoking cessation programs. Figure 1.2 shows the leading causes of death from 1965 to 2006. Overall cancer rates have not changed since 1965, but lung cancer

**FIGURE 1.2: Leading causes of death, United States, 1950 to 2004**

Source: CDC/NCHS, *Health, United States, 2009*, Figure 18. Data from the National Vital Statistics System.

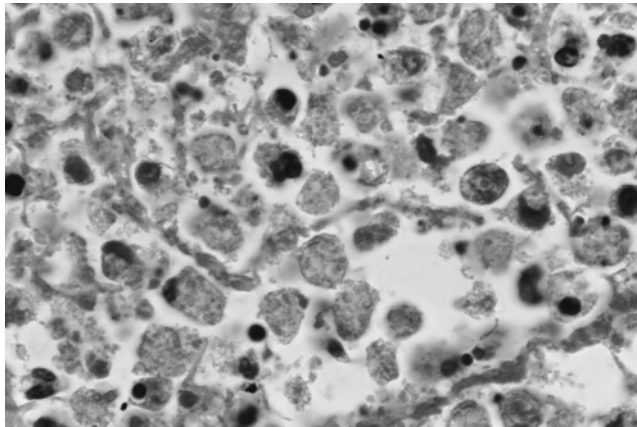
deaths have declined. Deaths due to stroke have decreased dramatically, which can be attributed to tobacco cessation programs. Also, because of public health awareness and legislation, unintentional motor vehicle injuries have decreased due to mandatory seat belt usage and protective restraints.

Other accomplishments of public health include global eradication of smallpox and establishing the relationship between Reye's syndrome and aspirin. The eradication of smallpox may be one of the greatest accomplishments of medicine and public health. Smallpox is a serious, contagious, and often fatal infectious disease. In the past, it killed almost 30 percent of infected people, and it left scars on the skin of those who survived. No vaccine or treatment existed until the end of the eighteenth century, when Edward Jenner introduced the smallpox vaccination. The last case of smallpox in the United States was in 1949, and the last naturally occurring case in the world was in Somalia in 1977.<sup>3</sup>

Reye's syndrome is a disease that affects all organs of the body but is particularly damaging to the liver and brain. The exact cause of Reye's syndrome is unknown, but it has been shown to be associated with aspirin usage. Cases are most often seen in January–March each year. An epidemic of flu or

chickenpox is commonly followed by an increase in the number of cases of Reye's syndrome.<sup>4</sup>

Epidemiology had a major role in the investigation of smallpox and Reye's syndrome. In fact, epidemiology is responsible for discovering the cause, and for developing control measures for other diseases such as Legionnaire's disease. Legionnaire's disease acquired its name in July 1976 when an outbreak of pneumonia occurred among people attending a convention of the American Legion in Philadelphia. On January 18, 1977, the causative agent was identified as a previously unknown bacterium, subsequently named *Legionella pneumophila*. An estimated 8,000 to 18,000 people get legionellosis in the United States each year. Some people can be infected with the *Legionella* bacterium and have only mild symptoms or no illness at all. When outbreaks do occur, they are usually in the summer and early autumn, though cases may occur at any time of the year.<sup>5</sup>



Another well-known accomplishment of epidemiology and public health is the work with AIDS. AIDS is the final stage of HIV infection. HIV attacks the body's immune system. Our bodies' immune system fights infections. HIV finds and destroys a white blood cell (called a T-cell) that is important for the immune system to fight infections. For someone who has HIV infection, it can take years before they have AIDS. AIDS is a disease in which a person has enough of a weakened immune system that the body has trouble fighting off infection. It was through the use of epidemiological methods that the HIV infection and AIDS were identified, along with the factors that were associated with a person's sus-



ceptibility. These factors were found to include both behavioral and social causes.



