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SECTION I

Principles of Population Health

Section I of *Public Health 101: Healthy People—Healthy Populations* introduces you to the ways that public health affects your every waking moment, from the food you eat, to the water you drink, to the car you drive. Even sleep matters. In public health, we use bed nets to prevent malaria, we use beds that prevent back pain, and we put infants to sleep on their backs to prevent sudden infant death syndrome (SIDS).

In section I, we will examine a range of approaches to public health that have been used over the centuries. Then we will focus on a 21st century approach known as population health. Population health includes the full range of options for intervention to address health problems, from community control of communicable disease and environmental health, to healthcare delivery systems, to public policies such as taxation and laws designed to reduce cigarette smoking. We will also look at how populations are changing by examining

three important transitions that are affecting population health today and will continue to do so for years to come.

In this section, we will also examine an evidence-based approach to population health that focuses on defining the problem, establishing the etiology, making evidence-based recommendations, implementing these recommendations into practice, and evaluating the impacts of interventions. The population health and evidence-based approaches introduced in section I provide an underpinning for all that follows.

At the end of section I, as with each section, there are cases with discussion questions that draw on chapters from the section. Each case is designed as a realistic description of the types of problems we face as we seek to achieve healthy people and healthy populations.

So with no further ado, let us take a look at how public health can and does affect all of our daily lives.

CHAPTER 1

Public Health: The Population Health Approach

LEARNING OBJECTIVES

By the end of this chapter, the student will be able to:

- identify multiple ways that public health affects daily life.
- define eras of public health from ancient times to the early 2000s.
- define the meaning of “population health.”
- illustrate the uses of health care, traditional public health, and social interventions in population health.
- identify a range of determinants of disease.
- identify ways that populations change over time, which affects health.

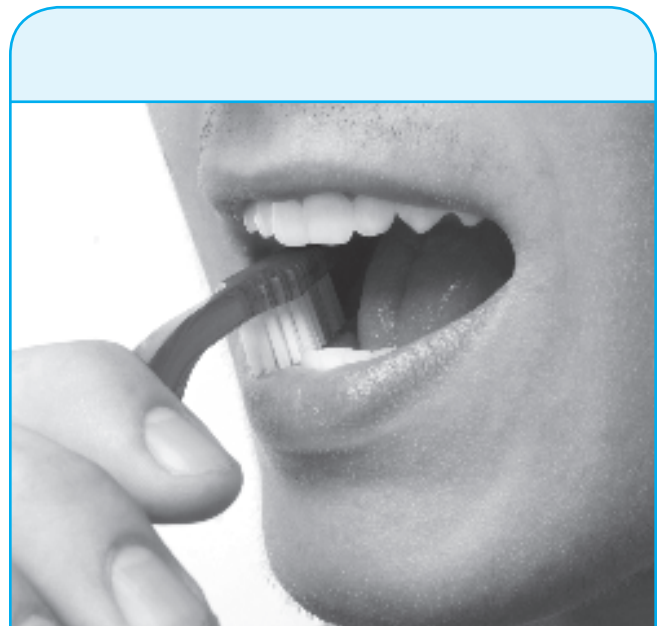
I woke up this morning, got out of bed, and went to the bathroom, where I used the toilet, washed my hands, brushed and flossed my teeth, drank a glass of water, and took my blood pressure medicine, cholesterol medication, and an aspirin. Then I did my exercises and took a shower.

On the way to the kitchen, I didn't even notice the smoke detector I passed or the old ashtrays in the closet. I took a low-fat yogurt out of the refrigerator and prepared hot cereal in the microwave oven for my breakfast.

Then I walked out my door into the crisp clean air and got in my car. I put on my seat belt, saw the light go on for the airbag, and safely drove to work. I got to my office, where I paid

little attention to the new defibrillator at the entrance, the “no smoking” signs, or the absence of asbestos. I arrived safely in my well-ventilated office and got ready to teach Public Health 101.

It wasn't a very eventful morning, but then it's all in a morning's work when it comes to public health.



This rather mundane morning is made possible by a long list of achievements that reflect the often-ignored history of public health.¹ We take for granted the fact that water chlorination, hand washing, and indoor plumbing largely eliminated the transmission of common bacterial diseases, which so often killed the young and not-so-young for centuries. Do not overlook the impact of prevention on our teeth and gums. Teeth brushing, flossing, and fluoridation of water have made a dramatic impact on the dental health of children and adults.

The more recent advances in the prevention of heart disease have been a major public health achievement. Preventive successes include the reduction of blood pressure and cholesterol, cigarette smoking prevention and cessation efforts, the use of low-dose aspirin, an understanding of the role of exercise, and the widespread availability of defibrillators. These can be credited with at least half the dramatic reductions in heart disease that have reduced the death rate from coronary artery disease by approximately 50% in the United States and most other developed countries in the last half century.

The refrigerator was one of the most important advances in food safety, which illustrates the impact of social change and innovation not necessarily intended to improve health. Food and product safety are public health achievements that require continued attention. It was public pressure for food safety that in large part brought about the creation of the U.S. Food and Drug Administration. The work of this public health agency continues to affect all of our lives from the safety of the foods we eat to the drugs and cosmetics we use.

Radiation safety, like radiation itself, usually goes unnoticed, from the regulation of microwave ovens to the reduction of radon in buildings. We rarely notice when disease does not occur.

Highway safety illustrates the wide scope of activities required to protect the public's health. From seat belts, child restraints, and airbags to safer cars, highways, designated driver programs, and enforcement of drunk driving laws, public health efforts require collaboration with professionals not usually thought of as having a health focus.

The physical environment too has been made safer by the efforts of public health. Improvement in the quality of the air we breathe both outdoors and indoors has been an ongoing accomplishment of what we will call "population health." Our lives are safer today because of interventions ranging from installation of smoke detectors to removal of asbestos from buildings.

However, the challenges continue. Globalization increases the potential for the spread of existing and emerging diseases

and raises concerns about the safety of the products we use. Climate change and ongoing environmental deterioration continue to produce new territory for "old" diseases, such as malaria and dengue fever. Overuse of technologies, such as antibiotics, has encouraged the emergence of resistant bacteria.

The 1900s saw an increase in life expectancy of almost 30 years in most developed countries, much of it due to the successes of public health initiatives.² We cannot assume that these trends will continue indefinitely. The epidemic of obesity already threatens to slow down or reverse the progress we have been making. The challenges of 21st century public health include the protection of health and continued improvement in quality of life, not just quantity of years individuals are living.

To understand the role of public health in these achievements and ongoing challenges, let us start at the beginning and ask: What do we mean by "public health"?

WHAT DO WE MEAN BY "PUBLIC HEALTH"?

Ask your parents what "public health" means and they might say, "Health care for the poor." Well, they are right that public health has always been about providing services for those with special vulnerabilities, either directly or through the health-care system. But that is only one of the ways that public health serves the most needy and vulnerable in our population. Public health efforts often focus on the most vulnerable populations, from reducing exposure to lead paint in deteriorating buildings to food supplementation to prevent birth defects and goiters. Addressing the needs of vulnerable populations has always been a cornerstone of public health. As we will see, however, the definition of "vulnerable populations" continues to change, as do the challenges of addressing their needs.

