CHAPTER 2

Understanding and Measuring Health

CHAPTER LEARNING OBJECTIVES

After completing Chapter 2, learners will be proficient in applying measures of population health and illness, including risk factors, in community health improvement activities and initiatives. Key aspects of this competency expectation include:

• Articulating several different definitions of health
• Identifying four or more categories of factors that influence health
• For each of these categories, specifying three or more factors that influence health
• Identifying several categories of commonly used measures of health status
• For each of these categories, identifying three or more commonly used measures
• Describing major trends in health status for the United States over the past 100 years
• Accessing and utilizing comprehensive and current national data on health status and factors influencing health in the United States
• Utilizing information on factors that influence health and measures of health to develop community health priorities and effective interventions for improving community health status

The 21st century began much as its predecessor did, with immense opportunities to advance the public’s health through actions to assure conditions favorable for health and quality of life. All systems direct their efforts toward certain outcomes; they track progress by ensuring that these outcomes are clearly defined and measurable. In public health, this calls for clear definitions and measures of health and quality of life in populations. That task is the focus of this chapter. Key questions to be addressed are:

• What is health?
• What factors influence health and illness?
• How can health status and quality of life be measured?
• What do current measures tell us about the health status and quality of life of Americans at the beginning of the 21st century?
• How can this information be used to develop effective public health interventions and public policy?

The relevance of these questions resides in their focus on factors that cause or influence particular health outcomes. Efforts to identify and measure key aspects of health and factors influencing health have relied on traditional approaches over the past century, although there are signs that this pattern may be changing. The key questions identified above will be addressed slightly out of order, for reasons that should become apparent as we proceed.

HEALTH IN THE UNITED STATES

Many important indicators of health status in the United States have improved considerably over the past century, although there is evidence that health status could be even better than it is. At the turn of the 20th century, nearly 2% of the U.S. population died each year. The crude mortality rate in 1900 was about 1,700 deaths per 100,000 population. Life expectancy at birth was 47 years. Additional life expectancy at age 65 was another 12 years. Medicine and health care were largely proprietary in 1900 and of questionable benefit to health. More extensive information on the health status of the population at that time would be useful, but very little exists.

Indicators of health status improved in the United States throughout the 20th century. Between 1900 and 2000, the crude mortality rate was cut nearly in half to 872 per 100,000.
By the year 2000, life expectancy at birth was nearly 77 years and life expectancy at age 65 was another 18 years.

The leading causes of death also changed dramatically over the 20th century, as demonstrated in Figure 2–1. In 1900, the 10 leading causes of death were influenza and pneumonia, tuberculosis, diarrhea and related diseases, heart disease, stroke, chronic nephritis, accidents, cancer, perinatal conditions, and diphtheria. By the year 2000, tuberculosis, gastroenteritis, and diphtheria dropped off the list of the top 10 killers, and deaths from influenza and pneumonia fell from first to seventh position on the list. Diseases of aging and other chronic conditions superseded these infectious disease processes as changes in the age structure of the population, especially the increase in persons over age 65, resulted in higher overall crude rates for heart disease and cancer and the appearance of diabetes, Alzheimer’s disease, chronic kidney conditions, and septicaemia on the modern list of the top 10 killers.

However, changes in crude death rates only partly explain the gains in life expectancy realized for all age groups over the 20th century. On an age-adjusted basis, improvements were even more impressive. Age-adjusted mortality rates fell about 75% between 1900 and 2000. Over the course of the entire 20th century, infant and child mortality rates fell 95%, adolescent and young adult mortality rates dropped 80%, rates for adults aged 25–64 fell 60%, and rates for older adults (older than age 65) declined 35%.

During the second half of the 20th century, overall age-adjusted mortality rates fell about 50% (see Figure 2–2) while infant mortality rates declined more than 75%. During that period, mortality rates among children and young adults (ages 1–24 years) and adults 45–64 years were reduced by more than one half. Mortality rates among adults 25–44 years fell more than 40%, and rates for elderly persons (age 65 and older) fell about one third.

Gains for adult age groups in recent decades have outstripped those for younger age groups, a trend that began about 1960 as progress accelerated toward reduction of mortality from injuries and certain major chronic diseases that largely affected adults (earlier reductions for children also left little room for further improvements). Table 2–1 demonstrates changes in the age-adjusted frequency of selected major causes of death over the second half of the 20th century. Dramatic reductions in the death rates for heart disease, stroke, unintentional injuries, influenza and pneumonia, and infant mortality have been joined by more recent reductions in rates for HIV infections, liver diseases, and suicide. Age-adjusted death rates have increased for diabetes, Alzheimer’s disease, and chronic lung and kidney conditions, signaling the new morbidities associated with longer life spans. Homicide rates have improved somewhat over the past decade but reflect a substantial increase since 1950.

Table 2–1 also demonstrates the considerable disparities that exist for many of the major causes of death. Differences among races are notable, but there are also significant differences by gender for the various causes of death. These differences are often dramatic and run from top to bottom through the chain of causation. Disparities are found not only in indicators of poor health outcomes, such as mortality, but also in the levels of risk factors in the population groups most severely affected. A poignant example of these disparities is reflected in the 12-year difference in life expectancy between white females and black males.

There is also evidence that health is improving and that disability levels are declining in the population over time. Disability levels among individuals aged 55–70 years who were offspring of the famous Framingham Heart Study cohort were substantially lower, in comparison with their parentsí experience at the same age.2 In addition, fewer offspring had chronic diseases or perceived their health as fair or poor. Self-reported health status and activity limitations due to chronic conditions changed little during the 1990s, and injuries with lost workdays steadily declined during the 1990s.

In sum, U.S. health indicators tell two very different tales. By many measures, the American population has never been healthier. By others, much more needs to be done for specific racial, ethnic, and gender groups. The gains in health status over the past century have not been shared equally by all subgroups of the population. In fact, relative differences have been increasing. This widening gap in health status creates both a challenge and a dilemma for future health improvement efforts. The greatest gains can be made through closing these gaps and equalizing health status within the population. Yet the burden of greater risk and poorer health status resides in a relatively small part of the total population, calling for efforts that target those minorities with increased resources. An alternative approach is to continue current strategies and resource deployment levels. Although this may continue the steady overall improvement among all groups in the population, it is likely to continue or worsen existing gaps. In the early years of the new century, the major health challenge facing the United States appears to be less related to the need to improve population-wide health outcomes than the need to eliminate or reduce disparities. This challenges the nation’s commitment to its principles of equality and social justice. However, addressing inequalities in measures of health and quality of life requires a greater understanding of health and the measures used to describe it than afforded by death rates and life expectancies.
**FIGURE 2–1** The 10 leading causes of death as a percentage of all deaths in the United States, 1900 and 2000.

### 10 Leading Causes of Death, 2000

<table>
<thead>
<tr>
<th>Cause</th>
<th>Percent of all Deaths</th>
</tr>
</thead>
<tbody>
<tr>
<td>Heart Disease</td>
<td>29.6%</td>
</tr>
<tr>
<td>Cancer</td>
<td>23%</td>
</tr>
<tr>
<td>Cerebrovascular Disease</td>
<td>7%</td>
</tr>
<tr>
<td>Chronic Obstructive Lung Disease</td>
<td>5.1%</td>
</tr>
<tr>
<td>Unintentional Injuries</td>
<td>4.1%</td>
</tr>
<tr>
<td>Diabetes</td>
<td>2.9%</td>
</tr>
<tr>
<td>Pneumonia/Influenza</td>
<td>2.7%</td>
</tr>
<tr>
<td>Alzheimer’s Disease</td>
<td>1.2%</td>
</tr>
<tr>
<td>Kidney Disease</td>
<td>1.1%</td>
</tr>
<tr>
<td>Septicemia</td>
<td>0.7%</td>
</tr>
</tbody>
</table>


### 10 Leading Causes of Death, 1900

<table>
<thead>
<tr>
<th>Cause</th>
<th>Percent of all Deaths</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pneumonia and Influenza</td>
<td>11.8%</td>
</tr>
<tr>
<td>Tuberculosis</td>
<td>11.3%</td>
</tr>
<tr>
<td>Diarrhea and Enteritis</td>
<td>8.3%</td>
</tr>
<tr>
<td>Heart Disease</td>
<td>6.2%</td>
</tr>
<tr>
<td>Liver Disease</td>
<td>5.2%</td>
</tr>
<tr>
<td>Injuries</td>
<td>4.2%</td>
</tr>
<tr>
<td>Cancer</td>
<td>3.7%</td>
</tr>
<tr>
<td>Senility</td>
<td>2.9%</td>
</tr>
<tr>
<td>Diphtheria</td>
<td>2.3%</td>
</tr>
</tbody>
</table>