Public health continues to make major improvements in health by controlling epidemics, providing safe water and food, and establishing maternal and child health services. As will be discussed throughout this book, public health, with the help of the science of epidemiology, has done such a remarkable job of preventing countless deaths and improving the quality of life that many of us take it for granted. One reason to study public health and epidemiology is to become aware of how our daily lives are affected by public health and epidemiology. According to the Institute of Medicine in the report, *The Future of Public Health*, “An impossible responsibility has been placed on America’s public health agencies: to serve as stewards of the basic health needs of entire populations, but at the same time avert impending disasters and provide personal health care to those rejected by the rest of the health system. The wonder is not that American public health has problems, but that so much has been done so well, and with so little.”<sup>6</sup>

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## Population Health

The health of a population is a prime focus of epidemiology and public health. The health of populations was first studied in the seventeenth century. A population is not a fixed, standard number of people but is a specific group under study because of some common traits. These traits are associated with disease exposures, including the effect of social conditions. Often when looking at a population, the total population is the target, but smaller parts of that

population may be studied (these are called *subpopulations*). For example, the students in a school constitute a population whereas the students in a classroom are a subpopulation.

Usually populations are defined by geographical boundaries—for example, residents in a country, regions of a country, states, cities, and sections of a city. This is done because people in specific geographical locations have common traits, including age, sex, race, and other characteristics. Geographical populations are studied because it is easy to gather the necessary data about the populations. This is due, in part, to the fact that geographically defined areas are related to political and governmental units as well as public health agencies.

A goal of epidemiology is to identify and prevent factors that cause disease in populations. To do this, epidemiology starts its study at the population level and then addresses the identified determinants of health and disease at this level.<sup>7</sup> Epidemiology studies populations that are made up of individuals, but the focus remains on the population.<sup>8</sup> So it is important to understand the relationship between disease and its causal factors at both the population and individual person levels.<sup>9</sup>

It is also important to remember that populations differ. Populations can be divided into several subpopulations based on many factors, including demographics. These different subpopulations will have different health care needs and will use health care services in different ways.<sup>10</sup>

It is now known that social conditions, conditions that people live in, can affect a population's health. Different socioenvironmental exposures are related to differing physical and mental health outcomes. Epidemiology studies the affect of social conditions in its branch science called *social epidemiology*. Social epidemiology studies how society and social organization influence the health and wellness of people in populations. Social epidemiology tries to explain the connection between exposure to social characteristics of the environment and its effects on health, with the hopeful result of a better understanding of how, where, and why social inequalities affect health.

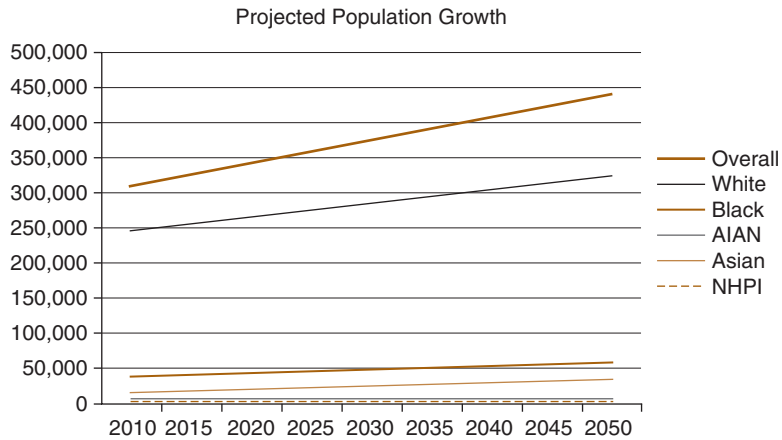
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## Population Trends

Epidemiology is a science that studies populations. The makeup of a population directly affects health and disease. If you can understand characteristics of a population, and if the population is changing, then it becomes easier to plan for disease prevention and treatment.

The population of the United States has been increasing for the past few decades. This increase is expected to continue to at least the year 2050. Figure

**FIGURE 1.3: Projected population growth, 2010 to 2050, in the United States**



Source: U.S. Census Bureau, Population Division, Projection of the Population and Components of Change for the United States: 2010–2050.