Ask your grandparents what "public health" means and they might say, "Washing your hands." Well, they are right too—public health has always been about determining risks to health and providing successful interventions that are applicable to everyone. But hand washing is only the tip of the iceberg. The types of interventions that apply to everyone and benefit everyone span an enormous range: from food and drug safety to controlling air pollution, from measures to prevent the spread of tuberculosis to vaccinating against childhood diseases, from prevention and response to disasters to detection of contaminants in our water.

The concerns of society as a whole are always in the forefront of public health. These concerns keep changing and the methods for addressing them keep expanding. New technologies and global, local, and national interventions are becoming a necessary part of public health. To understand

what public health has been and what it is becoming, let us look at some definitions of “public health.” The following are two definitions of “public health”—one from the early 1900s and one from more recent years.

Public health is “the science and art of preventing disease, prolonging life and promoting health through organized community effort.”²³

The substance of public health is the “organized community efforts aimed at the prevention of disease and the promotion of health.”²⁴

These definitions show how little the concept of public health changed throughout the 1900s; however, the concept of public health in the 2000s is beginning to undergo important changes in a number of ways, including:

- The goal of prolonging life is being complemented by an emphasis on the quality of life.
- Protection of health when it already exists is becoming a focus along with promoting health when it is at risk.
- Use of new technologies, such as the Internet, are redefining “community,” as well as offering us new ways to communicate.
- The enormous expansion in the options for intervention, as well as the increasing awareness of potential harms and costs of intervention programs, require a new science of “evidence-based” public health.
- Public health and clinical care, as well as public and private partnerships, are coming together in new ways to produce collaborative efforts rarely seen in the 1900s.
- Complex public health problems need to be viewed as part of larger health and social systems, which require efforts to simultaneously examine multiple problems and multiple solutions rather than one problem or one solution at a time.

Thus, a new 21st century definition of public health is needed. One such definition might read as follows:

The totality of all evidence-based public and private efforts that preserve and promote health and prevent disease, disability, and death.

This broad definition recognizes public health as the umbrella for a range of approaches that need to be viewed as a part of a big picture or population perspective. Specifically, this definition enlarges the traditional scope of public health to include:

- An examination of the full range of environmental, social, and economic determinants of health—not just

those traditionally addressed by public health and clinical health care

- An examination of the full range of interventions to address health issues, including the structure and function of healthcare delivery systems, plus the role of public policies that affect health even when health is not their intended effect

If your children ask you what public health is, you might respond: “It is about the big picture issues that affect our own health and the health of our community every day of our lives. It is about protecting health in the face of disasters, preventing disease from addictions such as cigarettes, controlling infections such as the human immunodeficiency virus (HIV), and developing systems to ensure the safety of the food we eat and the water we drink.”

A variety of terms have been used to describe this big picture perspective that takes into account the full range of factors that affect health and considers their interactions.⁵ A variation of this approach has been called the social-ecological model, systems thinking, or the population health approach. We will use the latter term. Before exploring what we mean by the **population health approach**, let us examine how the approaches to public health have changed over time.^a

HOW HAS THE APPROACH OF PUBLIC HEALTH CHANGED OVER TIME?

Organized community efforts to promote health and prevent disease go back to ancient times.^{6, 7} The earliest human civilizations integrated concepts of prevention into their culture, their religion, and their laws. Prohibitions against specific foods—including pork, beef, and seafood—plus customs for food preparation, including officially designated methods of killing cattle and methods of cooking, were part of the earliest practices of ancient societies. Prohibitions against alcohol or its limited use for religious ceremony have long been part of societies’ efforts to control behavior, as well as prevent disease. Prohibition

^a Turnock² has described several meanings of “public health.” These include the system and social enterprise, the profession, the methods, the government services, and the health of the public. The population health approach used in this text may be thought of as subsuming all of these different perspectives on public health.

of cannibalism, the most universal of food taboos, has strong grounding in the protection of health.^b

The earliest civilizations have viewed sexual practices as having health consequences. Male circumcision, premarital abstinence, and marital fidelity have all been shown to have impacts on health.

Quarantine or isolation of individuals with disease or exposed to disease has likewise been practiced for thousands of years. The intuitive notion that isolating individuals with disease could protect individuals and societies led to some of the earliest organized efforts to prevent the spread of disease. At times, they were successful, but without a solid scientific basis. Efforts to separate individuals and communities from epidemics sometimes led to misguided efforts, such as the unsuccessful attempts to control the black plague by barring outsiders from walled towns and not recognizing that it was the rats and fleas that transmitted the disease.

During the 1700s and first half of the 1800s, individuals occasionally produced important insights into the prevention of disease. In the 1740s, British naval commander James Lind demonstrated that lemons and other citrus fruit could prevent and treat scurvy, a then-common disease among sailors, whose daily nourishment was devoid of citrus fruit, the best source of vitamin C.

In the last years of the 1700s, English physician Edward Jenner recognized that cowpox, a common mild ailment of those who milked cows, protected those who developed it against life-threatening smallpox. He developed what came to be called a vaccine—derived from the Latin *vacca*, meaning “cow.” He placed fluid from cowpox sores under the skin of recipients, including his son, and exposed them to smallpox. Despite the success of these smallpox prevention efforts, widespread use of vaccinations was slow to develop, partially because at that time, there was not an adequate scientific basis to explain the reason for its success.

All of these approaches to disease prevention were known before organized public health existed. Public health awareness began to emerge in Europe and the United States in the mid-1800s. The U.S. public health movement has its origins in Europe, where concepts of disease as the consequence of social conditions took root in the 1830s and 1840s. This movement, which put forth the idea that disease emerges from social conditions of inequality, produced the

concept of **social justice**. Many attribute public health’s focus on vulnerable populations to this tradition.

While early organized public health efforts paid special attention to vulnerable members of society, they also focused on the hazards that affected everyone, such as contamination of the environment. This focus on sanitation and public health was often called the hygiene movement, although it began even before the development of the germ theory of disease. Despite the absence of an adequate scientific foundation, the hygiene movement made major strides in controlling communicable diseases, such as tuberculosis, cholera, and waterborne diseases, largely through alteration of the physical environment.

The fundamental concepts of epidemiology also developed during this era. In the 1850s, John Snow, often called the father of epidemiology, helped establish the importance of careful data collection and documentation of rates of disease before and after an intervention in order to evaluate effectiveness. He is known for his efforts to close down the Broad Street pump, which supplied water contaminated by cholera to a district of London. His actions quickly terminated that epidemic of cholera. John Snow’s approach has become a symbol of the earliest formal epidemiological thinking.

Ignaz Semmelweis, an Austrian physician, used much the same approach in the mid-1800s to control puerperal fever—or fever of childbirth—then a major cause of maternal mortality. Noting that physicians frequently went from the autopsy room to the delivery room without washing their hands, he instituted a hand-washing procedure and was able to document a dramatic reduction in the frequency of puerperal fever. Unfortunately, he was unable to convince many of his contemporaries to accept this intervention without a clear mechanism of action. Until the acceptance of the germ theory of disease, puerperal fever continued to be the major cause of maternal deaths in Europe and North America.