### FIGURE 2–2


### TABLE 2–1
Year 2000 Age-adjusted Death Rates (per 100,000 population) for Selected Leading Causes of Death, Percent of all 2000 Deaths, Percentage Rate Change from 1950–2000, and 2000 Ratio by Sex and Race, United States

<table>
<thead>
<tr>
<th>Cause of Death</th>
<th>Percent of 2000 Deaths</th>
<th>Year 2000 Rate*</th>
<th>Percent Change in Rates*</th>
<th>Male to Female 2000 Rate*</th>
<th>Black to White 2000 Rate*</th>
</tr>
</thead>
<tbody>
<tr>
<td>Diseases of the heart</td>
<td>29.6</td>
<td>257.9</td>
<td>−56.6</td>
<td>1.5</td>
<td>1.3</td>
</tr>
<tr>
<td>Malignant neoplasms</td>
<td>23.0</td>
<td>201.0</td>
<td>+3.7</td>
<td>1.5</td>
<td>2.3</td>
</tr>
<tr>
<td>Cerebrovascular disease</td>
<td>7.0</td>
<td>60.8</td>
<td>−66.4</td>
<td>1.0</td>
<td>1.4</td>
</tr>
<tr>
<td>Chronic lung diseases</td>
<td>5.1</td>
<td>44.3</td>
<td>x</td>
<td>1.4</td>
<td>0.7</td>
</tr>
<tr>
<td>Accidents &amp; adverse effects</td>
<td>4.1</td>
<td>35.5</td>
<td>−54.5</td>
<td>2.3</td>
<td>1.1</td>
</tr>
<tr>
<td>Diabetes</td>
<td>2.9</td>
<td>25.2</td>
<td>+9.1</td>
<td>1.2</td>
<td>2.2</td>
</tr>
<tr>
<td>Influenza &amp; pneumonia</td>
<td>2.7</td>
<td>23.7</td>
<td>−50.7</td>
<td>1.3</td>
<td>1.1</td>
</tr>
<tr>
<td>Suicide</td>
<td>1.2</td>
<td>10.6</td>
<td>−19.7</td>
<td>4.5</td>
<td>0.5</td>
</tr>
<tr>
<td>Chronic liver disease &amp; cirrhosis</td>
<td>1.1</td>
<td>9.6</td>
<td>−15.0</td>
<td>2.2</td>
<td>1.0</td>
</tr>
<tr>
<td>Homicide</td>
<td>0.7</td>
<td>6.1</td>
<td>+19.6</td>
<td>3.3</td>
<td>5.7</td>
</tr>
</tbody>
</table>


*Rates age-adjusted to the 2000 U.S. population.

x = 1950 comparison rate not available, although believed to be much lower than 2000 rate.
HEALTH, ILLNESS, AND DISEASE

The relationship between outcomes and the factors that influence them is complex, often confounded by different understandings of the concepts in question and how they are measured. Health is difficult to define and more difficult yet to measure. For much of history, the notion of health has been negative. This was due in part to the continuous onslaught of epidemic diseases. With disease a frequent visitor, health became the disease-free state. One was healthy by exclusion.

However, as knowledge of disease increased and methods of prevention and control improved, health was more commonly considered from a positive perspective. The World Health Organization (WHO) seized this opportunity in its 1946 constitution, defining health as not merely the absence of disease but a state of complete physical, mental, and social well-being. This definition of health emphasizes that there are different, complexly-related forms of wellness and illness, and suggests that a wide range of factors can influence the health of individuals and groups. It also suggests that health is not an absolute concept.

Although health and well-being may be synonyms, health and disease are not necessarily opposites. Most people view health and illness as existing along a continuum and as opposite and mutually exclusive states. However, this simplistic, one-dimensional model of health and illness does not comport very well with the real world. A person can have a disease or injury and still be healthy or at least feel well. There are many examples, but certainly Olympic wheelchair racers would fit into this category. It is also possible for someone without a specific disease or injury to feel ill or not well. If health and illness are not mutually exclusive, then they exist in separate dimensions, with wellness and illness in one dimension and the presence or absence of disease or injury in another.

These distinctions are important because disease is a relatively objective, pathologic phenomenon, whereas wellness and illness represent subjective experiences. This allows for several different states to exist: wellness without disease or injury, wellness with disease or injury, illness with disease or injury, and illness without physical disease or injury. This multidimensional view of health states is consistent with the WHO delineation of physical, mental, and social dimensions of health or well-being. Health or wellness is more than the absence of disease alone. Furthermore, one can be physically but not mentally and socially well.

With health measurable in several different dimensions, the question arises as to whether there is some maximum or optimal end point of health or well-being or whether health is something that can always be improved through changes in its physical, mental, and social facets. The latter alternative suggests that the goal should be a minimal acceptable level of health, rather than a state of complete and absolute health. Due in part to these considerations, WHO revised its definition in 1978, calling for a level of health that permits people to lead socially and economically productive lives. This shifts the focus of health from an end in itself to a resource for everyday life, linking physical to personal and social capacities. It also suggests that it will be easier to identify measures of illness than of health.

Disease and injury are often viewed as phenomena that may lead to significant loss or disability in social functioning, making one unable to carry out one’s main personal or social functions in life, such as parenting, schooling, or employment. In this perspective, health is equivalent to the absence of disability; individuals able to carry out their basic functions in life are healthy. This characterization of health as the absence of significant functional disabilities is perhaps the most common one for this highly sought state. Still, this definition is negative in that it defines health as the absence of disability.

In attempting to measure health, both quantity and quality become important considerations. However, it is not always easy to answer the questions: How much? Compared with what? For example, physical health for a 10-year-old child carries a much different expectation than physical health for an 80-year-old. It is reasonable to conclude that the natural processes of aging lead to gradual diminution of functional reserve capacity and that this is normal and not easily prevented. Thus, our perceptions of normal functioning are influenced by social and cultural factors.

The concept of well-being advanced in the WHO definition goes beyond the physical aspects of health that are the usual focus of measurements and comparisons. Including the mental and social aspects of well-being or health legitimizes the examination of factors that affect mental and social health. Together, these themes suggest that we need to consider carefully what we are measuring in order to understand what these measures are telling us about health, illness, and disease states in a population and the factors that influence these outcomes.

MEASURING HEALTH

The availability of information on health outcomes suggests that measuring the health status of populations is a simple task. However, although often interesting and sometimes even dramatic, the commonly used measures of health status fail to paint a complete picture of health. Many of the reasons are obvious. The commonly used measures actually reflect disease and mortality, rather than health itself. The longstanding misperception that health is the absence of disease is reinforced by the relative ease of measuring disease states, in comparison
with states of health. Actually, the most commonly used indicators focus on a state that is neither health nor disease—namely, death.

Despite the many problems with using mortality as a proxy for health, mortality data are generally available and widely used to describe the health status of populations. This is ironic because such data only indirectly describe the health status of living populations. Unfortunately, data on morbidity (illnesses, injuries, and functional limitations of the population) are neither as available nor as readily understood as are mortality data. This situation is improving, however, as new forms and sources of information on health conditions become more readily available. Sources for information on morbidities and disabilities now include medical records from hospitals, managed care organizations, and other providers, as well as information derived from surveys, businesses, schools, and other sources. Assessments of the health status of populations are increasingly utilizing measures from these sources. An excellent compilation of data and information on both health status and health services, Health United States,1 is published annually by the National Center for Health Statistics. Much of the data used in this chapter is derived from this source.

Mortality-Based Measures

Although mortality-based indicators of health status are both widely used and useful, there are some important differences in their use and interpretation. The most commonly used are crude mortality, age-specific and age-adjusted mortality, life expectancy, and years of potential life lost (YPLL). Although all are based on the same events, each provides somewhat different information as to the health status of a population.

Crude mortality rates count deaths within the entire population and are not sensitive to differences in the age distribution of different populations. The mortality comparisons presented in Figure 2–2 illustrate the limitations of using crude death rates to compare the mortality experience of the U.S. population late in the 20th century with that of the year 1950. On the basis of these data, we might conclude that mortality rates in the United States had declined about 20% since 1950. However, because there was a greater proportion of the late 20th century population in the higher age categories, these are not truly comparable populations. The 20% reduction actually understates the differences in mortality experience over the 20th century. Because differences in the age characteristics of the two populations are a primary concern, we look for methods to correct or adjust for the age factor. Age-specific and age-adjusted rates do just that.

Age-specific mortality rates relate the number of deaths to the number of persons in a specific age group. The infant mortality rate is probably the best-known example, describing the number of deaths of live-born infants occurring in the first year of life per 1,000 live births. Public health studies often use age-adjusted mortality rates to compensate for different mixes of age groups within a population (e.g., a high proportion of children or elderly). Age-adjusted rates are calculated by applying age-specific rates to a standard population (we now use the 2000 U.S. population). This adjustment permits more meaningful comparisons of mortality experience between populations with different age distribution patterns. Differences between crude and age-adjusted mortality rates can be substantial, such as those in Figure 2–2. The explanation is simply that the population at the end of the 20th century had a greater proportion of persons in older age groups than the 1900 or 1950 populations. Using crude rates, the improvement between 1950 and 2000 was about 20%; age-adjusted rates showed a 40% improvement.