AIAN refers to American Indians and Alaska Natives

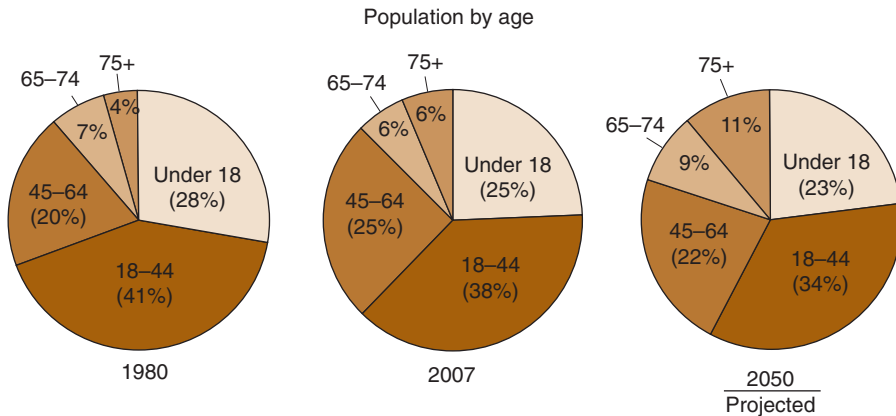
NHPI refers to Native Hawaiians and Pacific Islanders

1.3 shows the projected population growth from 2010 to 2050. Overall the population is expected to increase from just over 300 million people to almost 450 million. Growth is expected among all races—whites, blacks, American Indians and Alaska Natives, Asians, Native Hawaiians and Pacific Islanders.

As the population grows over the next forty years, the age percentages will change slightly, with an obvious aging of the population. The percentage of people younger than forty-four years will decrease, and the percentage will increase for people aged forty-five years and older. The percentage of people younger than eighteen years will decrease from 28 percent to 23 percent. Among people aged eighteen to forty-four, the percentage will decrease from 40 percent to 34 percent. The percentage of people older than seventy-five years will more than double from 4 percent to 11 percent of the population (see Figure 1.4).

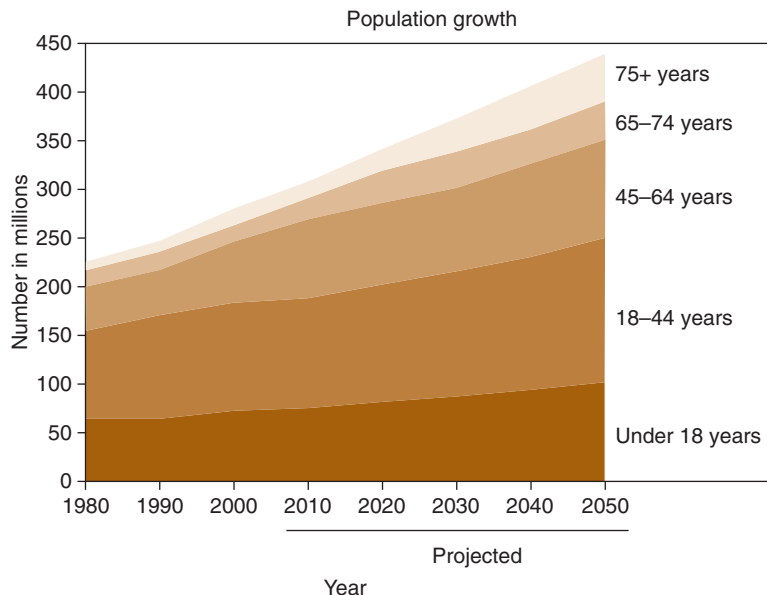
Figure 1.5 presents the population growth and expected growth for a hundred-year period, 1950 to 2050, in different age categories. As was mentioned above, the total population will increase to almost 450 million people. It is interesting to see the growth since 1990 in the age groups sixty-five years and

**FIGURE 1.4: Projected population percentage by race, 2010 to 2050, in the United States**



Source: CDC/NCHS, *Health, United States, 2009*, Figure 1B. Data from the U.S. Census Bureau.

**FIGURE 1.5: Population growth in the United States, 2010 to 2050**



Source: CDC/NCHS, *Health, United States, 2009*, Figure 1A. Data from the U.S. Census Bureau.

older and seventy-five years and older. These two age groups are contributing to the overall increase in the population because people are living longer.