The mid-1800s in England also saw the development of birth and death records, or vital statistics, which formed the basis of population-wide assessment of health status. From the beginning of this type of data collection, there was controversy over how to define the cause of death. Two key figures in the early history of organized public health took opposing positions that reflect this continuing controversy. Edwin Chadwick argued that specific pathological conditions or diseases should be the basis for the cause of death. William Farr argued that underlying factors, including what we would today call risk factors and social conditions, should be seen as the actual causes of death.

Thus, the methods of public health were already being established before the development of the germ theory of

^b In recent years, this prohibition has been indirectly violated by feeding beef products containing bones and brain matter to other cattle. The development of “mad cow” disease and its transmission to humans has been traced to this practice, which can be viewed as analogous to human cannibalism.

disease by Louis Pasteur and his European colleagues in the mid-1800s. The revolutions in biology that they ignited ushered in a new era in public health. U.S. physicians and public health leaders often went to Europe to study new techniques and approaches and brought them back to the United States to use at home.

After the Civil War, U.S. public health began to produce its own advances and organizations. In 1872, the American Public Health Association (APHA) was formed. According to its own historical account, “the APHA’s founders recognized that two of the association’s most important functions were advocacy for adoption by the government of the most current scientific advances relevant to public health, and public education on how to improve community health.”⁸

The biological revolution of the late 1800s and early 1900s that resulted from the germ theory of disease laid the groundwork for the modern era of public health. An understanding of the contributions of bacteria and other organisms to disease produced novel diagnostic testing capabilities. For example, scientists could now identify tuberculosis cases through skin testing, bacterial culture, and the newly discovered chest X ray. Concepts of vaccination advanced with the development of new vaccines against toxins produced by tetanus- and diphtheria-causing bacteria. Without antibiotics or other effective cures, much of public health in this era relied on prevention, isolation of those with disease, and case-finding methods to prevent further exposure.

In the early years of the 1900s, epidemiology methods continued to contribute to the understanding of disease. The investigations of pellagra by Goldberger and the United States Public Health Service overthrew the assumption of the day that pellagra was an infectious disease and established that it was a nutritional deficiency that could be prevented or easily cured with vitamin B-6 (niacin) or a balanced diet. Understanding the role of nutrition was central to public health’s emerging focus on prenatal care and childhood growth and development. Incorporating key scientific advances, these efforts matured in the 1920s and 1930s and introduced a growing alphabet of vitamins and nutrients to the U.S. vocabulary.

A new era of effective medical intervention against active disease began in force after World War II. The discovery of penicillin and its often miraculous early successes convinced scientists, public health practitioners, and the general public that a new era in medicine and public health had arrived.

During this era, public health’s focus was on filling the holes in the healthcare system. In this period, the role of public health was often seen as assisting clinicians to effec-

tively deliver clinical services to those without the benefits of private medical care and helping to integrate preventive efforts into the practice of medicine. Thus, the great public health success of organized campaigns for the eradication of polio was mistakenly seen solely as a victory for medicine. Likewise, the successful passage of Medicaid and Medicare, outgrowths of public health’s commitment to social justice, was simply viewed as efforts to expand the private practice of medicine.

This period, however, did lay the foundations for the emergence of a new era in public health. Epidemiological methods designed for the study of noncommunicable diseases demonstrated the major role that cigarette smoking plays in lung cancer and a variety of other diseases. The emergence of the randomized controlled trial and the regulation of drugs, vaccines, and other interventions by the Food and Drug Administration developed the foundations for what we now call evidence-based public health and evidence-based medicine.

The 1980s and much of the 1990s were characterized by a focus on individual responsibility for health and interventions at the individual level. Often referred to as health promotion and disease prevention, these interventions targeted individuals to effect behavioral change and combat the risk factors for diseases. As an example, to help prevent coronary artery disease, efforts were made to help individuals address high blood pressure and cholesterol, cigarette smoking, and obesity. Behavioral change strategies were also used to help prevent the spread of the newly emerging HIV/AIDS epidemic. Efforts aimed at individual prevention and early detection as part of medical practice began to bear some fruit with the widespread introduction of mammography for detection of breast cancer and the worldwide use of Pap smears for the detection of cervical cancer. Newborn screening for genetic disease became a widespread and often legally mandated program, combining individual and community components.

Major public health advances during this era resulted from the environmental movement, which brought public awareness of the health dangers of lead in gasoline and paint. The environmental movement also focused on reducing cancer by controlling radiation exposure from a range of sources, including sunlight and radon, both naturally occurring radiation sources. In a triumph of global cooperation, governments worked together to address the newly discovered hole in the ozone layer. In the United States, reductions in air pollution levels and smoking rates during this era had an impact on the frequency of chronic lung disease, asthma, and most likely coronary artery disease.

The heavy reliance on individual interventions that characterized much of the last half of the 1900s changed rapidly in the beginning of the 2000s. A new era in public health that is often called “population health” has begun to transform professional and public thought about health. From the potential for bioterrorism to the high costs of health care to the control of pandemic influenza and AIDS, the need for community-wide or population-wide public health efforts have become increasingly evident. This new

era is characterized by a global perspective and the need to address international health issues. It includes a focus on the potential impacts of climate change, emerging and reemerging infectious diseases, and the consequences of trade in potentially contaminated or dangerous products, ranging from food to toys.

Table 1-1 outlines these eras of public health, identifies their key defining elements, and highlights important events that symbolize each era.⁹

TABLE 1-1 Eras of Public Health

Eras of public health	Focus of attention/paradigm	Action framework	Notable events and movements in public health and epidemiology
Health protection (Antiquity–1830s)	Authority-based control of individual and community behaviors	Religious and cultural practices and prohibited behaviors	Quarantine for epidemics, sexual prohibitions to reduce disease transmission, dietary restrictions to reduce food-borne disease
Hygiene movement (1840–1870s)	Sanitary conditions as basis for improved health	Environmental action on a community-wide basis distinct from health care	Snow on cholera, Semmelweis and puerperal fever, collection of vital statistics as empirical foundation for public health and epidemiology
Contagion control (1880–1940s)	Germ theory: demonstration of infectious origins of disease	Communicable disease control through environmental control, vaccination, sanatoriums, and outbreak investigation in general population	Linkage of epidemiology, bacteriology, and immunology to form TB sanatoriums; outbreak investigation, e.g., Goldberger and pellagra
Filling holes in the medical care system (1950s–mid-1980s)	Integration of control of communicable diseases, modification of risk factors, and care of high-risk population as part of medical care	Public system for control of specific communicable diseases and care for vulnerable populations distinct from general healthcare system, beginning of integrated healthcare systems with integration of preventive services into general healthcare system	Antibiotics, randomized controlled trials, concept of risk factors, surgeon general reports on cigarette smoking, Framingham study on cardiovascular risks, health maintenance organizations and community health centers with integration of preventive services into general healthcare system
Health promotion/ Disease prevention (Mid-1980s–2000)	Focus on individual behavior and disease detection in vulnerable and general populations	Clinical and population-oriented prevention with focus on individual control of decision making and multiple interventions	AIDS epidemic and need for multiple interventions to reduce risk, reductions in coronary heart disease through multiple interventions
Population health (2000s)	Coordination of public health and healthcare delivery based upon shared evidence-based systems thinking	Evidence-based recommendations and information management, focus on harms and costs as well as benefits of interventions, globalization	Evidence-based medicine and public health; information technology; new approaches to avoid medical errors; antibiotic resistance; global collaboration, e.g., SARS; tobacco control; climate change

Adapted from: Awofeso N. What's new about the “New Public Health”? *American Journal of Public Health*. 2004;94(5):705–709.