Life expectancy, also based on the mortality experience of a population, is a computation of the number of years between any given age (e.g., birth or age 45) and the average age of death for that population. Together with infant mortality rates, life expectancies are commonly used in comparisons of health status among nations. These two mortality-based indicators are often perceived as general indicators of the overall health status of a population. Infant mortality and life expectancy measures for the United States are mediocre, in comparison with those of other developed nations. Figure 2–3 presents international comparisons of life expectancy by gender for the United States and selected other countries for 2001.

Years of potential life lost (YPLL) is a mortality-based indicator that places greater weight on deaths that occur at younger ages. Years of life lost before some arbitrary age (often age 65 or 75) are computed and used to measure the relative impact on society of different causes of death. If age 65 is used as the threshold for calculating YPLL, an infant death would contribute 65 YPLL, and a homicide at age 25 would contribute 40 YPLL. A death due to stroke at age 70 would contribute no years of life lost before age 65, and so on. Until relatively recently, age 65 was widely used as the threshold age. With life expectancies now exceeding 75 years at birth, YPLL calculations using age 75 as the threshold have become more common.

Table 2–2 presents data on YPLL before age 75, illustrating the usefulness of this approach in providing a somewhat different perspective as to which problems are most important in terms of their magnitude and impact. The use of YPLL ranks cancer, HIV/AIDS, and various forms of injury-related deaths higher than does the use of crude numbers or rates. Conversely, the use of crude rates ranks heart disease, stroke, pneumonia, diabetes, and chronic lung and liver diseases higher than does...
the use of YPLL. Four of the top 10 causes of death, as determined by the number of deaths, do not appear in the list of the top 10 causes of YPLL.

Each of these different mortality indicators can be examined for various racial and ethnic subpopulations to identify disparities among these groups. For example, age-adjusted rates of YPLL before age 75 for 2000 ranged from 6,284 per 100,000 population for Hispanics to 7,029 for whites and 13,177 for blacks. The rate for all groups was 7,694 per 100,000. The large disparity for blacks is attributable primarily to differences in infant mortality, homicide, and HIV infection deaths.

Mortality indicators can also be combined with other health indicators that describe quality considerations to provide a measure of the span of healthy life. These indicators can be an especially meaningful measure of health status in a population because they also consider morbidity and disability from conditions that impact on functioning but do not cause death (e.g., cerebral palsy, schizophrenia, arthritis). A commonly used measure of aggregate disease burden is the disability-adjusted life year or DALY. Other variants on this theme are span-of-healthy-life indicators (called years of healthy life [YHL]) that combine mortality data with self-reported health status and activity limitation data acquired through the National Health Interview Survey. In 1998, an average of 11.5 years of life (when life expectancy was 76.7 years at birth) involved limitations of major life activities, such as self-care (e.g., bathing, grooming, cooking), recreation, work, and school. The 65-year span of healthy life presents a better, although not precise, picture of health status and quality of life.

This indicator is illustrated in Figure 2–4, with 1998 data identifying disparities among blacks, whites, and Hispanics in both the number of healthy years of life and the percentage of healthy years in comparison with life expectancy. Hispanics had the greatest life expectancy at 82.1 years, of which 66.3 (81%) were years of healthy life. In contrast, blacks had 11 fewer years in life expectancy (71.3 years), but the same proportion (81%) were healthy years. Life expectancy for whites was 77.3 years, with a higher percentage of healthy years (86%) than Hispanics or blacks. These differences illustrate different forms of disparities among these groups, with blacks experiencing higher mortality (lower life expectancy) and Hispanics carrying a greater burden of disease prevalence (higher number of unhealthy life years) than the white population. Among the mortality-related measures...
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Table 2–2

<table>
<thead>
<tr>
<th>Causes of Death</th>
<th>YPLL</th>
<th>Rank by YPLL</th>
<th>Rank by Number of Deaths</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cancer</td>
<td>1,698,500</td>
<td>1</td>
<td>2</td>
</tr>
<tr>
<td>Heart Disease</td>
<td>1,270,700</td>
<td>2</td>
<td>1</td>
</tr>
<tr>
<td>Unintentional injuries</td>
<td>1,052,500</td>
<td>3</td>
<td>5</td>
</tr>
<tr>
<td>Suicide</td>
<td>343,300</td>
<td>4</td>
<td>11</td>
</tr>
<tr>
<td>Homicide</td>
<td>274,200</td>
<td>5</td>
<td>14</td>
</tr>
<tr>
<td>Cerebrovascular diseases</td>
<td>226,500</td>
<td>6</td>
<td>3</td>
</tr>
<tr>
<td>Chronic obstructive lung disease</td>
<td>190,700</td>
<td>7</td>
<td>4</td>
</tr>
<tr>
<td>Diabetes mellitus</td>
<td>141,200</td>
<td>8</td>
<td>6</td>
</tr>
<tr>
<td>HIV infections</td>
<td>178,900</td>
<td>9</td>
<td>18</td>
</tr>
<tr>
<td>Chronic liver disease and cirrhosis</td>
<td>141,700</td>
<td>10</td>
<td>12</td>
</tr>
</tbody>
</table>

Note: YPLL = Years lost before age 75 per 100,000 population younger than 75 years of age.


Figure 2–4

<table>
<thead>
<tr>
<th>Ethnicity</th>
<th>Total Life Expectancy</th>
<th>Years of Healthy Life</th>
</tr>
</thead>
<tbody>
<tr>
<td>All</td>
<td>74.2</td>
<td>77.3</td>
</tr>
<tr>
<td>White</td>
<td>78.7</td>
<td>82.1</td>
</tr>
<tr>
<td>Black</td>
<td>71.3</td>
<td>66.3</td>
</tr>
<tr>
<td>Hispanic</td>
<td>65.2</td>
<td>66.1</td>
</tr>
</tbody>
</table>


Figure 2–5 presents information on both morbidity and disability for children in terms of the prevalence of specific childhood diseases (here, the percentage of children 0–17 years old who have ever had these conditions) and the relationship between these conditions and self-reported health and activity status (a measure of disability).

Both prevalence (the number or rate of cases at a specific point or period in time) and incidence (the number or rate of new cases occurring during a specific period) are widely used measures of morbidity. One of the earliest systems for reporting on diseases of public health significance is the national notifiable disease-reporting system for specific diseases. This system operates through the collaboration of local, state, and federal health agencies. Although initially developed to track the incidence of communicable diseases, this system has steadily moved toward collecting information on noninfectious conditions, as well as important risk factors.

Increasingly, information on self-reported health status and on days lost from work or school due to acute or chronic conditions is collected through surveys of the general population. The National Center for Health Statistics also conducts ongoing surveys of...
health providers on complaints and conditions requiring medical care in outpatient settings. These surveys provide direct information on self-reported health status and illuminate some of the factors, such as household income levels depicted in Figure 2–6, that are associated with health status.

Influences on Health

In 1996, public health surveillance in the United States took a historic step, reflecting changes in national morbidity and mortality patterns as well as in the ability to identify specific factors that result in disease and injury. At that time, the Centers for Disease Control and Prevention (CDC) added prevalence of cigarette smoking to the list of diseases and conditions to be reported by states to CDC. This action marked the first time that a health behavior, rather than an illness or disease, was considered nationally reportable—a groundbreaking step for surveillance efforts. How the focus of public health efforts shifted from conventional disease outcomes to reporting on underlying causes amenable to public health intervention is an important story. That story is closely linked to one of the most important and most bitterly contested public health achievements of the 20th century, the recognition of tobacco use as a major health hazard. “Public Health Achievements in Twentieth-Century America: Tobacco Use,” chronicles this story, providing important lessons for public health efforts in the 21st century seeking to improve measures of health status and quality of life.