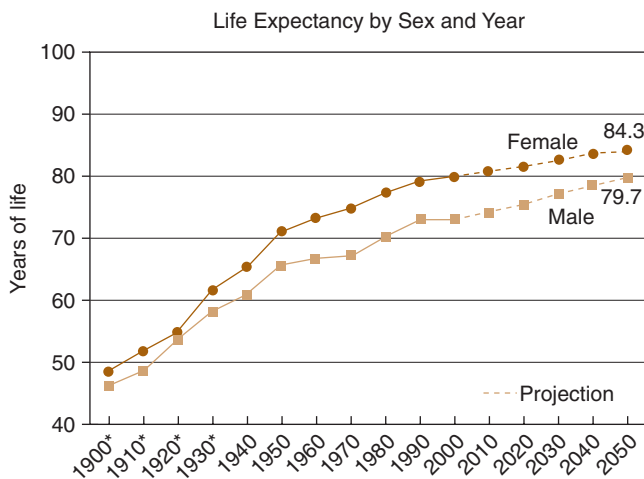
### Population Characteristics

Other aspects of the U.S. population need to be presented to fully understand the dynamics and characteristics. The *life expectancy* of the population is an important concern of public health. Life expectancy indicates the health of the country and the quality of life of the population. Figure 1.6 presents the projected life expectancy in the United States by sex, from 2010 to 2050.

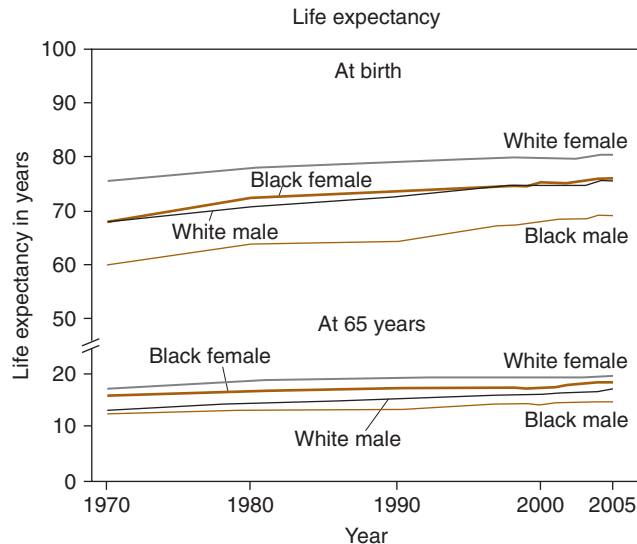
The projected life expectancy is expected to increase for both men and women over the next forty years. The projected increase will be greater for women than for men. By the year 2050, the gap between men and women will narrow, with women expected to live 4.6 years longer than men.

Figure 1.7 presents the projected life expectancy according to race and gender, at birth and after a person has reached sixty-five years of age. This shows how long someone is expected to live in total years from birth and how much longer someone should live past age sixty-five. White women have the highest life expectancy, closely followed by black women, from birth and at age sixty-five.

**FIGURE 1.6: Projected life expectancy in years by sex, United States, 2010 to 2050**



**FIGURE 1.7: Life expectancy from birth and at age 65 years by race and gender, United States, 1970 to 2005**

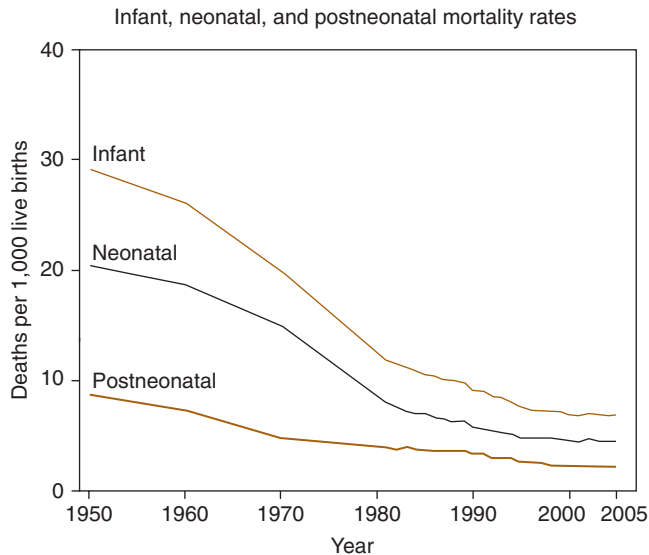


Source: CDC/NCHS, *Health, United States, 2009*, Figure 16. Data from the National Vital Statistics System.