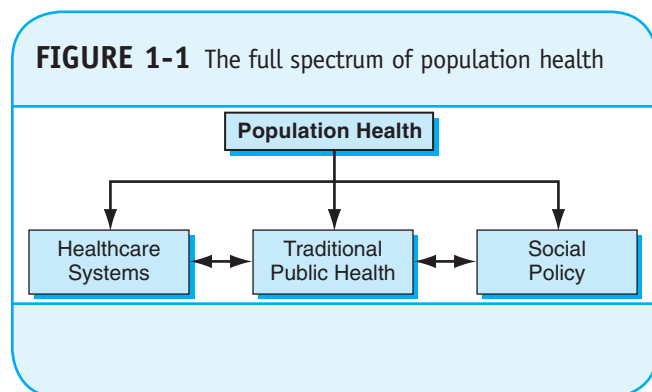
Thus, today we have entered an era in which a focus on the individual is increasingly coupled with a focus on what needs to be done at the community and population level. This era of public health can be viewed as “the era of population health.”

WHAT IS MEANT BY “POPULATION HEALTH”?

The concept of population health has emerged in recent years as a broader concept of public health that includes all the ways that society as a whole or communities within society are affected by health issues and how they respond to these issues. Population health provides an intellectual umbrella for thinking about the wide spectrum of factors that can and do affect the health of individuals and the population as a whole. **Figure 1-1** provides an overview of what falls under the umbrella of population health. Population health also provides strategies for considering the broad range of potential **interventions** to address these issues. By “intervention,” we mean the full range of strategies designed to protect health and prevent disease, disability, and death. Interventions include preventive efforts, such as nutrition and vaccination; curative efforts, such as antibiotics and cancer surgery; and efforts to prevent complications and restore function—from chemotherapy to physical therapy. Thus, population health is about healthy people and healthy populations.

The concept of population health can be seen as a comprehensive way of thinking about the modern scope of public health. It utilizes an evidence-based approach to analyze the determinants of health and disease and the options for intervention to preserve and improve health. Population health requires us to define what we mean by “health issues” and what we mean by “population(s).” It also requires us to define what we mean by “society’s shared health concerns,” as well as “society’s vulnerable groups.”

FIGURE 1-1 The full spectrum of population health



To understand population health, we therefore need to define what we mean by each of these four components:

- Health issues
- Population(s)
- Society’s shared health concerns
- Society’s vulnerable groups

WHAT ARE THE IMPLICATIONS OF EACH OF THE FOUR COMPONENTS OF HEALTH?

All four of the key components of public health have changed in recent years. Let us take a look at the historical, current, and emerging scopes of each component and consider their implications.

For most of the history of public health, the term “health” focused solely on physical health. Mental health has now been recognized as an important part of the definition; conditions such as depression and substance abuse make enormous contributions to disability in populations throughout the world. The boundaries of what we mean by “health” continue to expand, and the limits of health are not clear. Many novel medical interventions—including modification of genes and treatments to increase height, improve cosmetic appearance, and improve sexual performance—confront us with the question: Are these health issues?

The definition of “population,” likewise, is undergoing fundamental change. For most of recorded history, a population was defined geographically. Geographic communities, such as cities, states, and countries, defined the structure and functions of public health. The current definition of “population” has expanded to include the idea of a global community, recognizing the increasingly interconnected issues of global health. The definition of “population” is also focusing more on nongeographic communities. Universities now include the distance-learning community, health care is delivered to members of a health plan community, and the Internet is creating new social media communities. All of these new definitions of “population” are affecting the thinking and approaches needed to address public health issues.

What about the meaning of society-wide concerns—have they changed as well? Historically, public health and communicable disease were nearly synonymous, as symbolized by the field of epidemiology, which actually derives its name from the study of communicable disease epidemics. In recent decades, the focus of society-wide concerns has greatly expanded to include toxic exposures from the physical environment, transportation safety, and the costs of health care. However, communicable disease never went away as a focus of public health, and the 2000s are seeing a resurgence in

TABLE 1-2 Components of Population Health

	Health	Population	Examples of society-wide concerns	Examples of vulnerable groups
Historical	Physical	Geographically limited	Communicable disease	High-risk maternal and child, high-risk occupations
Current	Physical and mental	Local, state, national, global, governmentally defined	Toxic substances, product and transportation safety, communicable diseases, costs of health care	Disabled, frail elderly, uninsured
Emerging	Cosmetic, genetic, social functioning	Defined by local, national, and global communications	Disasters, climate change, technology hazards, emerging infectious diseases	Immune-suppressed, genetic vulnerability

concern over emerging infectious diseases, including HIV/AIDS, pandemic flu, and newly drug-resistant diseases, such as staph infections and tuberculosis. Additional concerns, ranging from the impact of climate change to the harms and benefits of new technologies, are altering the meaning of society-wide concerns.

Finally, the meaning of “vulnerable populations” continues to transform. For most of the 1900s, public health focused on maternal and child health and high-risk occupations as the operational definition of “vulnerable populations.” While these groups remain important to public health, additional groups now receive more attention, including the disabled, the frail elderly, and those without health insurance. Attention is also beginning to focus on the immune-suppressed among those living with HIV/AIDS, who are at higher risk of infection and illness, and those whose genetic code documents their special vulnerability to disease and reactions to medications.

Public health has always been about our shared health concerns as a society and our concerns about vulnerable populations. These concerns have changed over time, and new concerns continue to emerge. **Table 1-2** outlines historical, current, and emerging components of the population health approach to public health. As is illustrated by communicable diseases, past concerns cannot be relegated to history.

SHOULD WE FOCUS ON EVERYONE OR ON VULNERABLE GROUPS?

Public health is often confronted with the potential conflict of focusing on everyone and addressing society-wide concerns versus focusing on the needs of vulnerable populations.¹⁰ This conflict is reflected in the two different approaches

to addressing public health problems. We will call them the **high-risk approach** and the **improving-the-average approach**.

The high-risk approach focuses on those with the highest probability of developing disease and aims to bring their risk close to the levels experienced by the rest of the population. **Figure 1-2A** illustrates the high-risk approach.