Risk Factors

The recognition of tobacco use as a major health hazard was no simple achievement, partly because many factors directly or indirectly influence the level of a health outcome in a given population. For example, greater per capita tobacco use in a population is associated with higher rates of heart disease and lung cancer, and lower rates of early prenatal care are associated with higher infant mortality rates. Because these factors are part of the chain of causation for health outcomes, tracking their levels provides an early indication as to the direction in which the health outcome is likely to change. These factors increase the likelihood or risk of particular health outcomes occurring and can be characterized broadly as risk factors.
The types and number of risk factors are as varied as the influences themselves. Depending on how these factors are lumped or split, traditional categories include biologic factors (from genetic endowment to aging), environmental factors (from food, air, and water to communicable diseases), lifestyle factors (from diet to injury avoidance and sexual behaviors), psychosocial factors (from poverty to stress, personality, and cultural factors), and use of and access to health-related services. Some recent refinements of this framework differentiate several outcomes of interest, including disease, functional capacity, prosperity, and well-being that can be influenced by various risk factors (Figure 2-9). These various components are often interrelated (e.g., stress, a social environmental factor, may stimulate individual responses, such as tobacco or il-
licit drug use, which, in turn, influence the likelihood of disease, functional capacity, and well-being). In addition, variations in one outcome, such as disease, may influence changes in others, such as well-being, depending on the mix of other factors present. This complex set of interactions draws attention to general factors that can result in many diseases, rather than focusing on specific factors that contribute little to population-wide health outcomes.

Although many factors are causally related to health outcomes, some are more direct and proximal causes than others. Specific risk factors have been clearly linked to specific adverse health states through epidemiologic studies. For example, numerous studies have linked unintentional injuries to a variety of risk factors, including the accessibility to firearms and the use of alcohol, tobacco, and seat belts. Tobacco, hypertension, overnutrition, and diabetes are well-known risk factors for heart disease. Epidemiologic research and studies over the past 50 years have identified behavioral risk factors for many common diseases and conditions, as shown in Table 2-3. In recent decades, the prevalence of obesity has doubled in virtually all gender, age, racial, and ethnic groups. Ongoing behavioral risk factor surveys often through telephone interviews—are conducted by governmental public health agencies to track trends in the prevalence of many important risk behaviors within the population. These surveys document that the health-related behaviors of tens of millions of Americans place them at risk for developing chronic disease and injuries. Despite the recent emphasis on behavioral factors, risk factors in the physical environment remain important influences on health. Air pollution, for example, is directly related to a wide range of diseases, including lung cancer, pulmonary emphysema, chronic bronchitis, and bronchial asthma. National standards exist for many of the most

FIGURE 2–7 Annual adult per capita cigarette consumption and major smoking and health events—United States, 1900–1998.


important air pollutants and are tracked to determine the extent of these risks in the general population. The proportion of the U.S. population residing in counties that have exceeded national standards for these pollutants suggests that air pollution risks, like behavioral risks, affect tens of millions of Americans. Environmental risks are ubiquitous and growing in the United States. Estimates from CDC are that 22–30 million people drink water from private wells; 40–45 million people are exposed to extreme heat; 150 million people are exposed to environmental tobacco smoke; and 65 million people reside in homes built before 1950, when lead paint was banned for residential use.

Behavioral and environmental risk factors are clearly germane to public health interest and efforts. Focusing on these factors provides a different perspective of the enemies of personal and public health than that conveyed by disease-specific incidence or mortality data. Such a focus also promotes rational policy development and interventions. Unfortunately, determining which underlying factors are most important is more difficult than it appears due to differences in the outcomes under study and measures used. For example, a study using 1980 data found tobacco, hypertension, and overnutrition responsible for about three fourths of deaths before age 65 and injury risks, alcohol, tobacco, and gaps in primary prevention accountable for about three fourths of all YPLL before age 65. Further complicating these analyses is the finding that individual risk factors may result in several different health outcomes. For example, alcohol use is linked with motor vehicle injuries, other injuries, cancer, and cirrhosis; tobacco use can result in heart disease, stroke, ulcers, fire and burn injuries, and low birth weight, as well as cancer.

Despite problems with their measurement, the identification of antecedent causes is important for public health policy and interventions. Table 2–4 provides a comparison of 2000 deaths by their listed causes of death, and their actual causes (major risk factors). The two lists provide contrasting views as to the major health problems and needs of the U.S. population. Although this debate has continued since the days of Chadwick and Farr (see Chapter 1), it is by no means settled.

Coroners and medical examiners view immediate and underlying causes of death somewhat differently from the perspective offered in Table 2–4. Death certificates have two parts, one for entering the immediate and underlying conditions that caused the death and a second for identifying conditions or injuries that contributed to death but did not cause death. For example, a death attributed to cardiovascular disease might list cardiac tamponade as the immediate cause, due to or a consequence of a ruptured myocardial infarction, which itself was due to or a consequence of coronary atherosclerosis. For this death, hypertensive cardiovascular disease might be listed as a significant condition contributing to, but not causing, the immediate and underlying causes.

do smoking, obesity, diet, and physical inactivity get identified as the real causes of such deaths? Perhaps the Chadwick-Farr debate continues into the 21st century in terms of whether deaths in the year 2000 should be attributed to tobacco use, just as many of those in England in 1839 should have been attributed to starvation.

### TABLE 2-3

<table>
<thead>
<tr>
<th>Cause of Death and Percent of all Deaths</th>
<th>Smoking</th>
<th>High Fat Low Fiber</th>
<th>Sedentary Lifestyle</th>
<th>High Blood Pressure</th>
<th>Elevated Cholesterol</th>
<th>Obesity</th>
<th>Alcohol Use</th>
</tr>
</thead>
<tbody>
<tr>
<td>Heart disease (30%)</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
</tr>
<tr>
<td>Cancer (23%)</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
</tr>
<tr>
<td>Stroke (7%)</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
</tr>
<tr>
<td>Chronic lung disease (5%)</td>
<td>X</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Unintentional injuries (4%)</td>
<td></td>
<td>X</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Pneumonia &amp; influenza (3%)</td>
<td>X</td>
<td></td>
<td></td>
<td>X</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Diabetes (3%)</td>
<td></td>
<td></td>
<td>X</td>
<td></td>
<td>X</td>
<td></td>
<td></td>
</tr>
<tr>
<td>HIV infection (1%)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>X</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Suicide (1%)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>X</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Chronic liver disease (1%)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>X</td>
<td></td>
</tr>
<tr>
<td>Atherosclerosis (1%)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>


### TABLE 2-4

<table>
<thead>
<tr>
<th>10 Leading Causes of Death</th>
<th>Number</th>
<th>Actual Causes of Death</th>
<th>Number</th>
</tr>
</thead>
<tbody>
<tr>
<td>Heart disease</td>
<td>710,760</td>
<td>Tobacco</td>
<td>435,000</td>
</tr>
<tr>
<td>Malignant neoplasm</td>
<td>553,091</td>
<td>Poor diet and physical inactivity</td>
<td>400,000</td>
</tr>
<tr>
<td>Cerebrovascular disease</td>
<td>167,661</td>
<td>Alcohol consumption</td>
<td>89,000</td>
</tr>
<tr>
<td>Chronic lower respiratory tract diseases</td>
<td>122,009</td>
<td>Microbial agents</td>
<td>75,000</td>
</tr>
<tr>
<td>Unintentional injuries</td>
<td>97,900</td>
<td>Tonic agents</td>
<td>55,000</td>
</tr>
<tr>
<td>Diabetes mellitus</td>
<td>86,301</td>
<td>Motor vehicle</td>
<td>41,000</td>
</tr>
<tr>
<td>Influenza and pneumonia</td>
<td>65,313</td>
<td>Firearms</td>
<td>29,000</td>
</tr>
<tr>
<td>Alzheimer disease</td>
<td>49,558</td>
<td>Sexual behavior</td>
<td>20,000</td>
</tr>
<tr>
<td>Nephritis, nephrotic syndrome, and nephrosis</td>
<td>37,251</td>
<td>Illicit drug use</td>
<td>17,000</td>
</tr>
<tr>
<td>Septicemia</td>
<td>31,224</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Other</td>
<td>499,283</td>
<td>Total</td>
<td>1,159,000</td>
</tr>
</tbody>
</table>


### Social and Cultural Influences

Understanding the health effects of biologic, behavioral, and environmental risk factors is straightforward in comparison with understanding the effects of social, economic, and cultural factors on the health of populations. This is due in part to a lack of agreement as to what is being measured.
Socioeconomic status and poverty are two factors that generally reflect position in society. There is considerable evidence that social position is an overarching determinant of health status, even though the indicators used to measure social standing are imprecise, at best.

Social class affects lifestyle, environment, and the utilization of services; it remains an important predictor of good and poor health in our society. Social class differences in mortality have long been recognized around the world. In 1842, Chadwick reported that the average ages at death for occupationally stratified groups in England were as follows: “gentlemen and persons engaged in the professions, 45 years; tradesmen and their families, 26 years; mechanics, servants and laborers, and their families, 16 years.” Life expectancies and other health indicators have improved considerably in England and elsewhere since 1842, but differences in mortality rates among the various social classes persist to the present day.