The health of infants and newborns is an indicator of the overall health status of a population. The United States is seen as a world leader in many things, including health care services. However, the United States has a higher death rate among infants and newborns than many other industrialized countries. This will be discussed in more detail in Chapter Five.

On a positive note, the death rates from infants and newborns have drastically decreased in recent times. Figure 1.8 shows infant mortality, neonatal, and postneonatal mortality rates from 1950 to 2006. Each rate has decreased greatly during the fifty-four-year period. For example, the infant mortality rate (the measurement of the number of deaths before age one year) decreased from almost 30 deaths per 1,000 live births in 1950 to less than 10 deaths in 2006. This is an indication that social, medical, and educational interventions have been successful in reducing deaths of infants and newborns. Again this shows how epidemiology, in conjunction with public health programs, has made our lives better.

**FIGURE 1.8: Death rates of infants and newborns, United States, 1950 to 2005**



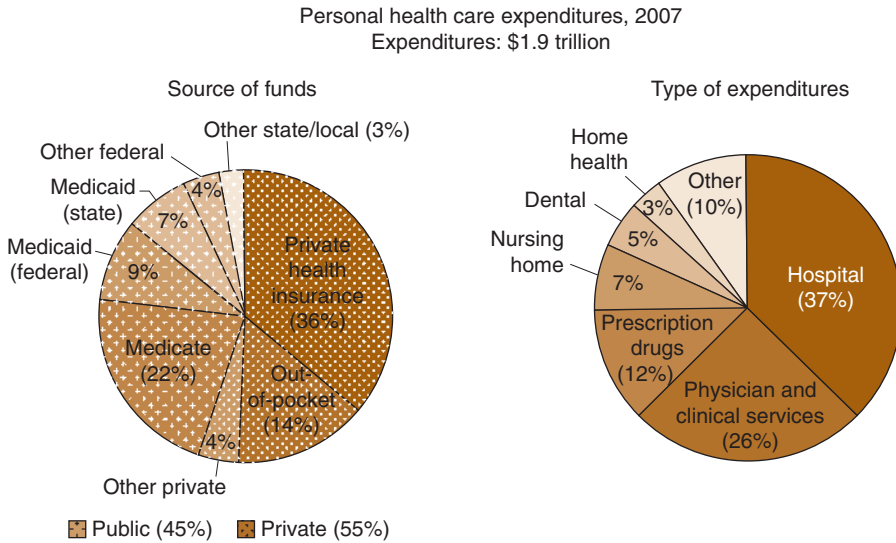
Source: CDC/NCHS, *Health, United States, 2009*, Figure 17. Data from the National Vital Statistics System.

## Health Costs

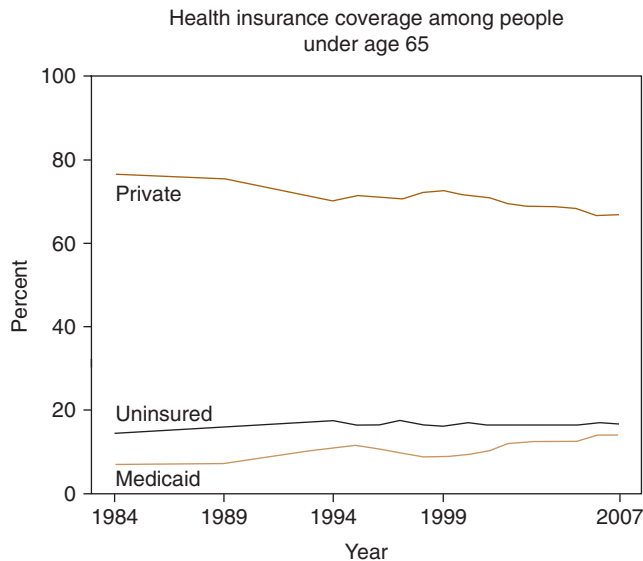
It is interesting to note how much it costs for our health care, including public health services, each year in the United States. In 2007 the total health care costs were \$1.9 trillion. Figure 1.9 shows how this money was spent for health care services and what were the sources of funding.