The success of the high-risk approach, as shown in **Figure 1-2B**, assumes that those with a high probability of

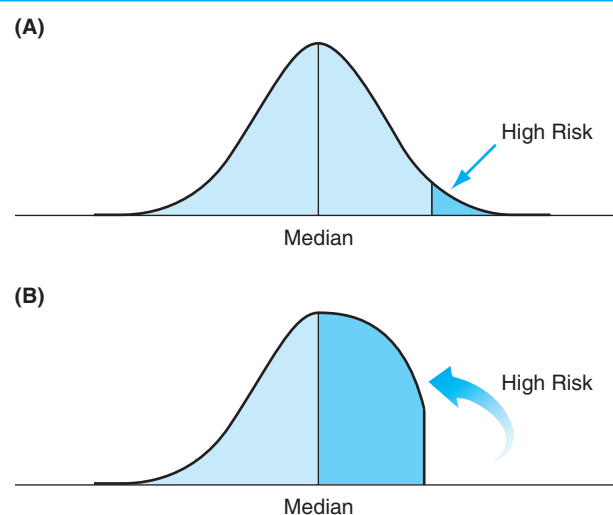
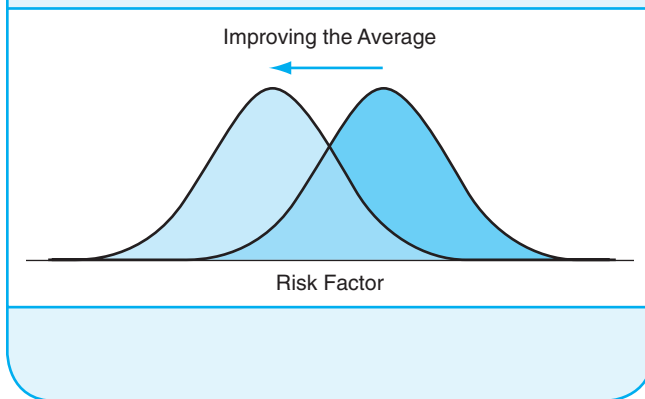
FIGURE 1-2 (A) High risk. (B) Reducing high risk

FIGURE 1-3 Improving the average

developing disease are heavily concentrated among those with exposure to what we call **risk factors**. Risk factors include a wide range of exposures, from cigarette smoke and other toxic substances to high-risk sexual behaviors.

The improving-the-average approach focuses on the entire population and aims to reduce the risk for everyone. **Figure 1-3** illustrates this approach.

The improving-the-average approach assumes that everyone is at some degree of risk and the risk increases with the extent of exposure. In this situation, most of the disease occurs among the large number of people who have only modestly increased exposure. The successful reduction in average cholesterol levels through changes in the U.S. diet and the anticipated reduction in diabetes via a focus on weight reduction among children illustrate this approach.

One approach may work better than the other in specific circumstances, but in general, both approaches are needed if we are going to successfully address today's and tomorrow's health issues. These two approaches parallel public health's long-standing focus on both the health of vulnerable populations and society-wide health concerns.^c

Now that we understand what is meant by "population health," let us take a look at the range of approaches that may be used to promote and protect health.

^c An additional approach includes reducing disparities by narrowing the curve so that the gap is reduced between the lowest of the low-risk and the highest of the high risk. For instance, this might be accomplished by transferring financial resources and/or health services from the low-risk to the high-risk category through taxation or other methods. Depending on the distribution of the factors affecting health, this approach may or may not reduce the overall frequency of disease more than the other approaches. The distribution of risk in Figures 1-1 and 1-2 assumes a bell-shaped or normal distribution. The actual distribution of factors affecting health may not follow this distribution.

WHAT ARE THE APPROACHES AVAILABLE TO PROTECT AND PROMOTE HEALTH?

The wide range of strategies that have been, are being, and will be used to address health issues can be divided into three general categories: health care, traditional public health, and social interventions.

Health care includes the delivery of services to individuals on a one-on-one basis. It includes services for those who are sick or disabled with illness or diseases, as well as for those who are asymptomatic. Services delivered as part of clinical prevention have been categorized as vaccinations, behavioral counseling, screening for disease, and preventive medications.¹¹

Traditional public health efforts have a population-based preventive perspective utilizing interventions targeting communities or populations, as well as defined high-risk or vulnerable groups. Communicable disease control, reduction of environmental hazards, food and drug safety, and nutritional and behavioral risk factors have been key areas of focus of traditional public health approaches.

Both health care and traditional public health approaches share a goal to directly affect the health of those they reach. In contrast, social interventions are primarily aimed at achieving other nonhealth goals, such as increasing convenience, pleasure, economic growth, and social justice. Social interventions range from improving housing, to improving education and services for the poor, to increased global trade. These interventions may have dramatic and sometimes unanticipated positive or negative health consequences. Social interventions, like increased availability of food, may improve health, while the availability of high-fat or high-calorie foods may pose a risk to health.

Table 1-3 describes the characteristics of health care, traditional public health, and social approaches to population health and provides examples of each approach.

None of these approaches is new. However, they have traditionally been separated or put into silos in our thinking process, with the connections between them often ignored. Thinking in systems and connecting the pieces is an important part of the 21st century challenge of defining public health.

Now that we have explained what we mean by "public health" and seen the scope and methods that we call "population health," let us continue our big-picture approach by taking a look at what we mean by the "determinants of health and disease."

WHAT FACTORS DETERMINE THE OCCURRENCE OF DISEASE, DISABILITY, AND DEATH?

To complete our look at the big picture issues in public health, we need to gain an understanding of the forces that determine disease and the outcome of disease, including

TABLE 1-3 Approaches to Population Health

	Characteristics	Examples
Health care	Systems for delivering one-on-one individual health services, including those aimed at prevention, cure, palliation, and rehabilitation	Clinical preventive services, including vaccinations, behavioral counseling, screening for disease, and preventive medications
Traditional public health	Group- and community-based interventions directed at health promotion and disease prevention	Communicable disease control, control of environmental hazards, food and drug safety, reduction in risk factors for disease
Social interventions	Interventions with another non-health-related purpose, which have secondary impacts on health	Interventions that improve the built environment, increase education, alter nutrition, or address socioeconomic disparities through changes in tax laws; globalization and mobility of goods and populations

what in public health has been called morbidity (disability) and mortality (death).^d

We need to establish what are called contributory causes based on evidence. **Contributory causes** can be thought of as immediate causes of disease. For instance, the HIV virus and cigarette smoking are two well-established contributory causes of disease, disability, and death. They directly produce disease, as well as disability and death. However, knowing these contributory causes of disease is often not enough. We need to ask: What determines whether people will smoke or come in contact with the HIV virus? What determines their course once exposed to cigarettes or HIV? In public health, we use the term **determinants** to identify these underlying factors, or “causes of causes” that ultimately bring about disease.

Determinants look beyond the known contributory causes of disease to factors that are at work often years before a disease develops.^{12, 13} These underlying factors may be thought of as “upstream” forces. Like great storms, we know the water will flow downstream, often producing flooding and destruction along the way. We just do not know exactly when and where the destruction will occur.

There is no official list or agreed-upon definition of what is included in determinants of disease.^e Nonetheless, there is

wide agreement that the following factors are among those that can be described as determinants in that they increase or at times decrease the chances of developing conditions that threaten the quantity and/or quality of life. Some but not all of these factors are related to socioeconomic status and are categorized as social determinants of health.

Behavior
Infection
Genetics
Geography
Environment
Medical care
Socioeconomic-cultural

BIG GEMS provides a convenient device for remembering these determinants of disease. Let us see what we mean by each of the determinants.

Behavior—Behavior implies actions that increase exposure to the factors that produce disease or protect individuals from disease. Actions such as smoking cigarettes, exercising, eating a particular diet, consuming alcohol, having unprotected intercourse, and using seat belts are all examples of the ways that behaviors help determine the development of disease.