Some countries (such as Great Britain and the United States) have identifiable social strata that permit comparisons of health status by social class. Britain conducts ongoing analyses of socioeconomic differences according to official categorizations based on general social standing within the community. For the United States, educational status, race, and family income are often used as indirect or proxy measures of social class. Despite the differences in approaches and indicators, there is little evidence of any real difference between Britain and the United States in terms of what is being measured. In both countries, explanations for the differences in mortality appear to relate primarily to inequalities in social position and material resources. This effect operates all up and down the hierarchy of social standing; at each step improvements in social status are linked with improvements in measures of health status. For example, a study based on 1971 British census follow-up data found that a relatively affluent, home-owning group with two cars had a lower mortality risk than did a similar relatively privileged group with only one car.

In the United States, epidemiologists have studied socioeconomic differences in mortality risk since the early 1900s. Infant mortality has been the subject of many studies that have consistently documented the effects of poverty. Findings from the 1986 National Maternal and Infant Health Survey, for example, demonstrated that the effects of poverty were greater for infants born to mothers reporting fair or poor health than for those of higher-income mothers. Poverty affects many health outcomes, as illustrated in Table 2–5. Low-income families in the United States have an increased likelihood (or relative risk) of a variety of adverse health outcomes, often two to five times greater than that of higher-income families. The percentage of persons reporting fair or poor health is about four times as high for persons living below the poverty level as for those with family income at least twice the poverty level (22.2% and 5.5%, age adjusted).1

The implications of the consistent relationship between measures of social status and health outcomes suggest that studies need to consider how and how well social class is categorized and measured. Imprecise measures may underestimate the actual differences that are due to socioeconomic position in society. Importantly, if racial or ethnic differences are simply attributed to social class differences, factors that operate through race and ethnicity, such as racism or ethnism, will be overlooked. These additional factors also affect the difference between the social position one has and the position one would have attained, were it not for one’s race or ethnicity. Race in the United States, independent of socioeconomic status, is linked to mortality, although these effects vary across age and disease categories.

Studies of the effect of social factors on health status across nations add some interesting insights. In general, health appears to be closely associated with income differentials within countries, but there is only a weak link between national mortality rates and average income among the developed countries. This pattern suggests that health is affected less by changes in absolute material standards across nations and more by relative material standards.
affluent populations than by relative income differences and the resulting disadvantage in each country. It is not the richest countries that have the greatest life expectancy. Rather, it is those developed nations with the narrowest income differentials between rich and poor, as illustrated in Figure 2–3. This finding argues that health in the developed world is less a matter of a population’s absolute material wealth than of how the population’s circumstances compare with those of other members of their society. A similar perspective views income to be related to health through two pathways: a direct effect on the material conditions necessary for survival, and an effect on social participation and the opportunity to control one’s own life circumstances. In settings or societies that provide little in the way of material conditions (e.g., clean water, sanitation services, ample food, adequate housing), income is more important for health. Where material conditions are conducive to good health, income acts through social participation.

The effects of culture on health and illness are also becoming better understood. To medical anthropologists, diseases are not purely independent phenomena. Rather, they are to be viewed and understood in relation to ecology and culture. Certainly, the type and severity of disease varies by age, sex, social class, and ethnic group. The different distributions and social patterns of diseases reveal differences in culture-mediated behaviors. Such insights are essential to developing successful prevention and control programs. Culture serves to shape health-related behaviors, as well as human responses to diseases in the social and physical environment, which, in turn, affect health. As a mechanism of adapting to the environment, culture has great potential for both positively and negatively affecting health.

There is evidence that different societies shape the ways in which diseases are experienced and that social patterns of disease persist, even after risk factors are identified and effective interventions become available. For example, the link between poverty and various outcomes has been well established; yet even after advances in medicine and public health and significant improvement in general living and working conditions, the association persists. One explanation is that as some risks were addressed, others developed, such as health-related behaviors, including violent behavior and alcohol, tobacco, and drug use. In this way, societies create and shape the diseases that they experience. This makes sense, especially if we view the social context in which health and disease reside—the setting and social networks. For problems such as HIV/AIDS, sexually transmitted diseases, and illicit drug use, spread is heavily influenced by the links between those at risk. This also helps to explain why people in disorganized social structures are more likely to report their own health as poor than are similar persons with more social capital.

Societal responses to diseases are also socially constructed. Efforts to prevent the spread of typhoid fever by limiting the rights of carriers (such as Typhoid Mary) differed greatly from those to reduce transmission risks from diphtheria carriers. Because many otherwise normal citizens would have been subjected to extreme measures in order to avoid the risk of transmission, it was not socially acceptable to invoke similar measures for these similar risks.

If these themes of social and cultural influences are on target, they place the study of health disparities at the top of the public health agenda. They also argue that health should be viewed as a social phenomenon. Rather than attempting to identify each and every risk factor that contributes only marginally to disparate health outcomes of the lower social classes, a more effective approach would be to directly address the broader social policies (distribution of wealth, education, employment, and the like) that foster the social disparities that cause the observed differences in health outcomes. This finding argues that health in the developed world is less a matter of a population’s absolute material wealth than of how the population’s circumstances compare with those of other members of their society. A similar perspective views income to be related to health through two pathways: a direct effect on the material conditions necessary for survival, and an effect on social participation and the opportunity to control one’s own life circumstances. In settings or societies that provide little in the way of material conditions (e.g., clean water, sanitation services, ample food, adequate housing), income is more important for health. Where material conditions are conducive to good health, income acts through social participation.

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Global Health Influences

Considerable variation exists among the world’s nations on virtually every measure of health and illness currently in use. The principal factors responsible for observed trends and obvious inequities across the globe fall into the general categories of the social and physical environment, personal behavior, and health services. Given the considerable variation in social, economic, and health status among the developed, developing, and underdeveloped nations, it is naive to make broad generalizations. Countries with favorable health status indicators, however, generally have a well-developed health infrastructure, ample opportunities for education and training, relatively high status for women, and economic development that counterbalances population growth. Nonetheless, countries at all levels of development share some problems, including the escalating costs involved in providing a broad range of health, social, and economic development services to disadvantaged subgroups within the population. Social and cultural upheaval associated with urbanization is another problem common to countries at all levels of development. Over the course of the 20th century, the proportion of the world’s population living in urban areas tripled—to about 40%; that trend is expected to continue into the new century.

The principal environmental hazards in the world today appear to be those associated with poverty. This is true for
fying and understanding these forces and their interrelation-

tances in the politics of human relations, and a nation's liter-

tatus and national wealth is not firm, and comparisons across na-

tions are seldom straightforward. Improved health status

correlates more closely with changes in standards of living, ad-

It surprises many Americans that population is a major

global health concern. Birth rates vary inversely with the level

In general, public health approaches to dealing with world

The factors linked with specific health problems are often

generically termed risk factors and can exist at one of three lev-

eels. Those risk factors most closely associated with the health

Determinants are scientifically established factors that re-

Although many of these factors appear to stem from low

levels of national wealth, the link between national health sta-

status and national wealth is not firm, and comparisons across na-

tions are seldom straightforward. Improved health status

correlates more closely with changes in standards of living, ad-

The ability to identify risk factors and pathways for causation

is essential for rational public health decisions and actions to

address important health problems in a population. First,

however, it is necessary to define what is meant by health prob-

less. Here, health problem means a condition of humans that
can be represented in terms of measurable health status or

quality-of-life indicators. In later chapters, additional dimen-

sions will be added to this basic definition for the purposes of

community problem solving and the development of inter-

ventions. This characterization of a health problem as some-

thing measured only in terms of outcomes is difficult for some
to accept. They point to important factors, such as access to
care or poverty itself, and feel that these should rightfully be
considered as health problems. Important problems they may
be, but if they are truly important in the causation of some un-

acceptable health outcome, they can be dealt with as related

factors rather than health problems.

The factors linked with specific health problems are often

generically termed risk factors and can exist at one of three lev-

els. Those risk factors most closely associated with the health

outcome in question are often termed determinants. Risk factors

that play a role further back in the chain of causation are called
direct and indirect contributing factors. Risk factors can be de-
scribed at either an individual or a population level. For exam-

ple, tobacco use for an individual increases the chances of
developing heart disease or lung cancer, and an increased preva-
lence of tobacco use in a population increases that population’s

incidence of (and mortality rates from) these conditions.

Determinants are scientifically established factors that re-
late directly to the level of a health problem. As the level of the
determinant changes, the level of the health outcome changes.

Determinants are the most proximal risk factors through which

other levels of risk factors act. The link between the determi-
nant and the health outcome should be well established through

scientific or epidemiologic studies. For example, for neonatal

mortality rates, two well-established determinants are the low-

birth-weight rate (the number of infants born weighing less

than 2,500 g, or about 5.5 lb, per 100 live births) and weight-
specific mortality rates. Improvement in the neonatal mortality

rate cannot occur unless one of these determinants improves.

Health outcomes can have one or many determinants.