Looking at where the money is spent, the majority goes to hospitals and physicians. Other areas of spending are nursing home care and prescription drugs. It is also clear that most of the money for health care services comes from insurance, both private and federally funded. Some funds come from state and local programs, with the remainder paid by people who use the services.

With such a large health care industry and an equally large health insurance industry, it seems that all Americans should receive needed care. But this is not the case. Figure 1.10 shows the percentage of health insurance coverage for people younger than sixty-five years in the United States (Americans sixty-five

**FIGURE 1.9: Funding health care in the United States**

Source: CDC/NCHS, *Health, United States, 2009*, Figure 21. Data from the Centers for Medicare & Medicaid Services.

**FIGURE 1.10: Health insurance coverage among people younger than 65 years**

Source: CDC/NCHS, *Health, United States, 2009*, Figure 19. Data from the National Health Interview Survey.



years and older are eligible to receive Medicare benefits). The percentage of Americans who are uninsured has increased nearly 20 percent in the past twenty-five years. It is important to remember that the total population in the United States has significantly increased since 1984, so the number of uninsured Americans has drastically increased as well.

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## Global Health Threats

Today, epidemiology and public health face many challenges such as chronic diseases, West Nile virus, AIDS, and the worry over pandemic flu. As the world is getting progressively smaller with rapid methods to travel, global health threats are occurring everywhere, including in the United States. According to the World Health Organization (WHO), by the year 2030, chronic and noncommunicable diseases will cause more than 75 percent of all deaths. Today 12 percent of all deaths worldwide are caused by heart disease whereas 3.5 percent of deaths are a result of HIV/AIDS. By 2030, more than 14 percent of deaths will be caused by heart disease, with HIV/AIDS deaths decreasing to 1.9 percent. Diseases and conditions that are receiving attention globally today include infant mortality, neonatal mortality, HIV/AIDS, malaria, effects of tobacco use, breast cancer, and disease outbreaks in developing countries.

When we talk about global health threats, we usually discuss possible pandemics of infectious diseases. However, our attention should shift to chronic and non-communicable diseases and conditions. Although infectious diseases are an immediate worry, more people today die from chronic diseases. The worry of infectious diseases is rooted in the unknown and unexpected effects of pandemics. The science of epidemiology can help us to sort real threats from unwarranted concerns.

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## Summary

In this chapter we introduced the science known as epidemiology and its role in public health. The ways in which our everyday lives are touched, whether we know it or not, by epidemiology and public health was described. In addition, examples of how public health and epidemiology have positively affected people's lives were presented. The emphasis from infectious disease to chronic and infectious diseases was discussed.

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## Key Terms

Causal factors, 4

Life expectancy, 13

Public health, 9

Social epidemiology, 10

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## Chapter Exercise

1. Define epidemiology.
2. Compare and contrast medicine and public health.
3. Discuss in some detail one of the public health accomplishments that was mentioned in the chapter.

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## Chapter Review

1. Epidemiology has been defined as the
  - a. study of epidemic diseases.
  - b. study of clinical diseases.
  - c. study of the distribution and determinants of disease in human populations.
  - d. the basic service of health education.
2. Epidemiology is a branch of public health. True or False?
3. The leading cause of death in the United States is
  - a. cancer.
  - b. heart disease.
  - c. automobile accidents.
  - d. stroke.
4. The U.S. population is expected to increase for all races between 2010 and 2050. True or False?
5. The projected life expectancy in the United States in the year 2005 is greater for blacks than for all other races. True or False?
6. Neonatal mortality rates have increased from 1950 to 2004. True or False?
7. The number of Americans who are uninsured has stayed the same since 1964. True or False?
8. Most money spent on health care goes for hospital and physician services. True or False?

9. In 2005 the federal government provided most of the funds for health care services in the United States. True or False?
10. By the year 2050, the percentage of whites in the United States will
  - a. increase.
  - b. remain the same.
  - c. decrease.
  - d. cannot be determined