Infection—Infections are often the direct cause of disease. In addition, we are increasingly recognizing that early or long-standing exposures to infections may contribute to the development of disease or even protection against disease. Diseases as diverse as gastric and duodenal ulcers, gallstones, and hepatoma or cancer originating in the liver are increasingly suspected to have infection as an important determinant. Early exposure to infections may actually reduce diseases ranging from polio to asthma.

^d We will use the term “disease” as shorthand for the broad range of outcomes that includes injuries and exposures that result in death and disability.

^e Health Canada¹² has identified 12 determinants of health, which are: 1) income and social status, 2) employment, 3) education, 4) social environments, 5) physical environments, 6) healthy child development, 7) personal health practices and coping skills, 8) health services, 9) social support networks, 10) biology and genetic endowment, 11) gender, and 12) culture. Many of these are subsumed under socioeconomic-cultural determinants in the BIG GEMS framework. The World Health Organization’s Commission on Social Determinants of Health has also produced a list of determinants that is consistent with the BIG GEMS framework.¹³

Genetics—The revolution in genetics has focused our attention on roles that genetic factors play in the development and outcome of disease. Even when contributory causes, such as cigarettes, have been clearly established as producing lung cancer, genetic factors also play a role in the development and progression of the disease. While genetic factors play a role in many diseases, they are only occasionally the most important determinant of disease.

Geography—Geographic location influences the frequency and even the presence of disease. Infectious diseases such as malaria, Chagas disease, schistosomiasis, and Lyme disease occur only in defined geographic areas. Geography may also imply local geological conditions, such as those that produce high levels of radon—a naturally occurring radiation that contributes to the development of lung cancer. Geography implies that special locations are required to produce disease, such as frostbite in the arctic or snake bites in the tropics.

Environment—Environmental factors determine disease and the course of disease in a number of ways. The unaltered or “natural” physical world around us may produce disability and death from sudden natural disasters, such as earthquakes and volcanic eruptions, to iodine deficiencies due to low iodine content in the food-producing soil. The altered physical environment produced by human intervention includes exposures to toxic substances in occupational or nonoccupational settings. The physical environment built for use by humans—the **built environment**—produces determinants ranging from indoor air pollution, to “infant-proofed” homes, to hazards on the highway.

Medical care—Access to and the quality of medical care can be a determinant of disease. When a high percentage of individuals is protected by vaccination, nonvaccinated individuals in the population may be protected as well. Cigarette smoking cessation efforts may help smokers to quit, and treatment of infectious disease may reduce the spread to

others. Medical care, however, often has its major impact on the course of disease by attempting to prevent or minimize disability and death once disease develops.

Socioeconomic-cultural—In the United States, socioeconomic factors have been defined as education, income, and occupational status. These measures have all been shown to be determinants of diseases as varied as breast cancer, tuberculosis, and occupational injuries. Cultural and religious factors are increasingly being recognized as determinants of diseases because beliefs sometimes influence decisions about treatments, in turn affecting the outcome of the disease. While most diseases are more frequent in lower socioeconomic groups, others, such as breast cancer, may be more common in higher socioeconomic groups.

Determinants of disease come up again and again as we explore the work of population health. Historically, understanding determinants has often allowed us to prevent diseases and their consequences even when we did not fully understand the mechanism by which the determinants produced their impact. For instance:

- Scurvy was controlled by citrus fruits well before vitamin C was identified.
- Malaria was partially controlled by clearing swamps before the relationship to mosquito transmission was appreciated.
- Hepatitis B and HIV infections were partially controlled even before the organisms were identified through the reduction in use of contaminated needles and the establishment of standards for blood transfusions.
- Tuberculosis death rates were greatly reduced through less crowded housing, the use of TB sanitariums, and better nutrition.

Using asthma as an example, **Box 1-1** illustrates the many ways that determinants can affect the development and course of a disease.

BOX 1-1 Asthma and the Determinants of Disease

Jennifer, a teenager living in a rundown urban apartment in a city with high levels of air pollution, develops severe asthma. Her mother also has severe asthma, yet both of them smoke cigarettes. Her clinician prescribed medications to prevent asthma attacks, but she takes them only when she experiences severe symptoms. Jennifer is hospitalized twice with pneumonia due to

common bacterial infections. She then develops an antibiotic-resistant infection. During this hospitalization, she requires intensive care on a respirator. After several weeks of intensive care and every known treatment to save her life, she dies suddenly.

Asthma is an inflammatory disease of the lung coupled with an increased reactivity of the airways, which together produce

(continues)

BOX 1-1 Asthma and the Determinants of Disease (*continued*)

a narrowing of the airways of the lungs. When the airways become swollen and inflamed, they become narrower, allowing less air through to the lung tissue and causing symptoms such as wheezing, coughing, chest tightness, breathing difficulty, and predisposition to infection. Once considered a minor ailment, asthma is now the most common chronic disorder of childhood. It affects over 6 million children under the age of 18 in the United States alone.

Jennifer's tragic history illustrates how a wide range of determinants of disease may affect the occurrence, severity, and development of complications of a disease. Let us walk through the BIG GEMS framework and see how each determinant had impacts on Jennifer.

Behavior—Behavioral factors play an important role in the development of asthma attacks and in their complications. Cigarette smoking makes asthma attacks more frequent and more severe. It also predisposes individuals to developing infections such as pneumonia. Treatment for severe asthma requires regular treatments along with more intensive treatment when an attack occurs. It is difficult for many people, especially teenagers, to take medication regularly, yet failure to adhere to treatment greatly complicates the disease.

Infection—Infection is a frequent precipitant of asthma, and asthma increases the frequency and severity of infections. Infectious diseases, especially pneumonia, can be life-threatening in asthmatics, requiring prompt and high-quality medical care. The increasing development of antibiotic-resistant infections poses special risks to those with asthma.

Genetics—Genetic factors predispose people to childhood asthma. However, many children and adults without a family history develop asthma.

Geography—Asthma is more common in geographic areas with high levels of naturally occurring allergens due to

flowering plants. However, today even populations in desert climates in the United States are often affected by asthma, as irrigation results in the planting of allergen-producing trees and other plants.

Environment—The physical environment, including that built for use by humans, has increasingly been recognized as a major factor affecting the development of asthma and asthma attacks. Indoor air pollution is the most common form of air pollution in many developing countries. Along with cigarette smoke, air pollution inflames the lungs acutely and chronically. Cockroaches often found in rundown buildings have been found to be highly allergenic and predisposing to asthma. Other factors in the built environment, including mold and exposure to pet dander, can also trigger wheezing in susceptible individuals.

Medical care—The course of asthma can be greatly affected by medical care. Management of the acute and chronic effects of asthma can be positively affected by efforts to understand an individual's exposures, reducing the chronic inflammation with medications, managing the acute symptoms, and avoiding life-threatening complications.

Socioeconomic-cultural—Disease and disease progression are often influenced by an individual's socioeconomic status. Air pollution is often greater in lower socioeconomic neighborhoods of urban areas. Mold and cockroach infestations may be greater in poor neighborhoods. Access to and the quality of medical care may be affected by social, economic, and cultural factors.