Direct contributing factors are scientifically established

factors that directly affect the level of a determinant. Again,
there should be solid evidence that the level of the direct contributing factor affects the level of the determinant. For the neonatal mortality rate example, the prevalence of tobacco use among pregnant women has been associated with the risk of low birth weight. A determinant can have many direct contributing factors. For low birth weight, other direct contributing factors include low maternal weight gain and inadequate prenatal care.

Indirect contributing factors affect the level of the direct contributing factors. Although several steps distant from the health outcome in question, these factors are often proximal enough to be modified. The indirect contributing factor affects the level of the direct contributing factor, which, in turn, affects the level of the determinant. The level of the determinant then affects the level of the health outcome. Many indirect contributing factors can exist for each direct contributing factor. For prevalence of tobacco use among pregnant women, indirect contributing factors might include easy access to tobacco products for young women, lack of health education, and lack of smoking cessation programs.

The health problem analysis framework begins with the identification of a health problem (defined in terms of health status indicators) and proceeds to establish one or more determinants; for each determinant, one or more direct contributing factors; and for each direct contributing factor, one or more indirect contributing factors. Intervention strategies at the community level generally involve addressing these indirect contributing factors. When completed, an analysis identifies as many of the causal pathways as possible to determine which contributing factors exist in the setting in which an intervention strategy is planned. The framework for this approach is presented in Table 2–7 and Figure 2–10.

<table>
<thead>
<tr>
<th>Disease</th>
<th>Morbidity (Episodes per Year)</th>
<th>Mortality (Deaths per Year)</th>
<th>Relationship to Water Supply, Sanitation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Diarrheal (drinking)</td>
<td>1 billion</td>
<td>3.3 million</td>
<td>UNSANITARY EXCRETA DISPOSAL, POOR PERSONAL AND DOMESTIC HYGIENE, UNSAFE WATER</td>
</tr>
<tr>
<td>Infection with intestinal helminths</td>
<td>1.5 billion*</td>
<td>100,000</td>
<td>UNSANITARY EXCRETA DISPOSAL, POOR PERSONAL AND DOMESTIC HYGIENE</td>
</tr>
<tr>
<td>Schistosomiasis</td>
<td>200 million*</td>
<td>200,000</td>
<td>UNSANITARY EXCRETA DISPOSAL AND ABSENCE OF NEARBY SOURCES OF SAFE WATER</td>
</tr>
<tr>
<td>Dracunculiasis</td>
<td>100,000*†</td>
<td>—</td>
<td>UNSAFE DRINKING WATER</td>
</tr>
<tr>
<td>Trachoma</td>
<td>150 million§</td>
<td>—</td>
<td>LACK OF FACE WASHING, OFTEN DUE TO ABSENCE OF NEARBY SOURCES OF SAFE WATER</td>
</tr>
<tr>
<td>Malaria</td>
<td>400 million</td>
<td>1.5 million</td>
<td>POOR WATER MANAGEMENT AND STORAGE, POOR OPERATION OF WATER POINTS AND DRAINAGE</td>
</tr>
<tr>
<td>Dengue fever</td>
<td>1.75 million</td>
<td>20,000</td>
<td>POOR SOLID WASTES MANAGEMENT, WATER STORAGE, AND OPERATION OF WATER POINTS AND DRAINAGE</td>
</tr>
<tr>
<td>Poliomyelitis (drinking)</td>
<td>114,000</td>
<td>—</td>
<td>UNSANITARY EXCRETA DISPOSAL, POOR PERSONAL AND DOMESTIC HYGIENE, UNSAFE WATER</td>
</tr>
<tr>
<td>Trypanosomiasis</td>
<td>275,000</td>
<td>130,000</td>
<td>ABSENCE OF NEARBY SOURCES OF SAFE WATER</td>
</tr>
<tr>
<td>Bancroftian filariasis</td>
<td>72.8 million*</td>
<td>—</td>
<td>POOR WATER MANAGEMENT AND STORAGE, POOR OPERATION OF WATER POINTS AND DRAINAGE</td>
</tr>
<tr>
<td>Onchocerciasis</td>
<td>17.7 million*§</td>
<td>40,000</td>
<td>POOR WATER MANAGEMENT AND LARGE-SCALE PROJECTS</td>
</tr>
</tbody>
</table>

*People currently infected.
†Excluding Sudan.
§Case of active disease. Approximately 3.9 million cases of blindness or severe complications of trachoma occur annually.
### TABLE 2–7 Risk Factors

<table>
<thead>
<tr>
<th>Determinant</th>
<th>Scientifically established factor that relates directly to the level of the health problem. A health problem may have any number of determinants identified for it.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Direct contributing factor</td>
<td>Scientifically established factor that directly affects the level of the determinants. Example: Use of prenatal care is one factor that affects the low-birth-weight rate.</td>
</tr>
<tr>
<td>Indirect contributing factor</td>
<td>Community-specific factor that affects the level of a direct contributing factor. Such factors can vary considerably from one community to another. Example: Availability of day care or transportation services within the community may affect the use of prenatal care services.</td>
</tr>
</tbody>
</table>

Source: Data from Centers for Disease Control and Prevention, Public Health Practice Program Office.

### FIGURE 2–10 Health problem analysis worksheet.

framework forms the basis for developing meaningful interventions; it is used in several of the processes and instruments to assess community health needs that are currently in wide use at the local level. Community health improvement processes and tools will be further described in Chapter 3.

Although this framework is useful, it does not fully account for the relationships among the various levels of risk factors. Some direct contributing factors may affect more than one determinant, and some indirect contributing factors may influence more than one direct contributing factor. For example, illicit drug use during pregnancy influences both the likelihood of low birth weight and birth weight-specific survival rates. To account fully for these interactions, some direct and indirect contributing factors may need to be included in several different locations on the worksheet. Despite the advancement of epidemiologic methods, many studies ignore the contributing factors that affect the level of these major risk factors, leading to simplistic formulations of multiple risk factors for health problems that exist at the community level.25

ECONOMIC DIMENSIONS OF HEALTH OUTCOMES

The ability to measure and quantify outcomes and risks is essential for rational decisions and actions. Specific indicators, as well as methods of economic analysis, are available to provide both objective and subjective valuations. Several health indicators attempt to value differentially health status outcomes, including age-adjusted rates; span of healthy life; and YPLL. For example, YPLL represents a method of weighting or valuing health outcomes by placing a higher value on deaths that occur at earlier ages. Years of life lost thus become a common denominator or, in one sense, a common currency. Health outcomes can be translated into this currency or into an actual currency, such as dollars. This translation allows for comparisons to be made among outcomes in terms of which costs more per person, per episode, or per another reference point.

Cost comparisons of health outcomes and health events have become common in public health. Approaches include cost-benefit, cost-effectiveness, and cost-utility analyses. Cost-benefit analyses provide comprehensive information on both the costs and the benefits of an intervention. All health outcomes and other relevant impacts are included in the determination of benefits. The results are expressed in terms of net costs, net benefits, and time required to recoup an initial investment. If the benefits are expressed in health outcome terms, years of life gained or quality-adjusted life years (QALYs) may be calculated. This provides a framework for comparing disparate interventions. QALYs are calculated from a particular perspective that determines which costs and consequences are included in the analysis. For public health analyses, societal perspectives are necessary. When comprehensively performed, cost-benefit analyses are considered the gold standard of economic evaluations.

Cost-effectiveness analyses focus on one outcome to determine the most cost-effective intervention when several options are possible. Cost-effectiveness examines a specific option's costs to achieve a particular outcome. Results are often specified as the cost per case prevented or cost per life saved. For example, screening an entire town for a specific disease might identify cases at a cost of $150 per new case, whereas a screening program directed only at high-risk groups within that town might identify cases at a cost of $50 per new case. Although useful for evaluating different strategies for achieving the same result, cost-effectiveness approaches are not very helpful in evaluating interventions intended for different health conditions.

Cost-utility analyses are similar to cost-effectiveness studies, except that the results are characterized as cost per quality-adjusted life years. These are most useful when the intervention affects both morbidity and mortality, and there are a variety of possible outcomes that include quality of life.

These approaches are especially important for interventions based on preventive strategies. The argument is frequently made that "an ounce of prevention is worth a pound of cure." If this wisdom is true, preventive interventions should result in savings equal to 16 times their actual cost. Not all preventive interventions measure up to this standard, but even crude information on the costs of many health outcomes suggests that prevention has economic as well as human savings. Table 2–8 presents information from Healthy People 2000HP2000) regarding the economics of prevention for a number of common diseases and conditions; for each, the potential savings represents an enormous sum. Figure 2–11 illustrates that the impacts of disease and injuries can be many in terms of medical care costs for treatment in outpatient, emergency department, and hospital settings.27 The U.S. Public Health Service has estimated that as much as 11% of projected health expenditures for the year 2000 could have been averted through investments in public health for six conditions: motor vehicle injuries, occupationally related injuries, stroke, coronary heart disease, firearms-related injuries, and low-birthweight infants.28 Beyond the direct medical effects, there are often nonmedical costs related to lost wages, taxes, and productivity.

Economists assert that the future costs for care and services that result from prevention of mortality must be considered a negative benefit of prevention. For example, the costs of preventing a death due to motor vehicle injuries should include all subsequent medical care costs for that individual over his or her lifetime, because these costs would not have occurred after death.
otherwise. They also argue that it is unfair to compare future savings to the costs of current prevention programs and that those savings must be discounted to their current value. If a preventive program will save $10 million 20 years from now, that $10 million must be translated into its current value in computing cost benefits, cost-effectiveness, or cost utility. It may be that the value of $10 million 20 years from now is only $4 million now. If the program costs $1 million, its benefit/cost ratio would be 4:1 instead of 10:1 before we even added any additional costs associated with medical care for the lives that were saved. These economic considerations contribute to the difficulty of marketing preventive interventions.

Two additional economic considerations are important for public health policy and practice. The first of these is what economists term opportunity costs. These represent the costs involved in choosing one course of action over another. Resources spent for one purpose are not available to be spent for another. As a result, there is a need to consider the costs of not realizing the benefits or gains from paths not chosen. A second economic consideration important for public health is related to the heavy emphasis of public health on preventive strategies. The savings or gains from successful prevention efforts are generally not reinvested in public health or even other health purposes. These savings or gains from investments in prevention are lost. Maybe this is proper, because the overall benefits accrue more broadly to society, and public health remains, above all else, a social enterprise. However, imagine the situation for American industry and businesses if they could

<table>
<thead>
<tr>
<th>Condition</th>
<th>Overall Magnitude</th>
<th>Avoidable Intervention*</th>
<th>Cost/Patient†</th>
</tr>
</thead>
<tbody>
<tr>
<td>Heart disease</td>
<td>7 million with coronary artery disease</td>
<td>Coronary bypass surgery</td>
<td>$30,000</td>
</tr>
<tr>
<td></td>
<td>500,000 deaths/year</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>284,000 bypass procedures/year</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Cancer</td>
<td>1 million new cases/year</td>
<td>Lung cancer treatment</td>
<td>$29,000</td>
</tr>
<tr>
<td></td>
<td>510,000 deaths/year</td>
<td>Cervical cancer treatment</td>
<td>$28,000</td>
</tr>
<tr>
<td>Stroke</td>
<td>600,000 strokes/year</td>
<td>Hemiplegia treatment and rehabilitation</td>
<td>$22,000</td>
</tr>
<tr>
<td></td>
<td>150,000 deaths/year</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Injuries</td>
<td>2.3 million hospitalizations per year</td>
<td>Quadriplegia treatment and rehabilitation</td>
<td>$570,000</td>
</tr>
<tr>
<td></td>
<td>142,500 deaths/year</td>
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<td></td>
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<tr>
<td></td>
<td>177,000 persons with spinal cord injuries in the United States</td>
<td></td>
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<tr>
<td>HIV infection</td>
<td>1–1.5 million infected</td>
<td>Hip fracture treatment and rehabilitation</td>
<td>$40,000</td>
</tr>
<tr>
<td></td>
<td>118,000 AIDS cases (as of Jan. 1990)</td>
<td>Severe head injury treatment and rehabilitation</td>
<td>$310,000</td>
</tr>
<tr>
<td>Alcoholism</td>
<td>18.5 million abuse alcohol</td>
<td>AIDS treatment</td>
<td>$75,000</td>
</tr>
<tr>
<td>Drug abuse</td>
<td>105,000 alcohol-related deaths/year</td>
<td>Liver transplant</td>
<td>$250,000</td>
</tr>
<tr>
<td></td>
<td>Regular users:</td>
<td>Treatment of cocaine-exposed infant</td>
<td>$66,000</td>
</tr>
<tr>
<td></td>
<td>1–3 million, cocaine</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>900,000, IV drugs</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>500,000, heroin</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Drug-exposed infants:</td>
<td>375,000</td>
<td>Neonatal intensive care for LBW infant</td>
<td>$10,000</td>
</tr>
<tr>
<td>LBW infants</td>
<td>260,000 LBW infants/year</td>
<td>Congenital rubella syndrome treatment</td>
<td>$354,000</td>
</tr>
<tr>
<td></td>
<td>23,000 deaths/year</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Adequate immunization</td>
<td>Lacking basic immunization series:</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>20–30% aged 2 and younger</td>
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</tr>
<tr>
<td></td>
<td>3% aged 6 and older</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

*Interventions represent examples (other interventions may apply).
†Representative first-year costs, except as noted. Not indicated are nonmedical costs, such as lost productivity to society.

not reinvest their gains to grow their businesses. This is often the situation faced by public health, further exacerbating the difficulty of arguing for and securing needed resources.

HEALTHY PEOPLE 2010

The data and discussion in this chapter only broadly describe health status measures in the United States in the early years of the new century. Several common themes emerge, however, that form the basis for national health objectives focusing on the year 2010. Figure 2–12 (similar to the model illustrated in Figure 2–9) presents a Healthy People 2010 (HP2010) process grounded in a broad view of the many factors influencing health. The year 2010 objectives build on the nation’s experience with panels of health objectives established for the years 1990 and 2000. The Healthy People 1990 effort was initiated in the late 1970s through the efforts of Surgeon General Julius Richmond and coordinated by the Office of Disease Prevention and Health Promotion within the Office of the Assistant Secretary for Health.

Progress toward achievement of the year 2000 national health objectives was assessed in 1998. The status of each of the 319 objectives was reviewed and classified as moving in the right direction, moving in the wrong direction, showing no change, or unable to be tracked. The midcourse review found that 15% had been accomplished, another 44% were moving in the right direction, 18% were moving in the wrong direction, 3% showed no change, 6% showed mixed results, and 14% could not be tracked. A substantially higher proportion of the objectives targeting special populations, especially blacks and American Indians, were found to be moving in the wrong direction. These findings raise concerns that disparities are persisting, if not increasing, in the United States. Progress toward some of the broader goals of the HP2000 effort was somewhat more positive; age-adjusted mortality targets for all age groups under age 70 were achieved.

The year 2010 national health objectives include 467 specific objectives addressing health status measures, risk factor prevalence, and use of preventive health services. These objectives fall into 28 priority categories (Table 2–9) and focus on two overarching goals: (1) to increase quality and years of healthy life and (2) to eliminate health disparities. Overall success will be gauged in relation to several age-adjusted summary measures for both the general population and racial and ethnic minorities: YPLL before age 75, hospital days per 100,000 population, and reported disability. Figure 2–13 presents data on several HP2010 objectives related to tobacco use. Because tracking 467 national targets is not practical, a list of leading indicators was developed (Table 2–10); these focus on 10 important health issues by incorporating 21 of the HP2010 objectives.

Although the overall goals appear appropriate, they are only arguably linked. From one perspective, they represent two very different approaches to improving outcomes for the population as a whole. If we view the health status of the entire population as a Gaussian curve, one approach would be to shift the entire curve further toward better outcomes, and a second approach would be to change the shape of the curve, reducing the difference between the extremes. These represent quite different strategies that would be associated with quite different policies and interventions. Focusing on the tail end of the distribution of health requires investment in questionably effective attempts that benefit relatively few and fail to promote the health of the majority. On the other hand, even small improvements in overall society-wide health measures have provided greater gains for society than very perceptible improvements in the health of a few. The choice is one that can be viewed as focusing on “epiphenomena,” such as risk factors or on the larger context and social environment. Healthy People 2010 ambitiously seeks to do both.

Monitoring all national health objectives is not considered feasible at the state and local level. Instead, priorities linked to the national health objectives will likely be tracked. An Institute of Medicine (IOM) committee in 1997 identified a basic set of indicators for use in community health...
FIGURE 2–12 The Healthy People 2010 model.