Thus, asthma is a condition that demonstrates the contributions made by the full range of determinants included in the BIG GEMS framework. No one determinant alone explains the bulk of the disease. The large number of determinants and their interactions provide opportunities for a range of health care, traditional public health, and social interventions.

Determinants of health may change over time, and the composition of populations may change in ways that affects health. Let us take a look at some of the ways that populations have changed and are changing that affect population health.

WHAT CHANGES IN POPULATIONS OVER TIME CAN AFFECT HEALTH?

A number of important trends or transitions in the composition of populations that affect the pattern of disease have been described in recent years. These transitions have

implications for what we can expect to happen throughout the 2000s. We will call these the demographic, epidemiologic, and nutritional transitions.

The **demographic transition** describes the impact of falling childhood death rates and extended life spans on the size and the age distribution of populations.¹⁴ During the first half of the 1900s, death rates among the young fell dramatically in today's developed countries. Death rates continued their dramatic decline in most parts of the developing world during the second half of the 1900s.

Birth rates tend to remain high for years or decades after the decline in deaths. High birth rates paired with lower death rates lead to rapid growth in population size, as we have seen in much of the developing world. This trend continues today and is expected to go on in many parts of the world well into the 2000s. **Figure 1-4** illustrates how the population of the Nigeria is expected to grow during the first half of the 2000s due to a high birth rate and a lowered death rate.

Despite the delay, a decline in birth rates reliably occurs following the decline in childhood deaths. This decline in births gradually leads to aging of the population. We are now seeing societies in much of Europe and Japan with growing elderly populations. Improved health care and extended life spans for the elderly have magnified this trend. Take a look at **Figure 1-5**, which shows what is expected to occur in the coming years in much of Europe and Japan. Japan is used as an example of the emergence of an inverted population pyramid, with a smaller young population and a larger older population. Populations with a large number of elderly relative to the number of younger individuals have a heavier burden of disease and create the conditions for aging to become a public health issue.

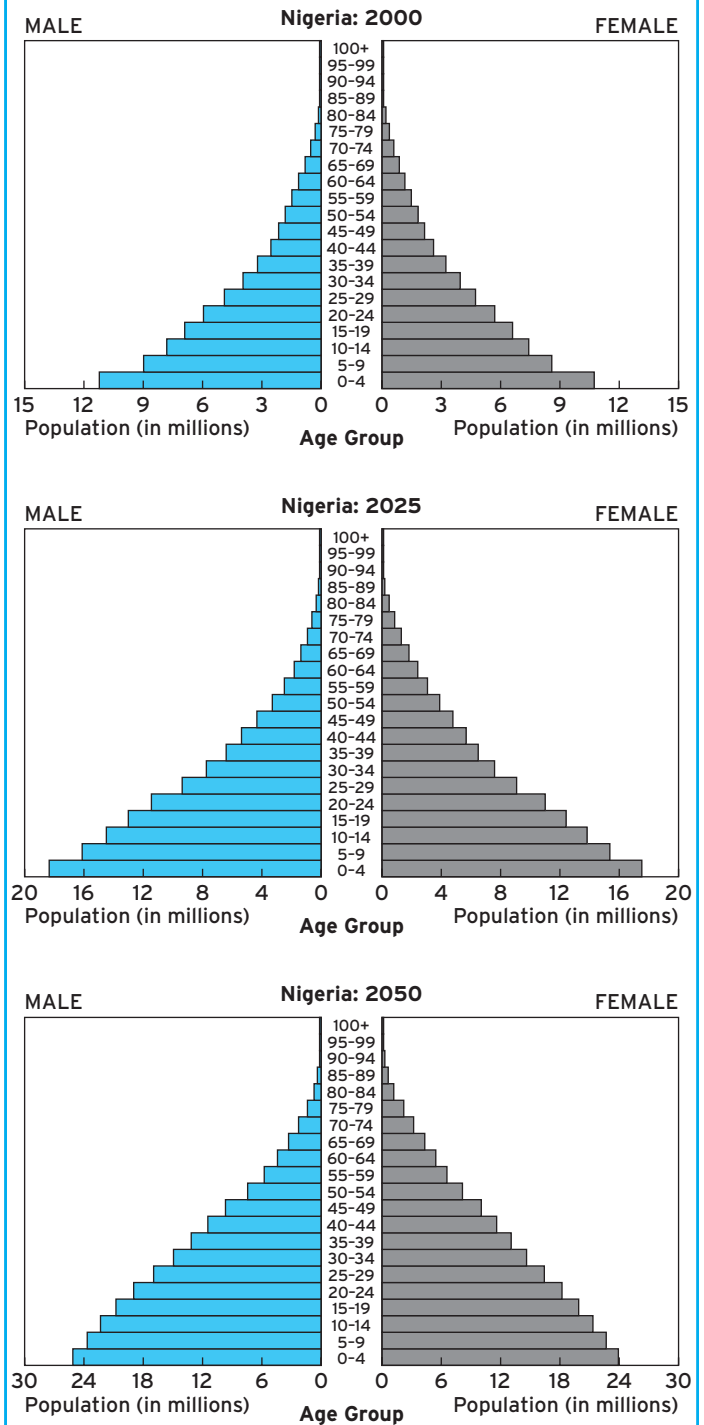
The large number of immigrants to the United States and their generally higher birth rates has slowed this process in the United States, but the basic trend of a growing elderly population continues. The U.S. baby boom, which occurred between 1946 and 1964, is expected to have major impacts on the numbers of elderly in coming years, as illustrated in **Figure 1-6**.

A second transition has been called the **epidemiological transition**,¹⁵ or public health transition. The epidemiological or public health transition implies that as social and economic development occurs, different types of diseases become prominent. Deaths in less developed societies are often dominated by epidemic communicable diseases and diseases associated with malnutrition and childhood infections. As a country develops, communicable diseases often come under control, and noncommunicable and chronic diseases, such as heart disease, often predominate.

A related transition known as the **nutritional transition**¹⁶ implies that countries frequently move from poorly balanced diets often deficient in nutrients, proteins, and calories to a diet of highly processed food, including fats, sugars, and salt. The consequences of both under- and overnutrition affect and will continue to affect the public's health well into the 2000s.

As we have seen population health focuses on the big picture issues and the determinants of disease. Increasingly, public health also emphasizes a focus on research evidence as

FIGURE 1-4 Population Pyramid Expected for Nigeria



Reproduced from U.S. Census Bureau. International Database. Available at <http://www.census.gov/population/international/data/idb/informationGateway.php>. Accessed July 22, 2013.