Healthy People in Healthy Communities
A Systematic Approach to Health Improvement

Goals

Objectives

Determinants of Health

- Policies and Interventions
  - Physical Environment
  - Behavior
  - Individual Biology
  - Social Environment

Health Status

Access to Quality Health Care

### TABLE 2–9 Healthy People 2010 Goals and Focus Areas

**Goals**
1. Increase Quality and Years of Healthy Life
2. Eliminate Health Disparities

**Focus Areas**
1. Access to Quality Health Services
2. Arthritis, Osteoporosis, and Chronic Back Conditions
3. Cancer
4. Chronic Kidney Disease
5. Diabetes
6. Disability and Secondary Conditions
7. Educational and Community-Based Programs
8. Environmental Health
9. Family Planning
10. Food Safety
11. Health Communication
12. Heart Disease and Stroke
13. HIV
14. Immunization and Infectious Disease
15. Injury and Violence Prevention
16. Maternal, Infant, and Child Health
17. Medical Product Safety
18. Mental Health and Mental Disorders
19. Nutrition and Overweight
20. Occupational Safety and Health
21. Oral Health
22. Physical Activity and Fitness
23. Public Health Infrastructure
24. Respiratory Diseases
25. Sexually Transmitted Diseases
26. Substance Abuse
27. Tobacco Use
28. Vision and Hearing


- **Adolescents in grades 9-12 who smoked one or more cigarettes in the past 30 days:**
  - 1990: 30%
  - 1991: 32%
  - 1992: 33%
  - 1993: 35%
  - 1994: 36%
  - 1995: 36%
  - 1996: 36%
  - 1997: 36%

- **Adults aged 18 years and older who smoked more than 100 cigarettes in their lifetime and smoked on some or all days in the past month:**
  - 1990: 16%
  - 1991: 18%
  - 1992: 19%
  - 1993: 20%
  - 1994: 21%
  - 1995: 22%
  - 1996: 23%
  - 1997: 24%

improvement processes (Table 2–11). This panel is notably more comprehensive than one promoted for use with the HP2000 activities of the 1990s. Together with the catalog of leading health indicators from the HP2010 process, these measures provide a useful starting point for population-based health improvement initiatives.

**CONCLUSION**

From an ecological perspective, the health status of a population is influenced by many factors drawn from biology, behavior, the environment, and the use of health services. Social and cultural factors also play an important role in the disease patterns experienced by different populations, as well as in the responses of these populations to disease and illness. Globally, risks associated with population growth, pollution, and poverty result in mortality and morbidity that are still associated with infectious disease processes. In the United States, behaviorally mediated risks, including tobacco, diet, alcohol, and injury risks, rather than infectious disease processes, are the major contributors to health status, and the considerable gap between low-income minority populations and other Americans continues to widen. Reduction of the disparities in health status among population groups has emerged as the most critical national health goal for the year 2010. With the increasing availability of data on health status, as well as on determinants and contributing factors, the potential for

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**TABLE 2–10 Healthy People 2010 Leading Indicators**

| Physical Activity | • Proportion of adolescents who engage in vigorous physical activity that promotes cardiorespiratory fitness 3 or more days per week for 20 or more minutes per occasion  
| | • Proportion of adults who engage regularly, preferably daily, in moderate physical activity for at least 30 minutes a day  
| Overweight and obesity | • Proportion of children and adolescents who are overweight or obese  
| | • Proportion of adults who are obese  
| Tobacco Use | • Proportion of adolescents who smoke  
| | • Proportion of adults who smoke  
| Substance Abuse | • Proportion of adolescents not using alcohol or any illicit drugs during the past 30 days  
| | • Proportion of adults using any illicit drug during the past 30 days  
| | • Proportion of adults engaging in binge drinking of alcoholic beverages during the past month  
| Responsible Sexual Behavior | • Proportion of adolescents who abstain from sexual intercourse or use condoms if sexually active  
| | • Proportion of sexually active persons who use condoms  
| Mental Health | • Proportion of adults with recognized depression who receive treatment  

more rational policies and interventions has increased. Over the long term, public policies that narrow income disparities and increase access to education, jobs, and housing do far more to improve the health status of populations than do efforts to provide more health care services. Health improvement efforts require more than data on health problems and contributing factors, which view health from a negative perspective. Also needed is information from a positive perspective, in terms of community capacities, assets, and willingness. More important still, there must be recognition and acceptance that the right to health is a basic human right and one inextricably linked to all other human rights, lest quality of life be seriously compromised.31 It is this right to health that enables the practice of public health and challenges public health workers to measure health and quality of life in ways that promote its improvement.

TABLE 2-11 Proposed Indicators for a Community Health Profile

<table>
<thead>
<tr>
<th>Sociodemographic Characteristics</th>
<th>Health Status</th>
<th>Health Risk Factors</th>
<th>Health Care Resource Consumption</th>
<th>Functional Status</th>
<th>Quality of Life</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Distribution of the population by age and race/ethnicity</td>
<td>10. Infant mortality rate by race/ethnicity</td>
<td>15. Proportion of 2-year old children who have received all age-appropriate vaccines, as recommended by the Advisory Committee on Immunization Practices</td>
<td>21. Per-capita health care spending for Medicare beneficiaries (the Medicaid adjusted average per-capita cost [AAPCC])</td>
<td>22. Proportion of adults reporting that their general health is good to excellent</td>
<td>24. Proportion of adults satisfied with the health care system in the community</td>
</tr>
<tr>
<td>2. Number and proportion of persons in groups such as migrants, homeless, or the non-English speaking for whom access to community services and resources may be a concern</td>
<td>11. Numbers of deaths or age-adjusted death rates for motor vehicle crashes, work-related injuries, suicide, homicide, lung cancer, breast cancer, cardiovascular diseases, and all causes, by age, race, and gender, as appropriate</td>
<td>16. Proportion of adults aged 65 and older who have ever been immunized for pneumococcal pneumonia; proportion who have been immunized in the past 12 months for influenza</td>
<td>23. During the past 30 days, average number of days for which adults report that their physical or mental health was not good</td>
<td>25. Proportion of persons satisfied with the quality of life in the community</td>
<td></td>
</tr>
<tr>
<td>3. Number and proportion of persons aged 25 and older with less than a high school education</td>
<td>12. Reported incidence of AIDS, measles, tuberculosis, and primary and secondary syphilis, by age, race, and gender, as appropriate</td>
<td>17. Proportion of the population who smoke, by age, race, and gender, as appropriate</td>
<td></td>
<td></td>
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</tr>
<tr>
<td>4. Ratio of the number of students graduating from high school to the number of students who entered ninth grade 3 years previously</td>
<td>13. Births to adolescents (ages 10–17) as proportion of total live births</td>
<td>18. Proportion of the population aged 18 or older who are obese</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>5. Median household income</td>
<td>14. Number and rate of confirmed abuse and neglect cases among children</td>
<td>19. Number and type of U.S. Environmental Protection Agency air quality standards not met</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>6. Proportion of children less than 15 years of age living in families at or below the poverty level</td>
<td></td>
<td>20. Proportion of assessed rivers, lakes, and estuaries that support beneficial uses (e.g., fishing-and swimming-approved)</td>
<td></td>
<td></td>
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<tr>
<td>7. Unemployment rate</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>8. Number and proportion of single-parent families</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>9. Number and proportion of persons without health insurance</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

databases and Web search engines by topic and agency

- Fedstats <http://www.fedstats.gov>, a gateway to a variety of federal agency data and information, including health statistics
- National Center for Health Statistics (NCHS) <http://www.cdc.gov/nchswww>, an invaluable resource for data and information, especially “Health, United States,” which can be downloaded from this site
- Centers for Disease Control and Prevention (CDC) Mortality and Morbidity Weekly Report <http://www2.cdc.gov/mmwr> and MMWR morbidity and mortality data by time and place <http://www2.cdc.gov/mmwr/distrnds.html>
- U.S. Census data <http://www.census.gov>, the best general denominator data anywhere

5. Compare two “Public Health Achievements in 20th Century America,” presented in Chapter 1 (control of infectious diseases) and Chapter 2 (tobacco use). Which of these accomplishments, in your opinion, has had the greatest impact on the health status and quality of life of Americans living in the early 21st century? Justify your selection.

6. After reviewing “Public Health Achievements in 20th Century America: Tobacco Use,” select a health outcome related to tobacco use and analyze that problem for its determinants and contributing factors, using the method described in the text. Identify at least two major determinants for the problem that you select. For each determinant, identify at least two direct contributing factors, and for each direct contributing factor, identify at least two indirect contributing factors. At what level of your analysis does tobacco use appear as a risk factor?

7. Figure 2–13 presents data on several Healthy People 2010 objectives related to tobacco use. What are some important factors that must be addressed to achieve these targets in view of trends since 1990?

8. Population, poverty, and pollution are sometimes cited as the three most important factors influencing global health status today. After examining the World
Health Organization (WHO) Web site <http://www.who.ch>, cite reasons for agreeing or disagreeing with this assertion.

9. Great Debate: There are three propositions to be considered. Proposition A: Disease entities should be listed as official causes of death. Proposition B: Underlying factors that result in these diseases should be listed as official causes of death. Proposition C: No causes of death should be listed on death certificates. Select one of these positions and develop a position statement with your rationale.

10. Projections call for a continuing increase in life expectancy through the first half of the 21st century. What effect will increased life expectancy have on the major goals of Healthy People 2010—increasing the quality and years of healthy life and eliminating health disparities?

REFERENCES


10. Projections call for a continuing increase in life expectancy through the first half of the 21st century. What effect will increased life expectancy have on the major goals of Healthy People 2010—increasing the quality and years of healthy life and eliminating health disparities?