FIGURE 1-5 Population Pyramid Expected for Japan

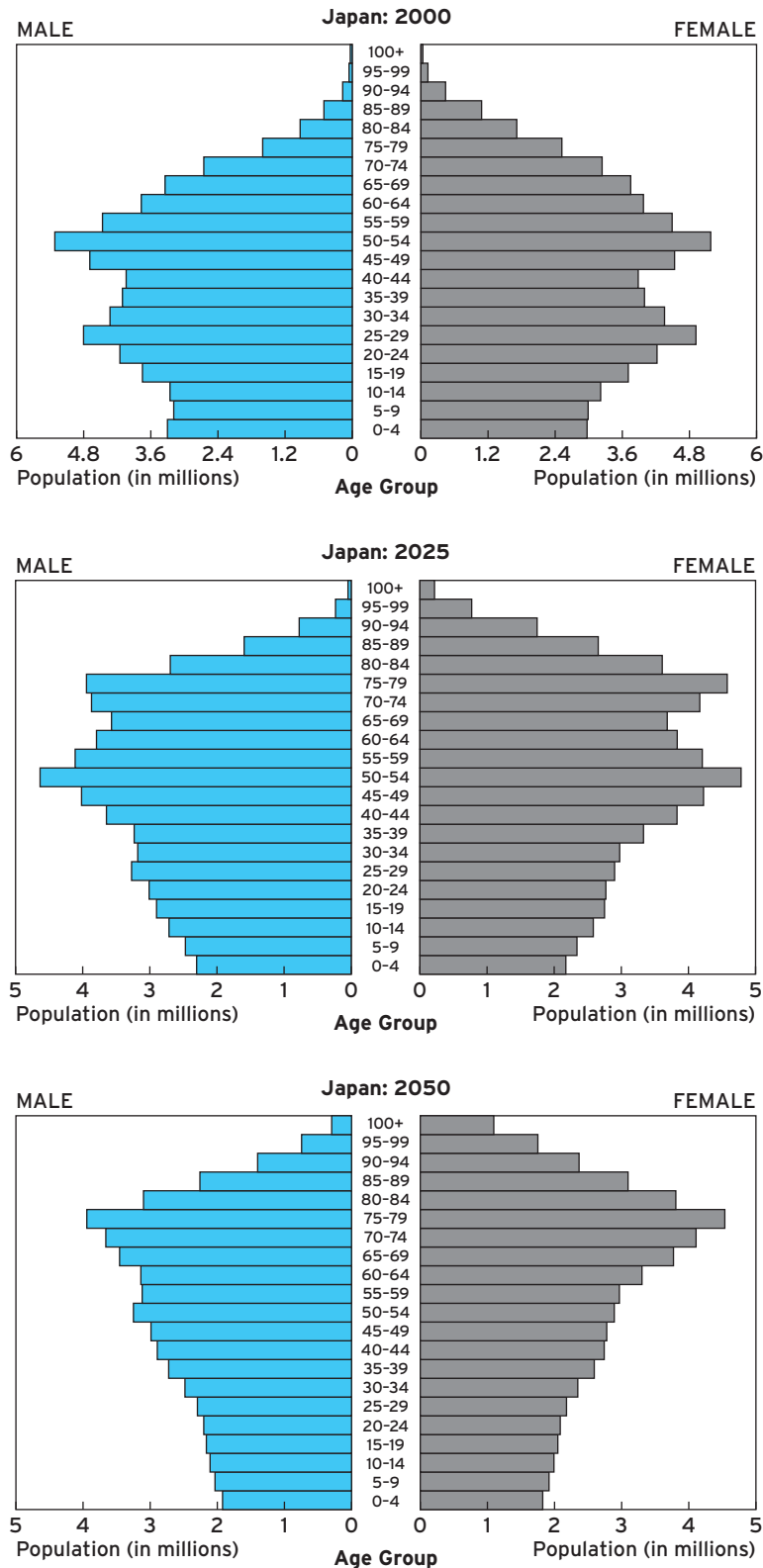
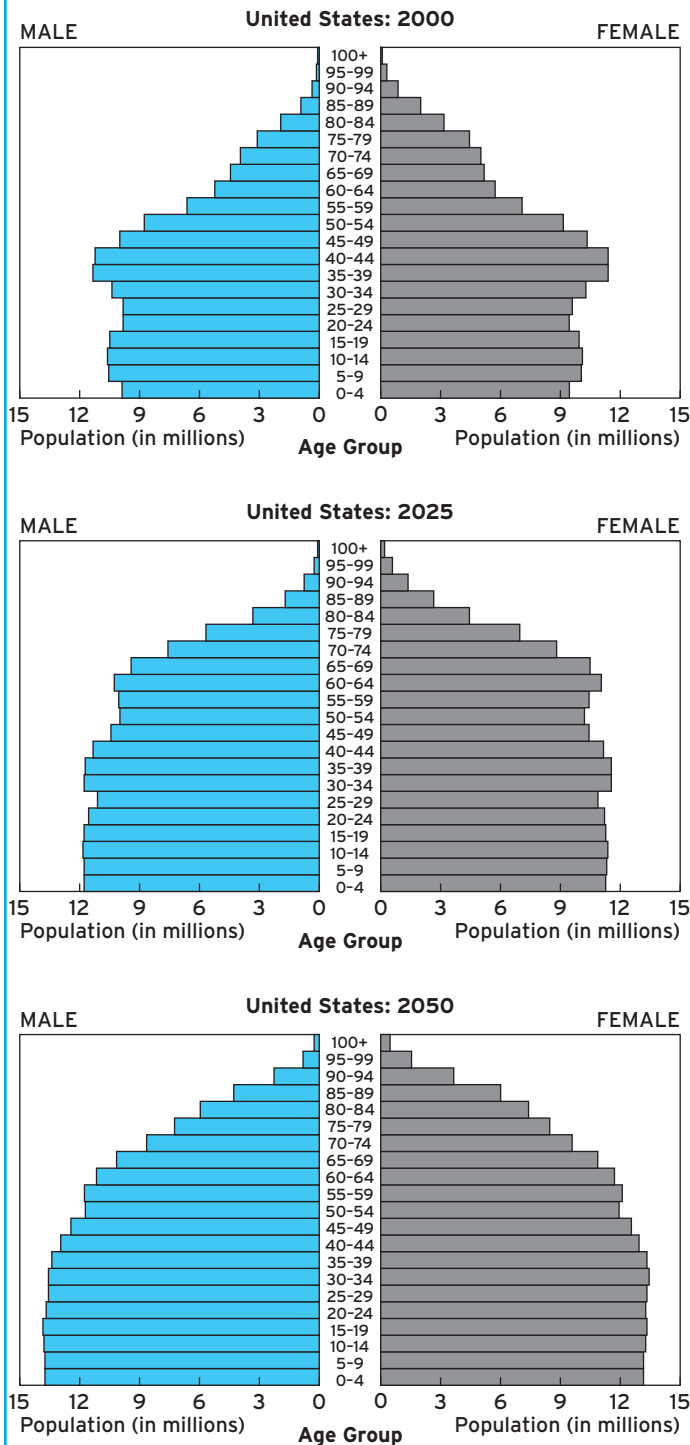


FIGURE 1-6 Population Pyramid Expected for the United States



Reproduced from U.S. Census Bureau. International Database. Available at <http://www.census.gov/population/international/data/idb/informationGateway.php>. Accessed July 22, 2013.

a basis for understanding the cause or etiology of disease and the interventions that can improve the outcome. Let us now explore what we mean by “evidence-based public health.”

KEY WORDS

- Population health approach
- Social justice
- Interventions
- High-risk approach
- Improving-the-average approach
- Risk factor
- Contributory causes
- Determinants
- BIG GEMS
- Built environment
- Demographic transition
- Epidemiological transition
- Nutritional transition



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Discussion Question

1. Think about a typical day in your life and identify ways that public health affects it.

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